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PROCEEDINGS

of the American Academy of Forensic Sciences

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SS1 Multidisciplinary Symposium on the Uses of Forensic Science -The Anatomy of a Coerced Murder Confession: Can Post-Conviction Relief Repair the Integrity of the Criminal Justice System?

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On January 17, 2001, Christopher Ochoa was released after serving 12 years in prison. He was convicted after he confessed that he and an accomplice, Richard Danzinger, committed a murder in 1988. Both men were convicted and sentenced to life in prison. The problem was that they did not commit the murder. Ochoa later claimed that the confession was a result of badgering and threats by police during his interrogation. Authorities acknowledged there was no other evidence against the two men, neither of whom had been incarcerated before. In one of many twists in the case, another man, Achim Josef Marino, who is serving life in prison for other crimes, wrote a series of letters from 1996 - 1998, to public officials in which he confessed to the killing in detail.

Attorneys for the two innocent men have criticized officials who received the letters for not aggressively acting on the information. Despite Marino's letters, authorities did not begin reinvestigating the case until 1999, after Ochoa contacted the Innocence Project at the University of Wisconsin Law School, and lawyers there began looking into the matter. DNA tests performed in 2000 ruled out Ochoa and Danzinger as sources of semen found in the victim, and implicated Marino.

Though this case was unusual in that the actual perpetrator came forward, biological evidence had been preserved and was still available for testing. Ochoa was able to get free representation, and the prosecutor's office cooperated; such is not always the case.

This session will examine some of the factors that contribute to erroneous convictions of innocent persons including the unreliability of eyewitness evidence, and how interrogation tactics taught to law enforcement play on psychology to cause innocent people to confess. In addition, recommendations for legislative post-conviction reform and the filing of John Doe warrants to stay the statute of limitations in no-suspect cases will be discussed. Finally, in instances where an innocent person is exonerated, not only are law enforcement and prosecutors left with an overturned conviction, but suddenly a case that may have been closed for decades once again becomes a live investigation. To address this issue, an integrated approach to instituting effective cold case squads will be considered.

Coerced Confessions, Post-Conviction Relief, Christopher Ochoa

SS2 Young Forensic Scientists Forum — Non-Traditional Careers in Forensic Science

Claire E. Shepard, MS, Crime Scene Investigator, DeKalb County Police Department, 3630 Camp Circle, Decatur, GA 30032; Allison M. Curran, BS*, Florida International University, 9601 SW 142 Avenue, #818, Miami, FL 33186; Christopher M. Gojcz, BS*, Drug Enforcement Administration Special Testing and Research Laboratory, 22624 Dulles Summit Court, Dulles, VA 22066; Amy Neumann, BS*, Paragon Genetics, 888 Adelaide Street West, Toronto, Ontario M6J 1B8, Canada; Amy C. Shaver, BS*, Virginia Division of Forensic Sciences, 6600 Northside HS Road, Roanoke, VA 24019; Sheila M. Estacio, BA*, Office of the Chief Medical Examiner, New York City Office, Department of Forensic Biology, 520 1st Avenue, New York, NY 10016; Kenneth E. Melson, JD*, United States Attorney's Office, 2100 Jamieson Avenue, Alexandria, VA 22314; José R. Almirall, MS, PhD*, Florida International University, U.P., Miami, FL 33199; Joseph T. Hefner, BS*, University of Florida, 4100 SW 20th Avenue, Apartment E-6, Gainesville, FL 32607; Kenneth G. Furton, PhD*, Florida International University, University Park Campus, DM 445C, Miami, FL 33199; Jeffrey H. Comparin, BS*, , Special Testing and Research Laboratory, 22624 Dulles Summit Court, Dulles, VA 22066; Gordon A. Angus, BS*, Miami-Dade Police Department, Forensic Computer Lab, 9690 NW 41 Street, Miami, FL 33199; Kenneth W. Goddard, MS*, National Fish and Wildlife Forensics Lab, 1490 East Main Street, Ashland, OR 97520; Steven C. Batterman, PhD*, School of Engineering and Applied Science, School of Medicine, University of Pennsylvania, 1964 Cardinal Lake Drive, Cherry Hill, NJ 08003; Jason H. Byrd, PhD*, Office of the Medical Examiner, 1360 Indian Lake Road, Daytona Beach, FL 32126; Howard Cash, BS*, Gene Codes Forensics, Inc., 775 Technology Drive, Suite 100A, Ann Arbor, MI 48108; Ronald L. Singer, MS*, Tarrant County Medical Examiner's Office, 200 Feliks Gwozdz Place, Fort Worth, TX 76104; Eve Tokumaru, MSFS*, DNA Secology, 6001 Moon Street NE #3821, Albuquerque, NM 87111; Eric Stauffer, MS*, MME, Forensic Service Unit, 1039 Industrial Court, Suwanee, GA 30024; Thomas M. Blackwell, BS*, Northeast Laboratory, 99 Tenth Avenue, Suite 721, New York, NY 10011; Susan H. Johns, MA*, Illinois State Police Division of Forensic Sciences, 630 East Washington Street, Springfield, IL 62701*

As its role in society evolves, the field of forensic science continues to grow and incorporate the skills and knowledge of many different experts and disciplines. This year's special program will bring to the forefront some emerging forensic science fields, and will consist of presentations by established members of the forensic science community. Emphasis will be placed on areas such as computer crimes, wildlife forensics, forensic engineering, entomology, and the role of the medical examiner's office. The session will also stress the importance of research and method development, and will serve to make emerging forensic scientists aware of the opportunities available to them. Complete with a discussion panel on "Realities of Forensic Science," the session will give students and emerging forensic scientists an open forum atmosphere in which to discuss the realities of working as a forensic scientist, and the qualifications necessary to pursue this exciting career.

Following the completion of this special session, the participants should be aware of the diversity of careers in forensic science, should understand how to compete for the FSF Emerging Forensic Scientist Award, should recognize the motivation behind and the guidelines for accreditation of forensic science academic programs, and should be aware of the realities in the field of forensic science according to young forensic scientists and crime laboratory directors. A breakfast session and an evening session will allow participants to mingle with students and

emerging scientists from across the nation and to establish relationships with members for mentoring and networking. While at the breakfast session, participants will also have a chance to learn about resumé building and are encouraged to bring their own resumés to be critiqued. While at the evening session participants will be able to view graduate student posters and to mingle with their peers in a comfortable environment.

This program should appeal to individuals with a strong desire to enter the field of forensic science as well as those with a few years of experience within the field and looking to get ahead. The session aims to cover a wide range of emerging fields through presentations, discussions, and interactions with new and established members of the forensic community. This program will provide a well-rounded understanding of different areas within forensic science.

The objectives of this special session are as follows:

- to introduce emerging fields in forensic science;
- to increase awareness of the accreditation process;
- to introduce emerging forensic scientists and prospective forensic scientists to established forensic scientists through interaction, discussions, and presentations;
- to provide an understanding of the FSF Emerging Forensic Scientist Award;
- to provide an opportunity for an open-forum discussion about realities in forensic science; and,
- to increase involvement within the Young Forensic Scientists Forum.

Careers, Education, Young Forensic Scientists Forum

SD1 Accreditation of Forensic Science Academic Programs Through the AAFS FEPAC

José R. Almirall, PhD, Department of Chemistry, International Forensic Research Institute, Florida International University, Miami, FL 33199; Max M. Houck, MA*, West Virginia University, 886 Chestnut Ridge Road, Suite 211, PO Box 6216, Morgantown, WV 26506-6212; Charles G. Tindall, PhD*, Metropolitan State College, Department of Chemistry, PO Box 173362, Campus Box 52, Denver, CO 80217-3362; Carl M. Selavka, PhD*, NIJ Office of Science and Technology, Investigative & Forensic Science Division, 810 7th Street, NW, Room 7235, Washington, DC 20531; Jay A. Siegel, PhD*, Michigan State University, School of Criminal Justice, 506 Baker Hall, East Lansing, MI 48824-1118*

After attending this presentation, attendees will understand the process of accreditation through the AAFS FEPAC mechanism and be able to participate in the process as an inspector of academic programs.

This presentation will impact the forensic community and/or humanity by providing a better understanding of the accreditation process and to encourage academic institutions to participate in the accreditation process. We also expect to encourage practitioners to invest in the process by volunteering to act as a site inspector. Forensic Science education will ultimately benefit from a bona fide accreditation process.

Attendance to this workshop will assist academic institutions who offer undergraduate and graduate degree programs in forensic science to prepare for the AAFS accreditation process through the Forensic Science Education Programs Commission (FEPAC). The workshop will also assist future site inspectors (academic and practitioners) in preparation for site inspections of academic programs.

The mission of the FEPAC is to maintain and enhance the quality of forensic science education through a formal evaluation and recognition of college level academic programs. The primary function of the committee is to develop and maintain standards and administer an accreditation program that recognizes and distinguishes high quality undergraduate and graduate forensic science programs.

Accreditation of Academic Programs in Forensic Science, FEPAC, AAFS

ES1 Advocacy For the Novice: How to Work For Forensic Sciences

J.C. Upshaw Downs, MD, Georgia Bureau of Investigation Medical Examiner, 925 A Mohawk Drive, Savannah, GA 31419; Barry A.J. Fisher, MS, MBA*, Scientific Services Bureau, Los Angeles County Sheriff's Department, 2020 West Beverly Boulevard, Los Angeles, CA 90057-2401; Elizabeth Lavach*, ELS & Associates, 9322 Old Burke Lake Road, Burke, VA 22015; Joseph P. Polski*, International Assoc for Identification, 2535 Pilot Knob Road, Suite 117, Mendota Heights, MN 55120-1120*

The goal of this special session is to provide a better understanding of how to effectively lobby budget makers at the local, state, and federal levels.

Forensic scientists and medical examiners are staunch advocates for their respective systems. Over the past few years, the overwhelming need for adequate resources in both systems has led to an attempt at synergy in advocacy. This effort has had variable results. While the credentials and skills of those within the nation's forensic community are unparalleled, negligible training has been available for the community as to why and how to lobby. Systems vary considerably in structure and operation, with the vast majority of U.S. forensic services provided at the local and state levels. Recent federal funding streams have also necessitated approaching congressional and senate members to impress upon them the needs of the U.S. forensic system.

The foundations of our nation's justice system are threatened by the current inability of forensic labs and medical examiners to process evidence quickly due to backlogs, the loss of crime scene expertise due to funding constraints, and the inability to perform certain tests for a myriad of reasons (such as lack of equipment, lack of training, and lack of expertise). All of these shortcomings directly relate to one thing - inadequate resources. When one realizes that state and local labs analyze over 90% of all forensic cases in the U.S., and that medical examiners analyze 20% of the ~2.5 million U.S. deaths annually, the potential impact of a continued under funding on the nation's forensic system is of utmost concern.

In 1999, the American Society of Crime Laboratory Directors (ASCLD) conducted a critical needs survey which concluded that 9,000 more forensic scientists are needed, $1.3 billion is needed for facility modernization and construction, 26% of forensic labs lack basic computer systems to track evidence, and $285 million is needed in equipment by laboratories. State and local funding continue to be inadequate, and with recent hard financial times, threaten to get worse before they get better. Federal monies have been slow to come and often are targeted (earmarked) during the legislative process.

For example, the federal Crime Lab Improvement Program (CLIP) which began in fiscal year 2000 has received a total of $95 million in appropriations. This program is intended to establish or improve forensic analyses by state or local forensic laboratories. To date, $23.4 million has gone to DNA backlogs, leaving $71.6 million for general forensic laboratory improvement. Of this, $59 million has been earmarked, leaving 13% ($12.6 million) of the total for competitive grants. The earmarked funds have been used for education, supplies, equipment, technology, facilities, and contract services. Unfortunately, the $35 million in the fiscal 2002 budget for the Crime Lab Improvement Program (of which 85% is earmarked) did not begin to make a dent in the national forensic infrastructure needs.

Efforts to secure additional federal monies concluded in 2000 with the passage and funding of the Paul Coverdell National Forensic Sciences Improvement Act (NFSIA). This program is intended to provide funding to crime laboratories and medical examiners' offices based on population and crime rates. The program permits funding for expenses related to facilities, personnel, computerization, equipment, supplies, accreditation, certification, education, and training in order to improve the quality and timeliness of forensic science or medical examiner services. NFSIA requires a

consolidated State plan for forensic science laboratories. Unfortunately, despite the authorization for hundreds of millions of dollars to date, only $10 million has actually been appropriated, largely because some see this initiative as duplicating that of the CLIP.

Part of the difficulty has been the interpretation by federal entities tied to funding issues that the nation's forensic community was not unified and not effective in getting the message across to those in charge of federal funds. Thus, the Consortium of Forensic Science Organizations (CFSO) was born. The CFSO represents some 11,000 forensic scientists and medical examiner/coroners. It consists of the ASCLD, the ASCLD/LAB, the NAME, the IAI, and the AAFS.

This special session will address the history of the efforts to secure additional funding for the forensic sciences. Through an interactive approach, techniques that have proven successful or unsuccessful in lobbying will be demonstrated and discussed. The content will cover local, state, and federal lobbying efforts and effective communication skills. Public relations skills and concise message driven delivery will be stressed. The attendee should leave with a better understanding of the ethics of lobbying; consensus building; and who, what, when, where, how, and why to lobby those public officials who are responsible for agency budgeting.

Lobbying, Advocacy, Funding

ES2 Forensic Scientific Investigations — Famous Cases Revisited Application and Limitations of Forensic Science: Why Experts Sometimes Disagree

Michael M. Baden, MD, Forensic Sciences Unit, New York State Police, Building 22, State Campus, Albany, NY 12226; Henry C. Lee, PhD*, Connecticut Forensic Laboratory, 278 Colony Street, Meriden, CT 06456; Cyril H. Wecht, MD, JD*, Allegheny County, 542 Fourth Avenue, Pittsburgh, PA 15219a*

Attendees will learn about the role and responsibilities of forensic scientists in the criminal justice system and how to handle their interprofessional relationships with opposing experts.

The great majority of homicide cases do not generate conflicting testimony from forensic pathologists and other forensic scientists. A large percentage of these cases do not entail arguable issues such as cause, manner, mechanism, place and time of death; hence, the roles of the prosecution's governmentary-related forensic scientists are quite pro forma. In fact, many of these cases are disposed of by plea-bargaining, and therefore, no testimony is ever required. Of those cases that do proceed to trial, most hinge on nonscientific matters, and it is not necessary for the defense to obtain and utilize independent forensic science experts.

Among the relatively small percentage of murder cases that do culminate in a full-blown trial, those that involve celebrities, physicians, and other well-known victims or alleged assailants, and some that become a national and international cause celèbre for inexplicable reasons, forensic scientific testimony is very often the most highly controversial and critical component of the entire courtroom drama. Nothing is more titillating, exciting, and intellectually provocative than a battle between two or more competent, experienced, and seasoned medical/scientific experts expressing directly opposing opinions relating to the circumstances of the victim's death or the alleged assailant's actions in causing that death.

Who to believe? What is the 'truth?' How can equally qualified experts arrive at mutually exclusive, divergent conclusions and opinions about such seemingly straightforward scientific issues as cause and manner of death? Does this kind of litigious-driven dichotomy indicate that one team of experts has mistakenly interpreted the physical evidence; or too much emphasis has been given to one particular area of evidence to the exclusion of other inconsistent or even contradictory facts and circumstances; or perhaps the intellectual divergence is simply attributable to economic greed?

A panel of experts will review several highly publicized cases that one or more of them have been involved with in recent years and will attempt to point out, and possibly help to explain, the likely basis for such conflicting testimony. The objective of this presentation will not be to convince the audience of the truthfulness and validity of one theory vs. another, but rather to edify skeptics and cynics who believe that there can be only one plausible and acceptable explanation for any alleged homicide scenario.

Forensic scientists need to be frequently reminded that medicine and some forensic fields are not absolute sciences. Just as there quite often are marked differences of opinion among various treating physicians in dealing with clinical matters, so can there be divergent opinions among forensic pathologists, psychiatrists, toxicologists, anthropologists, entomologists, criminalists, bloodstain and blood spatter experts, document examiners, forensic engineers, accident reconstructionists, linguists, accountants, and other forensic subspecialties. Those experts who love to use the phrase "absolutely, 100% certain" when proffering testimony should be admonished not to do so. No civil or criminal court in the United States requires that degree of certitude, and it is arguably unethical for an expert to make such a statement.

Such famous cases as Ted Binion, JFK Assassination, Chandra Levy, Laci Peterson, Michael Peterson, JonBenet Ramsey, O.J. Simpson, and Jayson Williams are among the cases to be discussed.

The essential background of each of these murder cases will be presented, and the panelists will present their respective analyses, conclusions, and opinions. Brief comments and succinct questions from the audience will then be welcomed.

Forensic Scientific Experts, Expert Testimony, Conflicting Opinions in Famous Cases

BS1 Theatre of the Absurd

Malcolm Stewart-Morris, MD, Human Performance, 12130 Skyline Boulevard, Oakland, CA 94619-2423*

After attending this presentation, attendees will understand the need for the restoration of confidence in the justice system and the part forensic science can play in bringing that about.

This presentation will impact the forensic community and/or humanity by demonstrating that this august body will see itself as a powerful voice in bringing about the changes in the judiciary which can restore public confidence and allow the rule of law to approach that of justice more reliably.

Bearing in mind the theme for the annual meeting, "Truth and Justice in the Balance," this presentation is designed to prepare the ground by suggesting that perceptions of the structure underlying those concepts have undergone cataclysmic change.

From a sadly mishandled election through 9/11 and the aftermath, including a controversial war which remains unresolved, truth and justice have not escaped a period in which the constitution itself has tottered.

In viewing a host of troubling issues in domestic and international affairs, the question posed by Lincoln as to whether government of, by and for the people can long survive has taken on new urgency which demands an answer. Forensic science cannot escape harm if its basis in the rule of law fails to hold the trust of the people.

The author will outline some of the barriers to the counterbalance forensic science is aiming to provide.

Disillusionment, Reexamination, Restoration

BS2 The Jack Ruby Case — A Miscarriage of Justice

Emanuel Tanay, MD, Wayne State University, 2977 Philadelphia Drive, Ann Arbor, MI 48103*

Upon completion of this presentation, attendees will be aware of the pitfalls of working with lawyers who do not follow the recommendations of the scientific experts.

On Friday, November 22, 1963, John F. Kennedy, the President of the United States, was shot in Dallas, Texas, by Lee Harvey Oswald. Lee Harvey Oswald was killed by Jack Ruby in the basement of the Dallas Police Department Headquarters. As the psychiatric expert retained by Jack Ruby's retrial lawyers, the author had considerable contact with the Warren Commission, including a number of exchanges with Justice Warren.

Less than twenty years later, John W. Hinckley, Jr., shot President Ronald Reagan.

The trial lawyer filed a malpractice lawsuit against a psychiatrist who discharged Hinckley from a psychiatric hospital before the shooting. The case did not survive the summary judgment motion but it did provide access to detailed information about John Hinckley's mental illness.

In the author's opinion the Hinckley verdict was consistent with the sense of justice and the letter of the law. This does not appear to be true in the Jack Ruby case.

This presentation will offer historical information that demonstrates Jack Ruby was a victim of a miscarriage of justice. He was improperly charged with first-degree murder even though the evidence clearly showed that it was manslaughter.

The trial was inconsistent with fundamental due process requirements. The judge was of questionable competence and integrity, the defense lawyer's behavior made meaningful defense, at best, difficult. Forensic psychiatric recommendations were violated. The prosecution was overzealous and the community sprit biased. While in jail Jack Ruby was a grossly psychotic man but was not given treatment for his mental illness.

Jack Ruby, Harvey Lee Oswald, John Hinckley

BS3 Movies: Reloaded

Haskell M. Pitluck, JD, Retired Judge, Illinois Circuit Court, 573 Lake Avenue, Crystal Lake, IL 60014; Linda B. Kenney, JD*, Law Offices of Linda B. Kenney, 2 Bridge Avenue, The Galleria, Atrium Building 5, Red Bank, NJ 07701; James E. Starrs, LLM*, George Washington University, 720 20th Street Northwest, Washington, DC 20052*

Just like the movie "Matrix: Reloaded," the production team of Pitluck, Kenney, and Starrs will focus on movies dealing with Texas justice and then some.

This year's breakfast will impart the viewers with an understanding of crime and the law through a wide variety of movie categories, including westerns, comedies, dramas, and perhaps even some ordinary home videos. If Texas movies can't rustle up enough controversy to supply the production team with material, they will revert to their archives and show how crime, the law, and justice remains the same from the 1930s through the present.

Crime, Justice, Movies

BS4 Discover the Electronic Trail of Evil: It's All About Evidence, Technology, and Crime!

Carrie M. Whitcomb, MSFS, National Center for Forensic Science, University of Central Florida, PO Box 162367, Orlando, FL 32816-2367*

Attendees will be given examples of the technical aspects of computers, the Internet, and the technological foundation for building a case against electronic crimes and a glimpse at the future.

The Internet and computers, with all their wonderful capabilities, have long been a place where evil lurks and where latent digital evidence remains. The technology is changing rapidly and investigators and forensic scientists must be skilled in tracking and preserving the digital evidence. Come to breakfast and learn more than you ever wanted to know about the technology and the possibilities the future holds related to digital evidence!

Technology, Digital Evidence, Computers

BS5 Death in Beirut

Richard C. Froede, MD, 3930 N Placita de la Escarpa, Tucson, Z 85750; John J. McDermott, JD*, Hall, Estill, Hardwick, Gable, Golden, & Nelson, 1120 20th Street Northwest, Washington, DC; Homer R. Campbell, Jr., DDS*, Office of the Medical Investigator, MSC11 6030, 1 University of New Mexico, Albuquerque, NM 87131-0001*

Participants will have an understanding of a historical kidnapping and forensic investigation and will gain an appreciation of the amount of time and effort in an investigation of terrorist activity.

The previously untold story of the kidnapping and subsequent deaths of two hostages, William R. Higgins, LTC, United States Marine Corps, and William F. Buckley, LTC, United States Army, in Beirut, Lebanon, will now be told. The investigative findings in the deaths in 1985 and 1989 and the discovery as well as recovery of the bodies can be revealed. The subsequent identification of the bodies and the post-mortem findings will be presented. Details of the "alleged hanging" of Col. Higgins in July 1989 will be discussed. Video presentations will be shown of the prepared statement by Col. Higgins, the digital identification by the Federal Bureau of Investigation, the evaluation of the "hanging," and of the story of Col. Buckley's activity in Lebanon. An analysis of the two trials in the United States District Court against the Islamic Republic of Iran, Ministry of Foreign Affairs, will be presented by the plaintiff's attorney.

Identification, Kidnapping, Recovery

BS6 Deep in the Heart of Texas Justice

James E. Starrs, LLM, The George Washington University, 720 20th Street, NW, Washington, DC 20052*

After attending this presentation, attendees will be provided with an overview of the Texas criminal and civil justice systems in extremis. It will enable the attendee to better appreciate the complexities of programming in the justice system.

This presentation will impact the forensic community and/or humanity by sensitizing the attendee to the nuances of various troublesome areas in the criminal and civil justice systems of which he/she is most likely unaware.

Lone Star Justice?

- What do Lance Armstrong and fleas in a courthouse have in common? They both have found a home in Texas.
- What do Carlton Dotson and James Grigson, MD, (a.k.a. "Dr. Death") have in common? They both have been featured in high profile Texas criminal cases.
- What do Juan Corona and Elmer Wayne Henley have in common? They rank one and two in numbers of serial murders committed by them with Texan Henley leading by one.
- What do a funeral urn and Darlene Routier have in common? They both were featured attractions in a Texas murder investigation.
- What do Joe Cannon, a defense lawyer caught sleeping during the trial of his client Calvin Burdine, and two consenting adults committing sodomy in private have in common? They both resulted in notable legal and popular clamor and also originated in Texas.
- What do John E. Wright, Esq., and three time convicted murderer Johnny Paul Penry have in common? They have both been fighting for justice in the courts of Texas with Wright seeking to continue his 20 year long defense of Penry.
- What do death row inmate Delma Banks and former FBI Director William Sessions have in common? They have joined forces in contesting the Texas capital murder conviction of Banks on Banks' appeal to the United States Supreme Court for a stay of execution - which was granted.
- What do Susan Basso and Jose Betancourt have in common? They are both losers in the Texas courts, Betancourt having forfeited his state lottery winnings of $5.5 million and Basso having her cover of deceit blown by a capital murder conviction.
- What do gypsum wallboard and a cockatoo have in common? They both were instrumental in separate Texas criminal investigations, the wallboard in upending drug enforcement in Dallas and the cockatoo in providing the essential DNA to convict a burglar/murderer.
- At this point or, hopefully earlier, you have gotten the message. The point and purpose of this breakfast seminar is to bring together and to focus upon Texas civil, criminal, and courtroom matters that are larger than life in the expectation that others might learn from these lessons in Lone Star justice.

Fraud, Forfeiture, Surveillance

BS7 The Quest for Truth in the Emergency Room

Jennifer M. Lafayette, MD, and Lawrence T. Park, MD, Massachusetts General Hospital, Warren 605, 33 Fruit Street, Boston, MA 02114; Felicia A. Smith, MD*, Massachusetts General Hospital, WACC 812, 15 Parkman Street, Boston, MA 02114*

This presentation will enhance the ability to evaluate patients with mental illness and legal issues in the emergency room.

Many patients with mental illness evaluated in the emergency room have complex legal issues. Some patients arrive while still in police custody or have outstanding warrants. Other patients may have such significant violent histories that they cannot be hospitalized in a general psychiatric inpatient unit. Occasionally children are brought to the emergency room with court orders for psychiatric treatment. Overall, legal status may not be clear. This panel presentation will describe several cases in which "the quest for truth" led to complex situations in which disposition was not clear. It will also describe steps for clarifying and understanding legal issues in the emergency room.

Emergency Room, Psychiatry, Legal

BS8 Tom Krauss Memorial Bite Mark Breakfast: Evolution of Bite Mark Analysis in North America From the 20th to the 21st Century

Robert B.J. Dorion, DDS, 1 Place Ville-Marie, Suite 11238, Montreal, Quebec H3B 3Y1, Canada*

While bitemark recognition in the living is the responsibility of first responders, emergency room personnel, physicians, pediatricians, dentists, nurses and social service personnel, the task is relegated to crime scene investigators, medical examiners, coroners, pathologists and odontologists in the deceased.

Not surprisingly, the development of a bitemark protocol resulted from a survey conducted for the odontology section of the AAFS in 1974, and subsequent ABFO workshops.

Protocols for photography, the collection, the preservation and the analysis of bitemarks and the respective guidelines and standards were subsequently established by the ABFO.

Past and current methods for evaluating bitemark evidence and improvements made in comparison techniques in an effort to improve the scientific basis for bitemark analysis will be discussed.

Contentious issues, prevention and contamination, and the legal responsibility and liability of the expert witness will be mentioned.

Most of the illustrations used in the keynote address are from the soon-to-be published textbook "Bitemark Evidence" edited by the speaker. A team of eminent forensic scientists from the disciplines of forensic odontology, DNA analysis, pathology and jurisprudence present their views in the book's highly organised thirteen sections. The 30 chapters unravel all aspects of bitemark evidence from its history, to recognition/diagnosis, to DNA, to genotypic comparison of oral bacteria, to expert witness liability. The 21 contributors from four countries present complementary views on bitemark evidence. The over 700 photographs include 32 color pages illustrating the many facets of bitemark evidence.

Bitemark Evidence, Bitemark History, Bitemark Techniques

L1 Networking Lunch

Carol Henderson, JD, Stetson University, College of Law, 1401 61st Street South, Gulf Port, FL 33707; Anjali R. Swienton, MFS, JD, SciLawForensics, Ltd., 25 Walnutwood Court, Germantown, MD 20874

Take a productive lunch break on Monday to meet new people and to establish networking relationships. Box lunches will be provided and participants will engage in "speed networking." The hottest trend to hit the dating scene in years, "speed dating" has been adapted as the latest craze in networking. Even if you've never engaged in "speed dating," we'll teach you to speed network - spending a few minutes with each new contact to exchange information and interests.

The lunch will provide an enjoyable opportunity to network with many others - the perfect beginning to a week of exciting activities at the AAFS annual meeting!

Networking, Relationships, Speed Networking

L2 Life in Death's Acre

Wm. Paul Phillips, JD, PO Box 10, Huntsville, TN 37756; William M. Bass III, PhD, University of Tennessee, Department of Anthropology, Knoxville, TN 37996

Dr. William M. Bass reflects on forensic science, violent death, the "Body Farm," and almost half a century in the company of corpses.

Dr. Bass is a legend in forensic circles. Nearly a quarter-century ago, Dr. Bass created the world's first (and still the world's only) laboratory devoted to human decomposition: the University of Tennessee's Anthropology Research Facility, or ARF—better known as "the Body Farm." Ever since its inception, this unique facility has produced pioneering scientific research on the rates of human decay under a wide variety of conditions. It also serves as the world's only setting where human corpses are regularly used in controlled scientific tests of cutting-edge forensic technologies such as ground-penetrating radar, artificial "noses" for sniffing out clandestine graves, and analytical instruments for gauging time since death on the basis of biochemical "markers" of decomposition. The Body Farm also provides a unique and realistic training environment for FBI agents, crime-lab technicians, homicide detectives, and cadaver-dog handlers.

Dr. Bass's unique research facility was thrust into the limelight in 1994 when it received title billing in Patricia Cornwell's best-selling fifth novel, *The Body Farm*. Besides providing scientific data for Ms. Cornwell's story, Dr. Bass's facility made a cameo appearance in her novel — as did a character inspired by Dr. Bass himself.

Besides guiding the research at the Body Farm, Dr. Bass has written or co-authored more than 200 scientific publications, many of them based either on the facility's research projects or on murder cases and other mysteries he's helped to prosecute or solve. In October 2003, Putnam published his career memoir, *Death's Acre*, co-authored with journalist and documentary filmmaker Jon Jefferson.

Body Farm, University of Tennessee, Anthropology Research Facility

L3 Truth is the First Casualty in Conflicts — The Kosovo Experience

Wm. Paul Phillips, JD, PO Box 10, Huntsville, TN 37756; Helena Ranta, DDS, PhD, University of Helsinki, Department of Forensic Medicine, PO Box 40, Helsinki 00014, Finland

The escalation of violence in Kosovo started in early 1998. While the jurisdiction of the International Criminal Tribunal for the Former Yugoslavia (ICTY) was not acknowledged by the Milosevic regime, several states and human rights organizations were considering ways to send a team of forensic experts to the region to investigate alleged human rights violations. The European Union Team was finally issued visas and the Team arrived in Pristina in mid-October 1998.

On January 16, 1999, after the discovery of 45 victims at the village of Racak, the Team was given a court order to participate in investigations. After the NATO air strikes in November 1999 and March 2000, the Team conducted scene investigations at the gullies in the vicinity of Racak and at the village. The results of these investigations, together with the autopsy protocols of January 1999, have been filed as evidence in the trial against Slobodan Milosevic at the ICTY. The speaker was summoned to testify in the capacity of a 'Chamber Witness' at the trial in March 2003.

In several instances, misleading information was distributed and even filed as evidence by the accused in relation to Racak. Also, there were severe shortcomings in the initial investigations at Racak and during the autopsies at the Institute of Forensic Medicine, University of Pristina. These include use of paraffin test for gun shot residue (GSR) analysis, recovery of foreign objects (bullets and bullet fragments), firing distances, claims of postmortem mutilation, and handling of bodies. After having testified, the speaker will address some of these issues in the light of the detailed analysis of forensic evidence and DNA profiles.

Kosovo, Chamber Witness, Misleading Information

W1 How to Be a Better Expert Witness

Gary R. Brown, BS, President, RT Environmental Services, 215 West Church Road, King of Prussia, PA 19406; James S. Smith, PhD*, President, Trillium, Inc., 28 Graces Drive, Coatesville, PA 19320; Mary Maloney Huss, BS, JD*, Partner, Wolf, Block, Schorr & Solis-Cohen, LLP, Wilmington Trust, 1100 North Market Street, Wilmington, DE 19801; Robert A. Middleburg, PhD*, Forensic Toxicologist, National Medical Services, 3701 Welsh Road, Willow Grove, PA 19090; James S. Smith, Jr., PhD*, Oak Creek, Inc., 60 Oak Creek, Buxton, ME 04093-6375*

After attending this presentation, attendees will have a better understanding of the responsibilities and legal aspects when called on to be an expert witness, and understand the techniques that experts use on expert witness assignments.

Scientists and engineers are often called upon to be an expert witness. All too frequently, they are not told by other experts, their peers, or lawyers the key skills necessary to help in a case. Being an expert witness can be a high point or low point in a professional's career, so learning the key skills early is key to professional success. Participants in this session will learn:

- How to scope an assignment;
- How to organize work activities and organize facts and data;
- How to prepare focused expert reports; and
- How to prepare for and deliver deposition and trial testimony

A toxic mold case will be used as a "working case" example throughout the workshop.

Expert Witness, Expert Reports, Trial Preparation

W2 The Role of Atmosphere in Forensic Investigation: A Closer Look at the Environment in Forensic Science

Jason H. Byrd, PhD, Director of Operations, Volusia County Office of the Medical Examiner, Office of the Medical Examiner, 1360 Idian Lake Road, Daytona Beach, FL 32124; Ke Chung Kim, PhD*, Penn State University, Department of Entomology, 501 ASI Building, University Park, PA 16802-3508; Gregory S. Forbes, PhD*, The Weather Channel, 300 Interstate North Parkway, Atlanta, GA 30339; Paul Knight, MS*, State Climatologist for Pennsylvania, affiliated with Penn State University, PSU 608A Walker Building, University Park, PA 16802-5014; Joseph P. Sobel, PhD*, Accu-Weather, Inc., 385 Science Park Road, State College, PA 16803*

After attending this presentation, the participant will gain information about the variety of atmospheric data sources, knowledge concerning the role of climatic conditions in cases, understanding of the procedures used in reconstruction of weather conditions for the investigation, and awareness of expertise in this aspect of forensic science.

The Role of Atmosphere in Forensic Investigation: A Closer Look at the Environment in Forensic Science Crime and crime scenes are potentially influenced by atmospheric and environmental conditions. During the forensic investigation of events that occur outdoors, the discovery phase should consider the weather conditions at the time of the incident. Data from the atmospheric sciences has changed significantly during the past decade and knowledge of its availability, utility, and potential limitations can assist in several parts of a case.

An overview of the tools and their application by forensic climatologists will be followed by the presentation of several case studies where reconstruction of atmospheric conditions played a crucial part of both civil and criminal investigations.

Examples of the use of this science will be shown in weather-related disasters, such as airplane accidents, tornados, hailstorms, damaging windstorms, and floods where the weather phenomena causing the damage is very small scale. Because of this, they miss the relatively sparse observing stations, and their conventional data does not represent the wind speeds and other conditions at the time and location of the incident. This presentation will describe the use of radar and other tools that can be used in cases of aircraft icing, microbursts, tornados, and floods, in which the speaker was the expert witness.

There will also be a presentation illustrating the use of climatology in accident related incidences where there had been a discrepancy about the road design and its safety during hazardous weather conditions, as well as a presentation of how weather conditions influence cases involving forensic entomology.

Atmospheric Conditions, Climatology, Environmental Impacts

W3 Forensic Human Mitochondrial DNA Analysis

Douglas R. Hares, PhD, DNA Unit II, FBI Laboratory, 2501 Investigation Parkway, Quantico, VA 22135; John E.B. Stewart, PhD and Patricia J. Aagaard, BS*, National Missing Person DNA Database, FBI Laboratory, DNA Unit II, 2501 Investigation Parkway, Quantico, VA 22135; Suzanne M. Barritt, MS*, Armed Forces DNA Identification Laboratory, 1413 Research Boulevard, Rockville, MD 20850; Robert A. Bever, PhD*, The Bode Technology Group, 7364 Steel Mill Drive, Springfield, VA 22150; Robert P. Biancavilla, MPS, JD*, Nassau County District Attorney's Office, 262 Old County Road, Mineola, NY 11501; Bruce Budowle, PhD*, FBI Laboratory, 2501 Investigation Parkway, Quantico, VA 22135; John M. Butler, PhD*, National Institute of Standards and Technology, 100 Bureau Drive, MS 8311, Building 227, Room A243, Gaithersburg, MD 20899-8311; Connie L. Fisher, PhD* and Alice R. Isenberg, PhD*, FBI Laboratory, DNA Unit II, 2501 Investigation Parkway, Quantico, VA 22135; Terry W. Melton, PhD*, Mitotyping Technologies, LLC, 1981 Pine Hall Drive, State College, PA 16801; Walther Parson, PhD*, Institute of Legal Medicine, University Innsbruck, Muellerstr. 44/III, A-6020 Innsbruck, Austria; John V. Planz, PhD*, DNA Identity Laboratory, University of North Texas, HSC, 3500 Camp Bowie Boulevard, Fort Worth, TX 76107; Eric G. Pokorak, BS*, Deborah Polanskey, BS*, and Catherine E. Thiesen, PhD*, BS, FBI Laboratory - DNA Unit II, National Missing Person DNA Database, 2501 Investigation Parkway, Quantico, VA 22135*

After attending this presentation, attendees will understand the research currently being conducted in the field, what technologies are on the horizon, legal issues faced by the forensic mtDNA community, and issues encountered in forensic mtDNA casework. Participants should also have a complete understanding of SWGDAM's Guidelines for Mitochondrial DNA Nucleotide Sequence Interpretation and the databasing efforts taking place in the mtDNA community, including missing persons and population data.

This presentation will impact the forensic community and/or humanity by reviewing the current issues in mitochondrial DNA analysis as well as exploring future technologies in the field.

Over the past decade, mitochondrial DNA (mtDNA) analysis has become more widely used in the forensic community. Mitochondrial DNA analyses are particularly important in cases where nuclear DNA analyses are not possible due to insufficient sample quantity and/(r quality, or lack of appropriate reference samples. While mtDNA analyses do not provide the discrimination potential of nuclear DNA tests, mtDNA sequence is often the only information which can be gathered from a piece of evidence.

This workshop will have three main objectives. The first objective will be to discuss issues in traditional mtDNA casework. Topics will include a discussion of The Scientific Working Group on DNA Analysis Methods (SWGDAM) published document containing guidelines for the interpretation of mtDNA sequence data, casework examples, heteroplasmy, the mtDNA population database maintained by the FBI Laboratory, the Combined DNA Indexing System Missing Person component (CODISmp) and the FBI's Regional Mitochondrial DNA Program. The second objective will be to discuss current research in the field of mtDNA. Topics will include single nucleotide polymorphisms (SNP's), automation, mixtures, phylogenetics, and possible future technologies. The third objective will be to discuss legal issues encountered in the forensic mtDNA arena. Panel discussions will allow attendees to address their specific questions and concerns to the speakers after both the morning and afternoon sessions.

mtDNA, Missing Persons, Mitochondrial DNA

W4 Forensic Science, Evidence Based Medicine, and the “Shaken Baby Syndrome”

Patrick E. Lantz, MD, Wake Forest University Health Sciences, Department of Pathology, Medical Center Boulevard, WInstom-Salem, NC 27157-1072; Thomas L. Bohan, PhD, JD*, MTC Forensics, 371 Fore Street, Portland, ME 04101; G.G.W. Adams, BSc, MBChB*, Mooresfields Eye Hospital, City Road, London, EC1V 2PD, United Kingdom; Faris A. Bandak, PhD*, Department of Neurology, F. Edward Hébert School of Medicine, Uniformed Services University of the Health Sciences, PO Box 60060, POTOMAC, MD 20854; Patrick D. Barnes, MD*, Lucile Satter Packard Children's Hospital, Stanford University Medical Center, 725 Welch Road, Palo Alto, CA 94304; Mark Donohoe, MBBS*, 129A Raglan Street, PO Box 328, Mosman, NSW 2088, Australia; Jan E. Leestma, MD*, The Children's Memorial Hospital, 1440 North Kingsbury Street, Suite 210, Chicago, IL 60622; Colin Smith, Neuropathology Unit, Department of Pathology, The University of Edinburgh, Western General Hospital, Crewe Road, Edinburgh, EH4 2XU, United Kingdom; Kirk Thibault, PhD* and Lawrence E. Thibault, ScD*, Biomechanics, Inc., Philadelphia Naval Shipyard, Quarters M-2, 4601 South Broad Street, Philadelphia, PA 19112*

After attending this presentation, attendees will from an evidence based medicine perspective, be able to discuss the quality of evidence limitations regarding the existing literature on 'Shaken Baby Syndrome' including retinal hemorrhages/ocular manifestations, radiographic findings, traumatic unconsciousness, criteria for case definition, and methodological flaws/selection bias in study design; and be able to summarize the biomechanics in age-related traumatic brain injury including causal mechanisms, scaling of tolerances for skull failure and brain injuries in adults and children, and limitations of diagnostic assumptions without biomechanical considerations.

More than three decades have passed since John Caffey's publication "On the Theory and Practice of Shaking Infants." Since then the 'Shaken Baby Syndrome' (SBS) has received extensive clinical attention as well as national and international publicity. Because of a number of highly publicized court cases, pathologists, pediatricians, ophthalmologists, radiologists, neurosurgeons and biomechanical engineers are being critically scrutinized about their opinions on this subject. No one can dispute that the protection of innocent children is beneficial for society; however, this must be grounded in objective, unbiased and reproducible scientific facts thereby permitting a balance between truth and justice. If not, others rights are endangered, the wrongfully accused.

Inertial loading with abrupt angular acceleration/deceleration during shaking has been postulated to cause cerebral shear strain deformation, tissue disruption at interfaces and diffuse (traumatic) axonal injury. Such a mechanism seems inherently logical in susceptible infants and young children who would be inclined to this type of injury by relatively weak neck muscles, a proportionally large head and vulnerability of an immature brain. Traditionally, this shaking mechanism hypothesis has assumed to explain the primary injury patterns (subdural hematoma, retinal hemorrhages and diffuse axonal injury) and secondary injury patterns (cerebral edema, hypoxia/ischemia and herniation) stated to be characteristic if not virtually pathognomonic for SBS.Presumably causing immediate symptoms without a lucid interval these serious and potentially life-threatening injuries are often readily demonstrated by neuroimaging, funduscopic examination and neuropathologic procedures. According to a number of medical articles, similar accidental cerebral/ocular injuries can only occur with massive forces associated with motor vehicular collisions or a fall from at least a two-story building. Also, an infant or child with a prior head injury who has changing symptoms would presumably indicate a newly inflicted injury and not an intracranial rebleed. Other authors have stated that "when extensive retinal hemorrhages accompanied by perimacular folds and retinoschisis are found in association with intracranial hemorrhage or other evidence of a traumatic brain injury in an infant, a shaking injury can be diagnosed regardless of other circumstances." With this reasoning, the last caregiver attending the injured infant/young child is automatically considered guilty of causing an abusive head injury, especially if unwitnessed since shaking is never considered accidental. This dilemma has been exacerbated by the absence of a consistent, reliable case definition for the diagnosis of SBS and the lack of evidence base within the SBS literature. Much of the current medical literature on SBS consists of case reports, non-comparative case series, unsystematic reviews and position papers. Inclusion criteria in a number of case reports and case series include vague diagnostic categories such as 'presumed' child abuse. Case control studies often exhibit selection bias in methodological design and circular reasoning. The only experimental biomechanical study of SBS measured forces from shaking versus impact in a doll model. Only forces observed with impact exceeded injury thresholds that would explain the pathological spectrum of the intracranial injuries. Although subsequent reports have corroborated that intracranial injuries are associated with impact, they also offered other evidence that shaking alone is sufficient to cause serious injury and/or death in infants and young children.

The first part of this workshop critically reviews the scientific literature on SBS including retinal hemorrhages/ocular manifestations, radiographic findings, and traumatic unconsciousness. The subsequent sessions review the clinical and biomechanical literature about the basic mechanisms of adult and pediatric head injury and address the question whether shaking alone is sufficient to explain the neuropathologic and ophthalmologic findings. Questions and comments from the audience are encouraged following each presentation and a panel discussion directed by questions from the audience concludes this informative workshop.

Evidence Based Medicine, Shaken Baby Syndrome, Traumatic Brain Injury

W5 Tryptamines and Other Psychotropic (Mind Altering) Substances: Analysis, Toxicology, and Pharmacology

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After attending this presentation, workshop attendees will have an awareness of the current drug abuse trends regarding new and unusual psychotropic drugs. Analytical data, pharmacological effects, and toxicological consequences will be emphasized.

In the last few years there has been a significant increase in the use, abuse and availability of new and different psychotropic drugs. These substances, commonly referred to as "Club Drugs" are not limited to LSD, DMT, MDA, MDMA (ecstasy), methoxyamphetamines (PMA, PMMA), Ketamine and GHB. Other new substances being encountered/abused more frequently include designer Tryptamines such as alpha-Methyltryptamine (AMT), 5-Methoxy-N,N diisopropyltryptamine (5-MeODIPT); Phenethylamines such as 2C-T-7, 2C-B (Nexus) and its' analogues 2C-C or 2C-I; and, Piperazines such as Benzylpiperazine (BZP) and Trifluromethylpiperazine (TFMPP). An example of an unusual substance that will be discussed is 'Ayahuasca', a South American herbal extract that contains Dimethyltryptamine (DMT) in combination with Harmine and Harmaline. Also presented will be poly-drug mixtures such as MDA/MDMA/Ketamine/Methamphetamine and examples of unusual synthesis reaction by-products.

This presentation will examine pharmacological effects, toxicity and current evaluation and control issues. Analytical reference data will be provided to all workshop attendees. This workshop is designed for practitioners in medicine, forensic sciences (medical examiners/pathologists, chemists, behavioral psychologists, and toxicologists) and law enforcement personnel.

Psychotropic Substances (Club Drugs), Toxicology and Pharmacology, Evaluation and Control

W6 Learning to Appreciate and Respect Differences

Carol E. Henderson, JD, Shepard Broad Law Center, Nova Southeastern University, 3305 College Avenue, Ft. Lauderdale, FL 33314; Anjali R. Sweinton, MFS, JD*, SciLaw Forensics, Ltd., 25 Walnutwood Court, Germantown, MD 20874; Carlton-Jane Beck, MS, Lake County Sheriff's Office, Crime Scene Investigations, 360 West Ruby Street, Tavares, FL 32778; Ashraf Mozayani, PhD, PharmD, Harris County Medical Examiner Office, 1885 Old Spanish Trail, Houston, TX 77054; Joye Carter, MD*, 3390 Ozark Street, Houston, TX 77021-1135; Mary Fran Ernst, BLS*, Saint Louis University School of Medicine, Division of Forensic Pathology and Education, 6039 Helen Avenue, St. Louis, MO 63134; Susan Hart Johns, MA*, Illinois State Police, Division of Forensic Services, 630 East Washington Street, Springfield, IL 62701; Patricia T. Kelly*, 8029 Wilson Terrace, Springfield, IL 62707; Yona Rozen, JD*, Gillespie, Rozen & Watsky, 3402 Oak Grove Avenue, Suite 200, Dallas, TX 75204, Teri Stockholm, PhD*, The Wise Woman Group, 1700SE 15th Street, Suite 309, Ft. Lauderdale, FL 33316*

By attending this presentation, attendees will be taught skills and strategies to successfully integrate the varied components necessary for a successful career in forensic science.

The demographics within forensic science are changing. Many of the positions in the crime laboratories and graduate schools are now being sought and held by women. As a result, it is important that the profession examine the differences that the demographic shift brings to forensic science. This workshop will feature speakers and activities addressing the skills and knowledge needed to be successful in this diverse environment. Topics include: mentoring and networking; communication skills; legal issues in the workplace (e.g., sexism, ageism, harassment); personal choices and balancing responsibilities; and gender stereotypes, values and standards. The workshop will include discussions on surviving politics in the workplace and overcoming adversity. Participants will be taught skills and strategies to successfully integrate the varied components necessary for a successful career in forensic science. Registration for the workshop includes a luncheon at The Women's Museum in Dallas, a Smithsonian affiliate, as well as a tour of the museum.

Mentoring, Networking, Communication

W7 Drug Enforcement Administration Forensic Drug Chemist Workshop

Rhesa G. Gilliland, MS, Drug Enforcement Administration, Office of Forensic Sciences, 2401 Jefferson Davis Highway, Alexandria, VA 22301; Darrell L. Davis, BS*, Laboratory Director, Drug Enforcement Administration South Central Laboratory, 10150 East Technology Boulevard, Dallas, TX 75220-4377; Sanford Angelos, MS, MEd*, Drug Enforcement Administration, 536 South Clark, Suite 800, Chicago, IL 60605-1526; John S. Chappell, PhD*, Drug Enforcement Administration Western Laboratory, 390 Main Street, Room 700, San Francisco, CA 94105; Tamara D. Keller, BS*, Drug Enforcement Administration, 10150 East Technology Boulevard, South Central Laboratory, Dallas, TX; Walter R. Rodriguez, MS*, Drug Enforcement Administration, 5202 NW 84th Avenue, Miami, FL 33166; Jerry A. Walker, BS*, Drug Enforcement Administration Mid-Atlantic Laboratory, 1440 McCormick Drive, Largo, MD 20774-5313*

After attending this presentation, attendees will be able to utilize information and material provided to improve current drug analysis procedures within their laboratory, to select appropriate instrumental techniques for controlled substance identification and quantitation, and to receive an overview of the DEA approach to controlled substance analysis.

This presentation will impact the forensic community and/or humanity by providing an opportunity for crime laboratories to interact with DEA forensic chemists concerning the challenges of controlled substance identification techniques.

The objective of this workshop is to present a synopsis of the methods currently being used in DEA laboratories to identify suspected controlled substances and other materials encountered in evidentiary drug analysis.

DEA has been training individuals in controlled substance analysis since the early 1970s. Over 5,000 students have been trained either during state and local seminars or within the DEA laboratory system. These students have been trained in the use of the most up to date analytical techniques in forensic drug chemistry. DEA forensic chemists form the core group responsible for presentations during the seminars or within the DEA field laboratories.

This workshop will be an abbreviation of the DEA Forensic Chemists Training Program. The presentations will include information which is currently disseminated in the state and local seminars and by each DEA training officer within the field laboratories. The students will receive infor-

mation on screening techniques to include color tests, microcrystalline tests, and thin layer chromatography; basic quantitative analysis including the use of gas chromatography, high performance liquid chromatography (HPLC), and capillary electrophoresis (CE); and confirmatory instrumental techniques to include Fourier Transform Infrared Spectrophotometry and gas chromatography/mass spectroscopy (GC/MS).

It would be impractical to attempt to include all facets of these techniques in a one-day presentation. However, the presentations will cover as much information as possible during the course of the seven hours of instruction. At a minimum, the following topics will be included:

- Advantages in the use of one type of analytical technique over another technique.
- Data evaluations problems which analysts and technical reviewers must consider prior to reaching conclusions
- Derivatization techniques and instrumental methods used to identify isomers
- Recommendations for quantitative methodology

The session will conclude with a 90-minute discussion hosted by the DEA Forensic Chemist instructors. Participants will be invited to ask questions, comment on the information which has been provided, and suggest solutions for problem solving techniques.

Controlled Substance, Drug Analysis, Instrumental Techniques

W8 Setting Up a Digital Evidence Unit and Preparing for Accreditation

Carrie M. Whitcomb, MSFS, SWGDE, PO Box 162367, Orlando, FL 32816-2367; Robert P. Bianchi, BS*, RCFL National Program Office, 5502 Chester Mill Court, Fairfax, VA 22030; Don Lewis*, Lakewood Police Department, Lakewood, CO 80226; Michael J. Phelan, MA*, Drug Enforcement Administration Computer Forensics Lab, 7704 Old Springhouse Road, McLean, VA 22102-3494; Mark Pollitt, MS*, Digital Evidence Professional Services, 8509 Nicole Court, Ellicott City, MD 21043; Dara Sewell*, Testing and Validation, Unit Chief, FBI CART, 935 Pennsylvania Avenue, Washington, DC 20535*

After attending this presentation, attendees should be able to understand the process and criteria for developing a digital evidence unit. Additionally they will learn about the accreditation process and will have a fundamental understanding of the basic principles required to develop a training manual, a quality manual and standard operating procedures manual for digital evidence.

This workshop will present an overview of establishing a digital evidence unit and developing quality programs that assist in meeting accreditation criteria for the unit.

Members of The Scientific Working Group on Digital Evidence (SWGDE) will present a workshop that describes the process from deciding to implement a digital evidence unit to its accreditation. The panel of experts will present the history of digital evidence, performing a needs assessment, and developing an implementation plan, designing the infrastructure for a quality digital evidence unit capable of achieving accreditation by The American Society of Crime Laboratory Directors /Laboratory Accreditation Board (ASCLD/LAB).

The American Society of Crime Laboratory Directors/Laboratory Accreditation Board (ASCLD/LAB) in 2003 approved Digital Evidence as a discipline in Crime Laboratories. SWGDE has defined digital evidence as "information of probative value that is stored or transmitted in a binary form." Sub-disciplines within digital evidence are:

- Computer Forensics
- Digital Audio Forensics
- Digital Images/Video Forensics

SWGDE has developed best practices and examples for digital evidence quality manuals, training manuals, and SOP manuals to assist laboratories develop a quality program. These documents will be introduced to the forensic community at this workshop and will assist attendees in preparing for digital evidence for accreditation.

As a matter of clarification, digital pictures of a crime scene are not considered to be digital evidence, unless the digital picture itself is the evidence, for example a digital picture or digital video of child pornography.

Digital Evidence, Accreditation, Quality Programs

W9 Serial Homicide, Myths, Legends, and Facts

Robert J. Morton, BA, MS, FBI, National Center for the Analysis of Violent Crime, FBI Academy, Quantico, VA 22135; Mary Collins-Morton, BS*, FBI Washington Field Office, 601 4th Street, Northwest, Washington, DC 20535; James J. McNamara, MS*, Alan C. Brantley, MA*, and James O. Beasley, MPA*, FBI, National Center for the Analysis of Violent Crime, FBI Academy, Quantico, VA 22135*

After attending this presentation, attendees will have a greater understanding of the "truth" about serial homicide, to include the scope of serial murder, motivations, methods of operation, victim selection, body disposal, forensic techniques, and cooperative investigative strategies useful to successful case resolution.

This presentation will impact the forensic community and/or humanity by exposing participants to empirical and case data concerning serial murder and the unique behavioral, forensic, and investigative issues facing professionals participating in serial murder investigations.

The purpose of this workshop is to provide investigators and medico-legal professionals with an understanding of serial murderers, their motives, methods of operation, victim selection, and body disposal scenarios highlighted through case examples. The focus of the workshop is on the practical issues involved in investigating and analyzing the actions of a serial murderer, the benefits of input from different disciplines and the need for cooperation between professionals.

This workshop is targeted at providing investigators and medico-legal practitioners with a broad base of knowledge concerning serial murder, as well as a thorough understanding of the nature of serial offenders. Workshop will include a discussion of serial murder and its parameters, motivations of serial offenders, forensic issues and investigative issues. Workshop discussions will be augmented by numerous case examples, including several "high profile" cases.

Serial homicide has long been an issue that generates much attention, from law enforcement, mental health practitioners, medico-legal professionals, and the media. There are a plethora of opinions. Law enforcement regard serial homicide as a painful anomaly, mental health practitioners look for causes, medico-legal professionals struggle with the results and the media inflates serial homicide into an epidemic. It's no surprise that many myths and legends abound concerning serial killers.

The FBI's National Center for the Analysis of Violent Crime (NCAVC) is routinely consulted by federal, state, and local authorities in a variety of cases of violent crimes, especially bizarre or serial homicides. The NCAVC has had extensive experience in assisting federal, state, and local law enforcement agencies in the investigation of serial homicides, and has reviewed hundreds of serial homicide cases for research purposes. Currently, the NCAVC is engaged in several research projects on serial offenders, including interviews of incarcerated serial offenders. The material presented in this workshop is based upon actual case experience, ongoing research, and current interviews with serial offenders.

Upon completion of this workshop, participants can expect to have a greater understanding of the "truth" about serial homicide, to include, the scope of serial murder, serial offenders and motivation, methods of operation, victim selection, body disposal, forensic techniques and collection strategies pertinent to serial homicide, and cooperative investigative strategies useful to successful case resolution.

Serial Homicide, Serial Murderer, Victimology

W10 Forensic Histopathology

Paul Fornes, MD, PhD, Department of Pathology, European Hospital Georges Pompidou, 20, Rue Leblanc, Paris, 75015, France; Steven Karch, MD*, PO Box 5139, Berkeley, CA 94705-0139; Bernd Brinkman, MD, PhD*, International Journal of Legal Medicine, Rontgenstrausse 23, Munster, D-48149, Germany; Chris M. Milroy MD*, University of Sheffield, Sheffield S3 7ES, United Kingdom; Helen L. Whitwell, MD*, Department of Forensic Pathology, University of Sheffield, Medico-Legal Centre, Watery Street, Sheffield, United Kingdom*

After attending this presentation, pathologists should be able to recognize and interpret main histologic lesions in forensic pathology. Non-pathologists should be able to understand and/or criticize a pathology report.

Surgical/general histopathology textbooks deal with diseases encountered in hospitals, but forensic issues are never addressed. On the other hand, in forensic textbooks, gross pathology, but rarely histopathology, is found. Forensic histopathology is also rarely taught in medical schools. Consequently, it may be difficult for a pathologist to get sufficient knowledge in forensic histopathology. In this workshop, main histologic lesions encountered in forensic practice, in different fields, will be examined.

Natural deaths account for half of autopsies in forensic practice. Among those, cardiovascular/sudden deaths are by far the leading causes of death. Examination of the heart is therefore of the greatest importance. Although some cardiac diseases may be diagnosed at gross examination, histology may prove useful in certain cases, such as myocarditis, arrhythmogenic right ventricular cardiomyopathies, conduction tissue lesions. The attendee will be able to examine a heart. Guidelines in sampling the heart, including conduction tissue will be provided. Main histologic lesions encountered in forensic practice will be displayed.

Toxic-related deaths are also frequent in forensic practice. In many cases, toxicology does not allow a clear-cut conclusion, because lethal substance blood levels are usually difficult to assess. Complete histology of organs should be systematically performed, because not only acute but also chronic lesions may have contributed to the fatal outcome. These issues will be examined, and correlation between toxicology and pathology will be discussed.

Gross examination of the formalin fixed brain is essential, but in many cases, histology provides useful information. Vascular malformations, non visible with the naked eye, may sometimes explain parenchymal hemorrhages, which can be misdiagnosed as traumatic. On the other hand, a trauma may contribute to the rupture of a vascular malformation. Neuronal necrosis, degenerative diseases, etc., require histologic examination. Immunohistochemistry is essential in diagnosing diffuse axonal injury, which is an important issue in forensic practice. The shaken baby syndrome requires meticulous handling of the brain. Eye histology is essential in this field. Guidelines in sampling the brain, performing immunohistochemistry will be provided. Histologic lesions of forensic interest will be displayed.

Diagnoses of mechanical asphyxia and drowning are difficult tasks in forensic practice. Although histologic lesions are usually not specific, histology of all organs always contributes to the diagnosis in addition with other findings (autopsy, toxicology, biochemistry, diatoms). Interpretation of histologic lesions will be discussed.

Dating wounds is a main concern in forensic pathology. Specific stains and immunohistochemistry can be applied. Up-to-date techniques will be examined.

Other issues will be finally illustrated by didactic cases. The attendee will be able to ask questions related to other issues, such as artefacts, autolysis, etc.

Forensic Histopathology, Heart, Brain

W11 Engineering Evidence and Lay Testimony

Richard W. McLay, PhD, PE, Professor of Biomedical Engineering, University of Iowa, 1231 Hamilton Court, Iowa City, IA 52245; Robert N. Anderson, PhD, PE*, RNA Consulting, Inc., 27820 Saddle Court, Los Altos Hills, CA 94022; Jon O. Jacobson, PhD, PE*, Jacobson Engineers, 5220 Roosevelt Way, NE, Seattle, WA 98105; Laura L. Liptai, PhD*, Biomedical Forensics, 1660 School Street, Suite 103, Moraga, CA 94556; James E. Starrs, LLM*, Professor of Law & Forensics, George Washington University, 720 20th Street, NW, Washington, DC 20052*

After attending this presentation, attendees will understand engineering evidence methods and evaluate lay engineering testimony.

This program studies the precedents in the law for the application of engineering to accident reconstruction. Examples of lay engineering testimony are shown and discussed relative to the rules of evidence. A panel discussion reviews methods for combatting questionable lay engineering testimony. Presentations include:

- Precedents in accident reconstruction law
  (The history of lay engineering testimony)
- A criminal case with lay engineering testimony
  (A defendant is convicted with improper momentum analyses and astounding human factors data)
- Precedents in the law of biomechanics testimony
  (Examples of questionable lay biomechanics testimony)
- Failure analysis methods in accident reconstruction
  (Examples of questionable lay metallurgical and materials science testimony)
- An example from the law
  (The Frank Olson case will be presented)

The panel will tie all of the presentations together by discussing several practical methods for combating questionable lay engineering testimony:

- The use of a deposition for sending a layman through an engineering oral exam, followed by a *Daubert* challenge;
- The use of the Racketeer Influenced Corrupt Organization (RICO) Statutes to pursue the municipalities that make use of questionable lay engineering testimony to obtain criminal convictions;
- The use of the ethics statutes, following a technical deposition of the expert, showing that the attorney has concealed evidence or otherwise violated a discovery order, having made misrepresentations to the court and clearly knows or should have known otherwise;
- Reporting the lay engineering testimony to the appropriate state licensing board with the objective of both criminal and civil actions for practicing engineering without license or experience;
- Civil rights litigation based on the violation of the defendant's rights having been convicted by laymen using questionable engineering evidence; and
- The use of the Racketeer Influenced Corrupt Organization (RICO) Statutes to uncover improper training by institutes that purport to train laymen for giving engineering testimony

A CD-ROM with abstracts of the presentations, figures, short film clips, and animations will be distributed to the attendees at the meeting.

Accident Reconstruction, Engineering Evidence, *Daubert* Challenge

W12 The Medicolegal Investigation of Recreational Diving Fatalities

James L. Caruso, MD, U.S. Navy Undersea Medical Offices and Flight Surgeon, Office of the Armed Forces Medical Examiner, 3929 Sweet Briar Lane, Urbana, MD 21704; Michael D. Bell, MD*, Broward County Medical Examiner's Office, 5301 SW 31 Avenue, Ft. Lauderdale, FL 33312*

After attending this presentation, attendees will have a basic understanding of the special physiology and specialized equipment associated with SCUBA diving; appreciate the epidemiology of deaths associated with recreational diving, including geographic distribution, common causes of death, and contributing factors to these fatalities; be able to adequately investigate and interpret the historical events and circumstantial evidence associated with diving fatalities; understand the recommended approach to the autopsy of persons who died while diving and be able to interpret the anatomical findings in the context of the historical events; have handout material and points of contact for future reference to competently investigate a diving related death; and gain a basic knowledge of other hazards in the ocean, including dangerous marine life.

The popularity of recreational diving using scuba (self-contained underwater breathing apparatus) has increased dramatically over the past three decades. Present estimates place the number of active recreational divers in the United States at between 500,000 to one million. The number of fatalities involving U.S. citizens performing recreational dives averages 90 to100 each year. These fatalities challenge the investigators and pathologists who must investigate and certify these deaths. Recreational diving fatalities are often litigated in civil court. This workshop is designed for the pathologist, criminalist, attorney, and general section member who may become involved in the investigation of a scuba diving accident or fatality. The instruction level is intermediate.

The initial portion of the workshop will include a brief overview of diving physiology, including the effects on the body of breathing compressed air at depth. The pathophysiology of barotrauma, nitrogen narcosis, oxygen toxicity, gas embolism, and decompression illness (caisson disease) will be reviewed. The pathophysiology of drowning will be reviewed since it is a frequent final outcome in a fatal diving mishap.

Following the discussion on physiology, the epidemiology and risk factors associated with recreational diving fatalities will be presented. A detailed presentation on the recommended investigation of a fatal diving mishap will be provided using illustrative cases from south Florida and the Divers Alert Network (DAN). The importance of interviewing witnesses and gathering information on the diver's past medical history, diving experience, pre-dive status, and the circumstances surrounding the dive will be emphasized. The relevance of knowing the exact depth and bottom time of the dive, as well as when and where the diver began to run into difficulty, will be discussed. Additionally, the workshop will include a hands-on section where typical diving equipment will be available for examination and familiarization by attendees. This will be accompanied by a brief discussion on the evaluation of dive gear.

In the final portion of the workshop, we will review the autopsy protocol for scuba diving victims and emphasize those tests and observations that are helpful in determining the cause of death. The significance of finding intravascular bubbles will be discussed, as will the proper interpretation of the findings of the autopsy. Natural diseases likely to cause sudden incapacitation and death while scuba diving will be reviewed. Finally, related topics such as hazardous marine animals, zoophagia, and trauma leading to recreational diving fatalities will be presented.

Thorough handouts will be provided by the speakers, including checklists of important information to obtain regarding a diving mishap, a diving fatality reporting form, a suggested autopsy protocol for use when diving related fatality, and recommended resources for consultation and referral.

Cause of Death, Diving Fatalities, Medicolegal Investigation

W13 Facial Imaging From Human Remains Using "Re/Face" (Reality Enhancement/ Facial Approximation by Computational Estimation)

Kevin W.P. Miller, PhD and JoAnn Buscaglia, PhD, Federal Bureau of Investigation, FBI Academy, Building 12, CTFSRU, Quantico, VA 22135; Rebecca E.B. Brown and Timothy Kelliher*, GE Global Research, One Research Circle, Niskayana, NY 12309; Michael Taister*, FBI Laboratory, Investigative and Prosecutive Graphics Unit, Quantico, VA 22135; Peter Tu*, GE Global Research, One Research Circle, Niskayana, NY 12309; Wesley Turrner*, GE Global Research, One Research Circle, Niskayana, NY 12309*

The goal of this workshop is to introduce attendees to the technology of dense facial approximation; introduce Re/Face (Reality Enhancement / Facial Approximation by Computational Estimation); and provide attendees an opportunity to experience Re/Face use, and provide feedback to developers.

Re/Face is a new tool for facial approximation that will impact the forensic community and/or humanity by significantly advancing the state of the art. The accuracy and density of the tissue depth measurements that are embodied in the tool provide the forensic artist with a wealth of information not previously available. Through this system, use of facial approximation as a forensic technique can be expanded into a more commonplace tool, adding in the timely identification of individuals for law enforcement activities. Ultimately Re/Face can be deployed into the approximation of wartime dead leading to identification, and closure for families, of the soldier.

Facial approximation techniques have a long history spanning over a century. Over most of its history the techniques have advanced incrementally. Refined techniques for collecting tissue depth information and an expansion of the database of information typify the advances in the field. In the past ten years, the field has received heightened attention as computer-based techniques open the possibility of dramatically increased fidelity. These techniques enable a move from a sparse set of tissue depth information to a more robust dense set of measurements guiding the approximation. CT scans and other medical imaging devices provide a means for gathering tissue depth data for the entirety of a face in-vivo. Collecting these scans, covering broad sections of the population, provide the basis for statistical models describing total skeletal-facial variance found within the population. Such models are used to rapidly create facial approximations for forensic use.

Human Identification, Forensic Art, Forensic Anthropology

W14 Forensic Image and Video Processing

Zeno J. Geradts, PhD, Netherlands Forensic Institute, Gerechtelijk Lab, Volmerlaan 17, Rijswijk 2288 GD, Netherlands; Richard W. Vorder Bruegge, PhD*, FBI Laboratory, 935 Pennsylvania Avenue, Room 3457, Washington, DC 20535-0001; Jurrien Bijhold, PhD*, Netherlands Forensic Institute, Volmerlaan 17, Rijswijk 2288 4D; Lenny Rudin, PhD*, Cognitech, 225 South Lake Avenue, Suite 601, Pasadena, CA 91101-3010; Carrie M. Whitcomb, MSFS*, National Center of Forensic Science, University of Central Florida, PO Box 162367, Orlando, FL 32816-2367*

After attending this presentation, attendees will know what the possibilities are with digital images and video streams, and which techniques can be used in forensic science.

This presentation will impact the forensic community and/or humanity by presenting new developments in Europe and the United States where attention is also given on aspects of accuracy.

During this workshop information will be provided on new developments of forensic investigation of (digital) images and video streams and the use of 3-dimensional computer modeling in forensic investigations.

Traditional sources of images as evidence concern crime scene photography, and more specifically, photographs of fingerprints, tool marks, shoe prints and other impressions. A short overview of image processing techniques is given. Special attention is given to the introduction of artifacts by image processing (e.g., FFT on fingerprints)

During the last 25 years the use of CCTV-camera systems has become widespread. Typical questions concern the quality and the selection of images from a specific camera in a multi-camera-recording. Digital processing of video streams for presentation and storage purposes, and the compression techniques that are applied in digital CCTV-systems, lead to questions about the integrity and authenticity of recordings.

New sources of video streams and images are video recordings from handy cams, digital photo camera's, internet and cellular phones. Typical questions about these recordings concern the integrity and authenticity of the recordings, the data compression techniques used, the synchronicity of sound and images, compensation for camera movement, and the conversion of a video stream to a higher resolution image.

We will focus on methods for digital capture and analysis of analogue and digital multiplex surveillance recordings, state-of-the-art image enhancement techniques as contrast stretching and de-blurring, as well as new methods as super resolution, stabilizing and automatic tracking.

Since more images are being processed for forensic investigation, new methods have been developed for answering questions about the interpretation of images. Examples given: Is it possible to read a license plate number? Is our suspect, or his car, the one depicted in the image? What is the body length of the robber or the speed of a car? Is it possible to do a reconstruction of an accident or a shooting incident from the information in these images? Methods for image comparison, image reconstruction, and photogrammetry are presented and discussed. Special attention is given to accuracy of the results and the impact on the conclusions from these investigations.

Finally, some extra attention is given to the use of 3-dimensional computer modeling in forensic investigations, since we believe that these techniques will have an impact on traditional crime scene photography.

Computer models and animations have been recently used for analyzing video by superimposition of computer generated views of the model on the video images, for the visualization of complex scenario's in animations and for testing scenario's against video footage and evidence in crime scene photographs. Examples: the reconstruction of car accidents from photographs, analysis of blood spatter patterns from photographs using a computer model of the crime scene, the visualization of wound channels in computer models of human bodies, the reconstruction of bullet trajectories, the reconstruction of a burglary using the limited information in dark images from a multi camera video recording, and the analysis of firework explosions from video recordings, photographs and geographical data. Special attention is given to modeling techniques, the accuracy of the models, methods for visualizing uncertainties and possibly erroneous suggestions coming from these visualizations.

Image Processing, Video, 3D Reconstruction

W15 Ephedrine: Drug or Supplement? Ephedrine Related Compounds and the Debate on Their Potential for Contribution to Injury

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After attending this presentation, attendees will have a better understanding of the arguments both for and against ephedrine's potential for harm. Data supporting these positions will also be discussed by experts in the area of ephedrine and related compounds who have been involved in ephedrine related litigation and policy development. Evidence from postmortem pathology, pharmacology, and analytical issues will be discussed. Additionally, the use of AER data from poison control centers will be discussed.

This presentation will impact the forensic community and/or humanity by providing objective information for the forensic community on the increasingly contentious topic of whether ephedrine and related compounds are dangerous and should be banned or regulated or if they are appropriately classified as nutritional supplements. This is important information for forensic toxicology professionals who are faced with interpretation of ephedrine findings and questions in court on the contribution of ephedrine to injury and death.

With several high profile deaths recently that have had questions of the contribution of ephedrine to the injury, many questions and opinions about the safety and efficacy of ephedrine have been debated. The policy landscape for ephedrine is continually evolving as congressional hearings into the ephedra issues are currently underway. This workshop is intended to provide a forum for the presentation of both plaintiff and defense opinions on the safety and efficacy of ephedrine and related compounds. This will include the issues surrounding the interpretation of ephedrine results.

This workshop will feature a discussion on the analytical challenges of ephedrine and related compounds in biological samples. This discussion will also include the challenges that this presents to the interpretation of these results. Discussion will also include mechanistic data of the understanding of the action of ephedrine on food intake and body weight. This discussion will also include how injury may occur from a mechanistic perspective.

As data from postmortem reports and AER data from poison control centers have been used in the debate, discussions about the appropriateness and use of these data will also be a part of this workshop.

An open forum period for greater discussion on opinions on ephedrine and related compounds will also be a part of the workshop. Thorough handouts will be provided by the speakers on data and topics presented.

Ephedrine, Injury Potential, Interpretation

W16 Adobe® Photoshop® for Forensic Document Examiners

Derek L. Hammond, BA, Forensic Document Examiner, U.S. Army Criminal Investigation Laboratory, 4553 North 2nd Street, Forest Park, GA 30297-5122; William J. Flynn, BS*, 7260 East Eagle Crest Drive, Unit 33, Mesa, AZ 85207-7145; Lee Miller**

After attending this presentation, attendees will be able to move documents from files to Adobe® Photoshop®, make case file worksheets, construct court exhibits for testimony, and provide legal precedents to attorneys and judges permitting Adobe® Photoshop® to be admissible in court.

This presentation will impact the forensic community and/or humanity by apprizing and updating attendees of latest techniques available to them for case work and court testimony presentation.

Courts at all levels are tightening the requirements for the admission of expert testimony. Adobe® Photoshop® is the current state-of-the art method for preparation of court exhibits/charts, particularly in questioned document cases. Since the evidence processed by Adobe® is digitized, the analyst must understand and be able to explain to what extent the images of the evidence have been visually changed for presentation purposes. Adobe® Photoshop® software has been available for some time but each version adds new features. This workshop will explain the particular uses of Photoshop® for the forensic document examiner in the areas of case file worksheets, court exhibit preparation and the court admissibility of the use of images processed through this software.

Digitize, Image, Photoshop®

W17 From Scene to Trial: A Quadruple Homicide Case Study

Mary H. Dudley, MD, RN, MSN, Sedgwick County Regional Forensic Science Center, 1109 North Minneapolis, Wichita, KS 67214; Bradley D. Grinage, MD*, Kansas University School of Medicine - Wichita, 1002 KU School of Medicine-Wichita, 1001 North Kansas, Wichita, KS 67214; Diana Schunn, RN, BSN*, SANE/SART via Christi Medical Center, 3600 East Harry, Wichita, KS 67218; Kim T. Parker*, 18th Judicial Court, 535 North Main, 2nd Floor, Wichita, KS 67203*

After attending this presentation, attendees will be able to describe the national standards in crime scene investigation; differentiate between blunt and sharp force injuries; identify the range of fire and entrance vs. exit wounds with GSW injuries; list three key points of expert witness testimony; identify symptoms of stress & burn out; and describe the role of the SANE nurse in fatal and non-fatal sexual assault examinations.

The national standards for death scene investigation will be presented and related to the actual application in the multiple homicide case study including the scene investigation and documentation, body examination and recording. Basic principles of differentiation of blunt and sharp force injuries with examples of each will be presented. Examples of blunt force injuries and patterned injuries from the case study will be compared to possible weapons used to inflict injury. Medical-legal aspects of gunshot wound injuries will include the range of fire and determining the entrance vs. exit wounds. Photographs of the gunshot wound injuries on the six homicide victims will be shown and detailed as presented in actual courtroom testimony.

The forensic pathologist involved in the multiple homicide case must attend the death scene to determine the circumstances surrounding the death including the position and relationship of the decedents to one another. At autopsy, the role of the forensic pathologist includes: documentation and collection of trace evidence while maintaining proper chain of custody, external and internal examinations of the body, interpretation of radiographs, collection of toxicology specimens and projectiles; and issuing an opinion in a final autopsy report as to the cause and manner of death.

This lecture will look at the overall care and responsibilities performed by a Sexual Assault Nurse Examiner (SANE). Health care for the sexual assault patient has dramatically changed in the past decade. With the development of SANE programs the specific care delivered to sexual assault patients has focused on not only what is best for the patient but also enhanced and equipped the healthcare provider with the appropriate education and support. The team focus has significantly improved this evolution to an advanced delivery of care. The primary goal of the sexual assault examination is to provide a comprehensive assessment with accurate and appropriate collection of evidence while avoiding re-traumatizing of the patient. The role of the SANE will be discussed in looking at the patient's history, conducting a head-to-toe assessment, completing a detailed genital evaluation and collection of forensic evidence. Courtroom testimony will also be discussed and how the medical/legal evaluation assists the jury in determining facts surrounding the charged case.

In a court trial the prosecutor and/or defense attorney may choose to utilize an "expert witness." The primary role of an expert witness is to provide the judge/jury or both, with accurate information and objective, unbiased, and impartial opinions about issues related to the case based on their field of expertise. The first and foremost responsibility of an expert witness is to the court, not to the attorney or person(s) who requests their testimony. The expert witness is used to provide their opinions impartially despite having been hired by one of the two opposing sides in the case. The expert witness will also be an unprejudiced educator of the judge/jury not finding favor with the side that hired them nor with the ultimate outcome of the case.

Critical Incident Stress Management (CISM) began as a crisis intervention model used to identify and relieve early symptoms of acute stress in professional responders to mass casualties. Originally developed by Mitchell (1983), techniques employed by critical incident stress debriefing (CISD), one component of CISM, have become mainstay response to various types of trauma throughout an array of organizations including firefighters, police and the military. The basics of CISD include structured group discussion of the trauma associated with education of stress-related symptoms and available resources for treatment if needed. Although CISM has come under recent criticism regarding the lack of empirical data supporting its effectiveness, current research findings yield mixed results regarding its ability to prevent future posttraumatic stress disorder pathology. The workshop will present the vital roles and duties of various members of the forensic science team stressing the importance of cooperation and interaction of team members in a complex multiple homicide case.

Multiple Homicides, Sexual Assault, Expert Testimony

W18 Bubble, Bubble, Boom! Fires and Explosions in Clandestine Drug Laboratories

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This workshop will provide the participants with the fundamental information to evaluate if a fire or explosion was a result of a clandestine laboratory. Both the arson investigator and the drug chemist will get an insight as to the elements of each others area of expertise.

This presentation will impact the forensic community and/or humanity by providing an excellent example of a multi-discipline approach

to a problem. Given the hazardous potential of clandestine laboratories the workshop will alert the forensic chemist to the fire and explosion threat and alert the arson investigators to the chemical hazards. Through interdisciplinary training the forensic examination of a fire site can lead to the success of the investigation.

During the past several years there has been a significant increase in the number of clandestine drug laboratories. The drug most commonly manufactured is methamphetamine. With this dramatic increase of clandestine laboratories there has been a corresponding increase in the number fires and explosions associated with laboratories. The very nature of a clandestine laboratory presents a variety of hazards and an increase in the possibility of a fire. The forensic chemist is increasing being called upon to evaluate a possible clandestine laboratory site that was discovered as a result of a fire or explosion. The arson investigator is equally being asked to evaluate a suspected arson fire that was a clandestine laboratory site. Providing the arson investigator with the information as to the typical synthesis methods and the chemicals involved will great enhance their capabilities in evaluating a fire site. The forensic drug chemist developing an understanding of the principles of chemical fueled fires, flash fires or solvent caused explosions will benefit greatly in processing a laboratory site.

Historically, the typical manufacturing process for methamphetamine was a variety of methods using phenylacetone, also known as phenyl-2-propanone (P2P). These methods used P2P that was either obtained directly or produced by the phenylacetic acid (PAA), sodium acetate, and acetic anhydride synthesis. However, when P2P was regulated as a schedule II controlled substance [21 C.F.R. 1308.12(g)(1)(i); 44 F.R. 71822(2/11/80)] alternative syntheses became common. In the early 1990s clandestine methamphetamine laboratories began to use ephedrine as the precursor. The precursor l-ephedrine or d-pseudoephedrine is obtained commercially from local 'super stores' and reduced to d-methamphetamine via one of the three synthesis procedures. The first synthesis uses the chemicals hydroiodic acid and red phosphorus; the second uses iodine and red phosphorus. The primary chemicals found at the clandestine laboratory site using the third synthesis method are anhydrous ammonia and an alkali metal such as either sodium or lithium. Common, to the three clandestine synthesis process are the general chemicals of solvents, inorganic acids, salt, and lye.

Fire science is the knowledge of fire, including the physics and behavior of the fire or explosions. All fires are chemical in nature; however their behavior is dependent on several factors, with fuel being a major concern. Clandestine laboratories typically have several gallons of solvents. The range of flammable solvents can be from diethyl ether to kerosene. Not only do these solvents provide a source of fuel for a fire, but they also diffuse into the air were they may ignite or explode. Most fires in clandestine laboratories are 'flash' fires caused by the flammable solvents and their improper handling. However, the use of the water reactive alkali metals, sodium and lithium, has introduced a new problem. A source of fuel that can in affect self ignite. The synthesis methods that require red phosphorus introduce a fuel that once ignited will continue to burn as a chemical reaction. This reaction has an increase in the intensity of the heat evolving from it. This makes it an ignition source to other combustible items near it. An additional concern is that a number of clandestine laboratory fires are not accidental, but intentional acts of setting a fire to prevent detection.

The workshop will provide the participants with the fundamental information to evaluate if a fire or explosion was a result of a clandestine laboratory. Given the hazardous potential of clandestine laboratories the workshop will alert the forensic chemist to the fire and explosion threat and alert the arson investigators to the chemical hazards. Both the arson investigator and the drug chemist will get an insight as to the elements of each others area of expertise.

Fire, Explosions, Clandestine Laboratories

W19 Psychological Evaluation and Litigation of Sexual Assault Cases

Mohan Nair, MD, 5212 Katella Avenue, Suite 106, Los Alamitos, CA 90720; Mace Beckson, MD*, PO Box 84507, Los Angeles, CA 90073; David Gypes, JD, PhD*, 1990 South Bundy Drive, Suite 320, Los Angeles, CA 90025; Ashok Jain, MD*, #1011,1200 North State Street, USC/LAC, Medical Center, Los Angeles ,CA 90033; Andrew Lloyd, JD*, 1111 Town &Country Road, Suite 49, Orange, CA 92868; John Love, JD*, Los Angeles Public Defender's Office, 9425 Penfield Avenue, Suite 2700, Chatsworth ,CA 91311; Wesley Maram, PhD*, Sex Offender Solutions, 1234 West Chapman Avenue ,Suite 203, Orange ,CA 92868; Amy Phenix, PhD*, California Department of Mental Health, Sex Offender Evaluation Program, P.O. Box 325, Cambria ,CA 93428*

After attending this presentation, mental health professionals and court officials will know the step-by-step strategies in conducting various forms of sexual assault evaluations on both victims and defendants; will become aware of the growing research and controversies in areas such as clergy sexual misconduct, sexually-violent predator, profiling, eyewitness testimony, memory distortion, suggestibility false confessions, false victimization and toxicology of date-rape drugs; will learn appropriate ways of evaluating child sexual abuse allegations in a variety of circumstances, i.e., child custody foster homes, schools; understand litigation strategies from plaintiff and defense view points; and will become familiar with instruments used for sexually violent predator evaluations, weaknesses and controversies.

This program is intended for mental health professionals and attorneys that deal with various areas of sexual assault. This work-up is divided up into four sections, lasting one and one-half hours each, with questions.

GHB and related compounds are commonly used drugs within the subculture of the "club scene." GHB as a "date rape drug" has attracted increasing attention by the media on the basis of high-profile cases such as that of Max Factor heir Andrew Luster, issues of victim credibility, crime reporting, concerns of delays in collecting urine samples, circumstances of alleged victimization, memory problems of victims, specimen collection, initial presentation to the emergency room, problems of forensic toxicological and laboratory methods, memory distortions, personality disorders and of false victimization will be discussed.

Dr. Jain will review the toxicology and pharmacodynamics of gamma amino butyric acid (GHB), Rohypnol, Chlorolhydrate and other so-called "date-rape" drugs. Large group exposures from raves and clubs and acute emergency room presentations of GHB will be discussed. The laboratory analysis of GHB will be addressed. Defense and prosecution strategies in drug facilitated rape cases will be explored.

Sexually Violent Predator Risk Assessments have been criticized as being both unethical and unscientific. Some of these criticisms are similar to those leveled against violent risk assessments ten years ago. The question is, if not us, who? Dr. Amy Phenix has been involved with the California Department of Mental Health Sex Offender Evaluation Program for the past ten years. She will review the California experience and provide a step-by-step strategy on evaluating static and dynamic risk factors and other tools used in the process. John Love will present the basis for the criticism of the science and legality of the civil commitment process.

The United States Supreme Court Decision on Stogner vs. California, notwithstanding, cases of clergy sexual misconduct, remains under intense ongoing public scrutiny. By 1992, the Church had spent upwards of one billion dollars for damages in medical treatment resulting from clergy sexual abuse In addition to directly suing alleged perpetrators and the church, lawsuits may focus in the future on institutions that have evaluated and treated clergy offenders in an attempt to widen the defendant pool. Even as the Stogner decision prevents criminal prosecution because of Statute of Limitation issues, the frustration may be channeled into increased number of civil cases, which require a lower burden of proof.

Attorneys and mental health professionals who deal with sexual

molestation by Clergy will learn about the steps in the forensic evaluation of offenders and their victims. This will include utility of psychological testing, sexual history questionnaires, instruments such as the ABEL screening, plethysmography, polygraphic examination, and review of treatment records. Victim evaluations will include issue suggestibility, false memory, contamination, fabrication, and indoctrination by therapists and others in support groups.

Assessment and litigation of child sexual assault allegations. Presenters will review the current psychological and legal concerns in this area. The process of developmentally appropriate examinations, appropriate and inappropriate interviewing techniques, reviewing records, psychological testing, interviewing parents and other resources. Factors including inadequate training, evaluator bias use of anatomic dolls contagion, parents/therapist indoctrination, and confusion, delusions, deceptions and fabrication by the child will be covered. Comprehensive evaluation of alleged offenders will be presented.

Sexual Assault, Litigation, Psychological Evaluation

W20 Grisly Business: An Examination of the Modus Operandi and Signature Characteristics of Killers and Their Crime Scenes

Robert D. Keppel, PhD, College of Criminal Justice, Sam Houston State University, Box 2296, Huntsville, TX 77341-2296; Vernon Geberth, MS*, PHI Investigative Consultants, Inc., PO Box 197, Garnerville, NY 10923*

After attending this presentation, attendees will gain an understanding of the development of Modus Operandi (MO) and Signature throughout the history of criminal investigation; will be able to determine how the offender's signature differs from his modus operandi from case to case within the same series; will enable the attendees to recognize a killer's crime scene behaviors that change and those that remain constant from one murder to the next; and will be able to develop and construct signature and MO testimony for court purposes.

The Grisly Business workshop will allow participants to learn that there are crime scene indicators that relate murders even when the MO changes. Many sexually sadistic repetitive killers, for example, go beyond the actions necessary to commit a murder. The MO of the killer can and does change over time as the killer discovers that some things he does are more effective.

Beyond the MO, there are many, many killers who are not satisfied with just committing the murder; they have a compulsion to express themselves (or do something that reflects their unique personality). The killer's personal expression is his signature, an imprint he leaves at the scene, an imprint he feels psychologically compelled to leave in order to satisfy himself sexually. The core of a killer's signature will never change. Unlike the characteristics of an offender's MO, the core remains constant. However, a signature may evolve over time in some cases where a necrophilic killer performs more and more post mortem mutilation from one murder to the next.

Experts once described the nature of the signature as the person's violent fantasies, which progress in nature and contribute to thoughts of committing extremely violent behavior. As a person fantasizes over time he develops a need to express those violent fantasies. Most serial killers have been living with their fantasies for years before they finally bubble to the surface and become translated into behavior. When the killer finally acts out, some characteristic of the murder will reflect some unique aspect played over and over in his fantasies.

Likewise, retired NYPD homicide detective Vernon Geberth (1996) wrote that it's not enough just to consummate the murder, the killer must act out his fantasies in some manner over and beyond inflicting death-producing injuries. This is the signature of the killer.

Detectives who investigate a series of murder scenes look for the same type of extraordinary violence and a bizarre set of similarities. Their gut instincts tell them there's more here that's alike than different, but another homicide investigator will say the killer used a pipe wrench as a blunt instrument here, a hammer there, and in this third crime we can't even figure out what weapon was used. Maybe he draped a pair of underpants on the victim's left leg. In the next crime scene, the underpants were on her right leg or maybe still on the bed. Yet, in each case, the victim was obviously beaten well beyond the point of death by an assailant whose violence seemed to increase in frenzy while he was attacking her. Also, the killer seemed preoccupied with the victim's clothing and took some time to arrange the crime scene even though there might have been people living just upstairs. These are the psychological calling cards the killer actually needs to leave at each scene. Other examples of signatures covered in the workshop are mutilation, overkill, carving on the body, leaving messages, rearranging or positioning the body, engaging in post-mortem activity, or making the victim respond verbally in a specified manner. These constitute a signature behaviors of a particular killer. What is important about a killer's signature, then, is that killers learn to treat victims the way they do in their fantasies, always attempting to satisfy their fantasies as they move from one victim to the next.

Workshop participants will learn that identifying a killer's signature is a multidisciplinary effort, using the findings of medical examiners, anthropologists, dentists, criminalists, and behavioral scientists. An examination of a series of murders requires typically, the information from the police investigative file, which includes officer's reports, statements, crime laboratory reports, crime scene diagrams, photographs, videotapes of crime scenes, autopsy reports, and report of other experts.

Police investigators and prosecutors need cases linked for their own purposes. From an investigative standpoint, the linking of crimes enables investigators to pursue the same suspect instead of operating without the knowledge that the cases were linked. Prosecutors want similar cases linked so the defendant can be tried on multiple charges in the same trial.

The threshold for using MO and signature as evidence at trial differs from state to state. In Virginia, for example, the Supreme Court in the Timothy Spencer murder convictions held that: "evidence of other crimes, to qualify for admission as proof of modus operandi, need not bear such an exact resemblance to the crime on trial as to constitute a 'signature,' but it is sufficient if the other crimes bear a singular strong resemblance to the pattern of the offense charged and the incidents are 'sufficiently idiosyncratic to permit an inference of pattern for purposes of proof,' thus tending to establish the probability of a common perpetrator."

The Grisly Business workshop presentations will highlight those cases most of which have had courtroom testimony and/or reports written dealing with MO and Signature aspects: Those cases are Morris Frampton, George Russell, and Robert Yates (Washington State), Richard Cottingham (New York), Timothy Spencer (Virginia), Terrence Burlingham (British Columbia, Canada), and David Parker Ray, the New Mexico Torture Chamber Killer.

Modus Operandi, Signature, Murder Characteristics

W21 Y-STR Analysis on Forensic Casework

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Upon completion of this workshop, the participants should be able to understand the characteristics of the polymorphic markers on the Y-chromosome, and population genetics. The participants should also become familiar with multiplexed Y-STR systems and their usefulness and limitations in forensic casework.

Upon attending this workshop, the forensic community will obtain the knowledge on the usefulness of Y-STR analysis in forensic casework. The participants will learn the aspects of the structures of different Y-STR markers, Y-STR markers used in forensic applications, population genetics, laboratory validation requirements, result interpretation issues and new Y-STR markers on the horizon.

Y-Chromosome Short Tandem Repeats (Y-STRs) have become a very useful tool in forensic casework, paternity testing and male lineage studies. Different types of challenges can arise in the analysis of autosomal STRs, mainly in the interpretation of results for samples containing mixtures of male and female DNA. The Y-STRs can be utilized in resolving such cases. The use of Y-STRs makes it possible to obtain an exclusive profile of male DNA in a sample containing mixtures of male and female DNA.

The contents of the workshop will target forensic scientists who are familiar with STR analysis and are interested in implementing or who have implemented Y-STR analysis for forensic casework. The Scientific Working Group on DNA Analysis Methods (SWGDAM) has identified a core set of eleven Y-STR loci for forensic analysis in the United States. Several new Y-STR loci have been discovered in the past few years.

The presentation topics will cover aspects of Y-STR analysis in forensic casework including the characteristics of Y-STRs, multiplex systems, validation studies according to the DAB standards, database studies, result interpretation, population genetics, courtroom testimony, QA/QC issues and casework studies. The speakers will include international scientists who have made milestone contributions, and scientists from academic institutions, crime laboratories, government institutions and private industries active in research and development of Y-STRs. Thus, a unique combination of expertise will be available for interpretation and discussion.

Y-STRs, Y-Chromosome, Forensic Casework

W22 Recovery, Examination, and Evidence of Decomposed and Skeletonized Bodies: An Anthropological and Entomological Approach

M. Lee Goff, PhD, Professor and Chair, Forensic Science Program Chaminade University, 3140 Waialae Avenue, Honolulu, HI 96816-1578; Wayne D. Lord, PhD*, Federal Bureau of Investigation, NCAVC, FBI Academy, Quantico, VA 22135; Edward T. McDonough, MD*, Office of the Chief Medical Examiner, 11 Shuttle Road, Farmington, CT 06032; William C. Rodriguez III, PhD*, Office of the Armed Forces Medical Examiner, AFIP, 1413 Research Boulevard, Building 102, Rockville, MD 20850*

After attending this presentation, attendees will be able to recognize bioenvironmental evidence; properly collect and preserve such evidence; and record supplementary data needed for later analyses of bioenvironmental evidence.

This presentation will impact the forensic community and/or humanity by presenting techniques from the disciplines of anthropology, entomology and pathology that can be employed in the processing of crime scenes. This interdisciplinary approach will maximize the information obtained from bioenvironmental evidence gathered from a scene. Techniques will be presented which, if used, will assure the proper collection, preservation and documentation of these types of evidence for later analyses.

One of the most challenging cases faced by any forensic scientist or investigator is that of the badly decomposed or skeletonized body. It is a common misconception that such remains, particularly those in a field or wooded area, provide little useful information concerning the circumstances of death. However, through the applications of techniques from the fields of anthropology and entomology, significant data may be obtained. The outdoor death scene is quite unique, since the remains and associated evidence can be viewed as temporary alterations to the ecology of the immediate area. Methods and techniques for the recognition, collection, preservation, and interpretation of this "bioenvironmental" evidence will be presented during the workshop. This workshop is designed to be at an intermediate level, with an overview of anthropological and entomological techniques, followed by considerations of recent advances in these areas of research combined with techniques for processing outdoor crime scenes. Decompositional processes will be covered along with the varied applications of entomological evidence, including entomotoxicology, preservation and processing of entomological evidence, and applications of entomological evidence in cases involving the living as well as the dead.

Entomology, Anthropology, Postmortem Interval

W23 Application of the Principles of Pharmacology and Pharmacokinetics to the Interpretation of Drug Blood Levels

David M. Benjamin, PhD, 77 Florence Street, Suite 107, Chestnut Hill, MA 02467-2121; Timothy P. Rohrig, PhD*, Regional Forensic Sciences Center, 11009 North Minneapolis Street, Wichita, KS 67214; Adam Negrusz, PhD*, Department of Pharmacodynamics; University of Illinois, 833 South Wood Street, Chicago, IL 60612; Robert H. Powers, PhD*, Hamilton County Coroner's Office, 3159 Eden Avenue, Cincinnati, OH 45219; Dorothy E. Dean, MD*, Franklin County Coroner's Office, 520 King Avenue, Columbus, OH 43201*

After attending this program, forensic scientists will be able to analyze drug blood level data from a pharmacokinetic perspective; be able to demonstrate an understanding of the four pharmacokinetic phases of drug disposition: absorption, distribution, metabolism and excretion; be able to recognize mechanisms of potentially toxic drug interactions and additive toxicities, will avoid pitfalls in interpreting drug blood level data involving postmortem blood samples, and will be able to recognize the variability involved in obtaining post-mortem blood samples from cardiac and peripheral sites.

Forensic scientists and clinicians alike are frequently called upon to interpret the results of blood and urine drug analyses in order to determine the cause of toxicity or death. With some drugs, there is a good correlation between their concentrations in blood and their therapeutic, toxic and lethal levels. With other drugs, there is no such relationship, and with still others, it is the unbound or unconjugated drug concentration that correlates well. Inhibition or enhancement of any of the four pharmacokinetic phases: absorption, distribution, metabolism and excretion can increase toxicity of a given dose or provide an increased safety margin.

Many errors are made by physicians, pathologists, and toxicologists who lack formal training in pharmacokinetics, regarding the interpretation of drug blood levels, especially samples taken in the post-mortem period. Few courses exist to teach the required pharmacokinetic skills to forensic scientists, thus perpetuating the same frequency of errors. This symposium is designed to teach many of the skills required to properly interpret drug blood levels obtained from living and deceased individuals. The course begins with a review of the essential pharmacokinetic relationships required to understand drug disposition and continues with presentations of cases selected to demonstrate the application of the principles of pharmacology and pharmacokinetics to the interpretation of drug blood levels in living and deceased subjects. Only few courses have been designed to teach these essential skills and attendees are sure to gain valuable training in the application of pharmacokinetics to their work.

Pharmacokinetics, Interpretation of Drug Blood Levels, Postmortem Redistribution

WS1 Pediatric Death Investigation Including Subtle Forms of Fatal Abuse: From the Scene to the Courtroom

Karen F. Ross, MD, Assistant Coroner, Jefferson Parish, 2018 8th Street, Harvey, LA 70058; Joni L. McClain, MD*, Medical Examiner, Dallas County Medical Examiners Office/SWIFS, 5230 Medical Center Drive, Dallas, TX 75235; Kathleen A. Diebold, BA*, Child Death Specialist, St. Charles, Jefferson, and Franklin Counties Medical Examiner, 1402 South Grand Boulevard, St. Louis, MO 63104; Robert G. Williams, DDS*, Chief Forensic Odontologist, Southwestern Institute of Forensic Sciences, 11661 Preston Road, Dallas, TX 75230; John W. Thompson, Jr., MD*, Associate Professor of Clinical Psychiatry, Tulane University School of Medicine, Dept. of Psych & Neurology TB 53, 1440 Canal Street, 10th Floor, New Orleans, LA 70112*

Upon completion of this workshop, the participant will be able to recognize the unique aspects of investigating deaths in childhood; be familiar with autopsy procedures and investigative techniques which may be employed in such cases; be aware of potential problems and possible solutions in pediatric toxicology; be able to recognize subtle forms of fatal child abuse including neglect; understand that designation of manner of death as accident or undetermined does not exclude the possibility of prosecution of the alleged perpetrator; recognize the role of the forensic odontologist in identification and prosecution of certain cases, and become familiar with the psychological features of the perpetrators of filicide including possible motivating factors.

Investigation of sudden unexpected deaths in childhood presents unique challenges to all involved in the process from the scene investigator to the forensic pathologist. In many cases, the cause of death is obvious as is the manner whether natural, accident, or homicide. In other cases, injuries identified at autopsy may obviously be the result of non-accidental injury; however, identification of the perpetrator may be difficult. In still other cases, the death, while classified as accidental or undetermined, may be the result of negligence on the part of the caretaker who may still be prosecuted. Thorough investigation, from the scene to the morgue, and cooperation between the various investigating agencies and representatives of the death investigation system ensure that cases of fatal child abuse are recognized and that the perpetrator is identified and prosecuted. This same cooperation may prevent innocent people from being wrongly accused of and charged with such crimes. The training of people specifically to investigate child hood deaths has been initiated in some medical examiner systems. Though there really is no sub-sub-specialty of pediatric forensic pathology, many forensic pathologists, for varying reasons, become particularly interested in childhood deaths. The special interests of trained professionals can only be considered a positive step in childhood death investigation. In addition to those involved in the primary aspect of the investigation, other forensic specialists such as odontologists and psychiatrists may be involved in the investigation of these cases, specifically in the identification and prosecution of the perpetrators. This workshop emphasizes the role of each of these professionals in the successful investigation of childhood deaths through lectures and case presentations.

Pediatric, Death, Investigation

WS2 Andrea Yates Trial — Revisited by the Defense

Emanuel Tanay, MD, Clinical Professor of Psychiatry, Wayne State University, 2977 Philadelphia Drive, Ann Arbor, MI 48103; Lise Van Susteren, MD*, Assistant Clinical Professor of Psychiatry, Georgetown University, 4707 Conn Avenue, Washington, DC 20008; George Parnham*, 440 Louisiana Street, Suite 800, Houston, TX 77002*

The goal of this presentation is to inform the participants about infanticide, insanity defense, and the ethical role of forensic psychiatry in criminal trials.

This presentation will impact the forensic community and/or humanity by informing members on the usefulness of insanity defense; increasing awareness of the conflict between requirements of law and science; highlighting the distortions that occur as the result of prosecutorial concerns with public opinion; and last not least, increasing awareness that a criminal trial is about justice and not gamesmanship.

A sane mother cannot will herself to kill her children, nor can she will herself not to when driven by psychotic delusions. To present the killing of five children by a mother as a result of a sane intellect is unreasonable and yet that is what the prosecution had to argue in order to obtain first-degree murder conviction.

The killing of five children by a mother is not a defect of conscience but a psycho-biological derangement. Maternal instinct is not only a matter of psychology but of biology. The mother-child bond is instinctual, therefore, the killing of five children by a human mother is a psycho-biological aberration. Yet, the prosecutors and their expert claimed that Andrea Yates drowned her children because "The children had become a hindrance, and she wanted them gone." The psychiatric expert witness who testified against insanity defense in the Andrea Yates case was paid by taxpayers $105,636.99.

One wonders what social value justified this type of expenditure on the part of the prosecutor's office. A psychotic mother who drowned her five children would be confined for the rest of her life if she was found insane or guilty of first degree murder. Thus, the effort from the persecution's perspective was about the location of the life-long confinement of this tragic figure.

The Congress was outraged by the insanity verdict in the John Hinckley case and crafted legislation to prevent such "abuse." In reality insanity pleas were made in only 2% of felony cases and failed in more than 75% of the cases. Most severely mentally ill homicide defendants are found guilty of first degree murder under the wrongfulness test.

Andrea Yates a chronically psychotic woman drowned her five children in a bathtub and called the police. She was found not insane and guilty of first-degree murder. There were no legislative hearings, no protest from organized medicine or psychiatry. John Hinckley like Andrea Yates was chronically schizophrenic. Neither Hinckley nor Yates received appropriate treatment before the criminal offense.

The Andrea Yates case and the many other killings of children by psychotic mothers raise profound moral, legal and psychiatric issues. Should we judge human behavior by its consequences and disregard the state of mind that gave rise to this behavior? Should we have a criminal justice system which does not consider intent? Are we to disregard the delusional beliefs that give rise to homicidal behavior? Should we make no distinction between rational beliefs and beliefs that are symptoms of psychosis? Are we to assume that there was no causal link between the psychosis and the drowning of five children?

The principle that knowledge of the difference between right and wrong is the criterion for insanity is the law. It cannot be questioned by an expert witness. Nevertheless, a psychiatric witness has to make the concept meaningful within his or her science. The very fact that psychiatric expert testimony is admissible as a matter of law presumes that the testimony will be given in accordance with the principles of psychiatry and pass the "Frye Test." It is our contention that relying upon a delusion as proof for knowledge of wrongfulness is contrary to science, law, and common sense.

Insanity, First-Degree Murder, Ethics of Expert Testimony

B1 Applications of Forensic Astronomy in Turkey

H. Bülent Üner, PhD, Institute of Forensic Sciences, Istanbul University, Adli Týp Enstitüsü, Cerrahpaþa, Istanbul, 34301, Turkey; Emre Albek, MD, Cerrahpaþa Medical Faculty, Istanbul University, Cerrahapaþa Týp Fakültesi, Istanbul, 34301, Turkey; Ismail Cakir, PhD, Council of Forensic Medicine, Turkey, Adli Týp Kurumu, Cerrahpaþa, Istanbul, 34246, Turkey*

After attending this presentation, attendees will understand applications of forensic astronomy.

Frequently, astronomy proves to be an important contributory science to criminalistic investigations.

Crime scene investigation on the date and at hours calculated by forensic astronomers is the only means to ascertain whether conditions of visibility at the time of a crime are consistent with the information obtained from victims, eye witnesses and the alleged assailants. During the crime scene investigations, meteorologic conditions at the time of the alleged crime should also be taken into consideration.

The forensic astronomer using degree of longitude and latitude of the scene as well as data from regular astronomical almanacs, calculates the moon phase, the time of moonrise and moonset, the time of sunrise and sunset, so determines the nights on which the same lunar illumination as in the night of the event will be present

In Turkey with its almost wholly muslimic population, persons involved in a criminal case sometimes report the time of occurrence in association with the muezzine's call for prayer. In such cases, forensic astronomers have to calculate the exact hour of the praying call at the time of the alleged crime.

Criminalistics, Astronomy, Sun and Moon

B2 A Rapid Analysis of Low Explosives With SEM/EDS—A Case Report

Ismail Cakir, PhD, Council of Forensic Medicine, Turkey, Adli Týp Kurumu, Cerrahpaþa, Istanbul, 34246, Turkey; H. Bülent Üner, PhD, Institute of Forensic Sciences, Istanbul University, Adli Týp Enstitüsü, Cerrahpaþa, Istanbul, 34301, Turkey; Salih Cengiz, PhD, Institute of Forensic Sciences, Istanbul University, Adli Týp Enstitüsü, Cerrahpaþa, Istanbul, 34301, Turkey*

After attending this presentation, attendees will understand rapid analysis of low explosives with SEM/EDS.

Scanning Electron Microscopy Energy Dispersive X-Ray Analysis (SEM/EDS) is a very useful method to analyze for most of inorganic materials like gunshot residues, paints, soil, glass etc. Also it is possible a rapid analyze of low explosives with SEM/EDS.

In the present study, we carried out rapid analysis of low explosives (potassium chlorate and sulphur) by the method mentioned above.

While four young men were at the seaside for fishing, they wanted to prepare a device of explosive-fishing by adding a powdered material to another that was in a bottle. At this time the bottle exploded with a huge noise and four young men were injured.

Crime scene investigators found two different powder materials and pieces of a broken glass bottle at the scene.

Although in this case, it was believed by crime scene investigators that these materials found at the scene, were calcium carbide, they were sent by the public prosecutor for analysis to our laboratory.

One of these materials was slightly moistened, white powder, and the other was dry, yellow powder. Approximately two grams of each powder was placed and heated in an 110º C oven for 1 h. Then materials removed from oven and were allowed to cool to room temperature. Each of these materials was placed on two different double-sided adhesive tape then attached to a stub, and coated with carbon. SEM/EDS analyses for these materials were carried out using a JEOL 5600LV scanning electron microscope equipped with a LINK-ISIS 300 X-ray analyzer.

The results obtained in this study indicate that elemental composition of the white powder consisted of potassium, chlorine, and oxygen (its compound was potassium chlorate), yellow powder was sulphur.

SEM/EDS, Low Explosives, Potassium Chlorate and Sulphur

B3 Evaluation of Y-STR Markers Using a Cajun Population

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Do the eight minimal haplotype Y-STR markers provide enough discrimination in a population that is potentially highly related? In this study, it can be demonstrated that in related populations, eight markers do not provide enough discrimination of the individuals in that population.

This presentation will impact the forensic community by demonstrating how the eight minimal haplotype Y-STR markers alone may be insufficient to reach individual characterization; therefore, additional markers may need to be used to discriminate some populations.

The Cajun population of southern Louisiana has a long history. The original population consisted of only a few family units that were continuously displaced from France to Canada to Louisiana. This population had sustained geographical and social isolation from the 1700s until the mid-late 1900s. Given the history of the Cajuns and since Y-STR's are inherited virtually unchanged from father to son(s), the possibility of observing a minimal number of different profiles form the Cajun population is greater than in the general population. Samples from the southern Louisiana area Cajun and non-Cajun populations were collected and processed. These samples were organically extracted, quantified, amplified, and analyzed using capillary electrophoresis. The eight minimal haplotype STR's plus two additional Y-STR's were analyzed. Even with ten loci, the results show more similarities and exact matches in the Cajun population than in a non-Cajun population.

Y-STR, Related Population, Discriminating Power

B4 Optimization of Spermatozoa Capture During the Differential Extraction Process for STR Typing With the Potential for Automation

Pamela L. Marshall, MS, Maryland State Police Crime Laboratory, 1201 Reistertown Road, Pikesville, MD 21208; Art Eisenberg, PhD, University of North Texas Health Science Center, 3500 Camp Bowie Boulevard, Fort Worth, TX 76107*

After attending this presentation, attendees will learn about a new method of spermatozoa capture that could enhance the differential extraction process already in place in most crime laboratories and learn about the research involved in this method

This research project shows tremendous potential as a new and improved method for obtaining a complete and separate sperm fraction from sexual assault samples. It could lead to an automated method, establishing a faster technique for the differentiation of sexual assault samples, and could be a tremendous breakthrough in the backlog of cases most states are currently facing.

In 1998, within the United States, it is estimated that a rape occurred every 2.3 minutes. In 1995, according to the Bureau of Justice Statistics, an estimated 350,000 rapes or sexual assaults (R/SA) were experienced by persons age 12 or older. Of the estimated 100,000 R/SA reported, there were only approximately 25,000 cases analyzed by crime labs nationwide. The majority of crime laboratories throughout the U.S., especially those in major metropolitan cities, have a significant backlog of unresolved R/SA cases. With the implementation of the Convicted Offender Database (CODIS), it is essential that all R/SA cases be analyzed, especially those lacking a known suspect. The comparison of the short tandem repeat (STR) profiles derived from sperm DNA recovered from evidentiary material with CODIS samples would provide the police with critical investigative leads resulting in the identification of the assailant.

The goal of this research is to develop a cellular sorting method for the isolation of the sperm cells from sexual assault samples which will: 1) take advantage of additional differentiating cellular features (extracellular antigenic sites) so that the separation of the cell types will be complete, 2) provide a more efficient means of sperm recovery, and 3) utilize commercially available equipment for the automation of the entire process, resulting in a cost effective and more reliable process. Overall, the proposed technique will increase the probability of success in the analysis of sexual assault case samples. (NIJGrant #: 2000-IJ-CX-K009).

Differential Extraction, Sexual Assault, Short Tandem Repeats

B5 Carboxyhemoglobin Analysis in Gunshot Wounds

Hakan Kar, MD, The Council of Forensic Medicine of Turkey, Adli Tip Kurumu, Cerrahpasa, Istanbul, 34246, Turkey; Salih Cengiz, PhD, Institute of Forensic Sciences, Adli TIP Enstitüsü Cerrahpaþa, Istanbul, Turkey; Bülent Üner, PhD, Institute of Forensic Sciences, Adli Týp Enstitüsü Cerrahpaþa, Istanbul, 34300, Turkey; Harun Tugcu, MD, Gülhane Military Academy of Medicine, Department of Forensic Medicine, Gülhane askeri Týp Akademisi, Ankara, Turkey; Necmi Cekin, MD, The Council of Forensic Medicine of Turkey, Adli Tip Kurumu, Cerrahpasa, Istanbul, 34246, Turkey*

After attending this presentation, attendees will understand the definition of the entrance and exit wounds together with estimation of the shooting range and the major criteria in determination of the origin of the gunshot wounds.

The goal of this Presentation is the definition of the entrance and exit wounds together with estimation of the shooting range and the major criteria in determination of the origin of the gunshot wounds.

Today, usage and ownership of firearms is rising rapidly over the world. As a result of this increasing demand, the rate of usage of firearms in crimes is also rising, even in countries where the ownership is strictly under the control of the government.

Determination of the origin in gunshot wounds is a process that starts with crime scene investigation and judicial investigation findings, developing with examination or autopsy together with laboratory tests and finalizing with jurisdiction. It's mentioned that the definition of the entrance and exit wounds together with estimation of the shooting range are the major criteria in order to determine the origin of the gunshot wounds. Crime scene investigation, collecting the evidences those are related to the case (like the guns, bullets, fingerprints, gunshot residues, clothes with gunshot holes, etc.), physical and morphological properties of the gunshot wounds, detection of the gun powder and soot on and under the dermis during the autopsy, analysis of the gunshot residues on the clothes and hands with chemical examinations, applying some advanced technological tests like "Neutron Activation Analysis," "Atomic Absorption Spectrophotometers," "Scanning Electron and Ion Microscopy," "Imaging Analysis" are enabling us to determine the entry-exit wounds and firing range.

Getting the clothes after washing and cleaning for the tests, clothes can mould and become useless because of the improper transportation and storage conditions. Even in some cases clothes that should be kept as evidences are being lost at crime scenes or hospitals during first aid.

In some cases gunshot wounds become impossible to examine when the body has been washed or embalmed, operated medically or cleaneased to hide the remains. There may be indeterminate results in cases when the epidermis is decayed, scar tissuehas formed, or insect activities occur around the gunshot wounds.

Determination of shooting range and entry-exit wounds cannot always be possible with classical and advanced methods mentioned above. In such cases carboxyhemoglobin (COHb) analysis in the blood samples obtained from the muscle tissues right under the gunshot wound will be a helpful criteria to determine entry-exit wounds.

The aim of this study is to compare the carboxyhemoglobin levels in blood samples obtained from the muscle tissues and veins in contact, near contact and close range gunshot wound cases; and with this method to distinguish the gunshot wounds from other types of wounds, to differentiate the entry and exit wounds and to define if the firing range is contact or not.

Material and Method: 52 contact, near contact and close range gunshot wound autopsy cases examined at the State Institute of Forensic Medicine between May 2001 and May 2002 were included. COHb levels of blood expressed from the muscle tissues at the entry and exit sites and veins were analyzed. The blood samples were filtered with the "Cloth Catcher" and analyzed with "Co-Oximeter."

Findings: 39 of the cases were shot with handguns, 13 with shotguns; and 47 of the cases were shot from contact range, 2 from near contact range and 3 from close range. The difference between the average COHb levels of the entry wounds (handgun: 8,673, shotgun: 23,000) and the exit wounds (handgun: 4,655, shotgun: 15,871) were statiscially significant in both handgun and shotgun wounds. And differences between the average COHb levels of the entry, exit wounds and venous blood samples (handgun: 1,545, shotgun: 5,729) were also statiscially significant.

Discussion and Conclusion: As a result; in suspected gunshot wound cases, a significant difference between the COHb levels of the venous blood and the blood expressed from the muscle tissues at the wound sites suggests that the lesion is a gunshot wound and is a result of a contact range shot. Therefore this method will be helpful criteria in differantial diagnosis of the suspected or controversial gunshot wound cases when used with other diagnostic criteria.

Carboxyhemoglobin, Gun Shot, Wounds

B6 Advancements Pertaining to the Physical Developer Process

David E. Burow, BS, Marshall University, 1401 Forensic Science Drive, Huntington, WV 25701; Don Seifert and Antonio A. Cantu, PhD, United States Secret Service, 950 H Street NW, Washington, DC 20001*

After attending this presentation, attendees will understand how latent fingerprints are developed on porous surfaces with the use of physical developer.

This presentation will demonstrate the reduction in cost of physical developer along with improved latent fingerprint development.

The silver physical developer (Ag-PD) is a water-based reagent that is commonly used to develop latent fingerprints on porous surfaces. It usually follows DFO and/or ninhydrin in the processing of latent prints. The Ag-PD reacts with certain water-insoluble components of latent print residue (e.g., lipids) while both DFO and ninhydrin are solvent-based reagents that react with certain water-soluble components (e.g., amino acids). The Ag-PD works by depositing silver on "triggering" (catalytic) sites in the latent print residue. The Ag-PD consists of silver nitrate, citric acid, surfactants, and a mixture of ferrous and ferric salts, of which the ferrous ions act as reducing agents for the silver ions. Recent changes were made to the Ag-PD when highly purified water was substituted for distilled water. These changes resulted in better performance and a *reduction* in components used and thus, a reduction in cost. This presentation will cover the approach taken in making the changes and the improvements they made.

Fingerprints, Physical Developer, Porous Surfaces

B7 Statistical Process Control in the Interpretation of DNA STR Profiles

Lawrence A. Presley, MS, MA, National Medical Services, 3701 Welsh Road, Willow Grove, PA 19090*

The goal of this presentation is to describe a data-driven method for the interpretation of low level DNA samples.

In 1992, the National Research Council recommended the use of the "ceiling principle" as a "conservative" estimate of the likelihood of a random match. This assumption was based on the limited availability of data, and by 1996 the National Research Council suggested that this "conservative" estimate was no longer necessary. Currently, many forensic DNA interpretational guidelines suggest that rfu cutoffs of 100 or 150 rfus, are a "conservative' cutoff estimate of what are callable DNA peaks. This "conservative" estimate is generally based on pre-casework validation studies of low-level DNA samples, but a continuous process may offer a better estimate.

Statistical process control offers a better and more data-driven approach for the estimation of the range of callable DNA peaks in a low level sample, rather than a pre-determined single number estimate. It is not scientifically reasonable to suggest a peak of 151 rfus is conclusively callable while a peak of 149 rfus is not without some continual basis for comparison. Statistical process control provides a reliable and accepted means of establishing an estimated range of rfu values for low-level DNA peaks, and a historical, data-driven, and continuous approach for interpreting low-level DNA peaks.

Background negative control sample data were collected, and meaningful noise levels were established. The variation ranges around the noise levels offer a degree of confidence around a recorded value, and suggest a range of values that can be used for the interpretation of 'real' low-level DNA peaks. Both positive and negative control samples were run with several sets of casework samples, and the SPC trends of data were monitored and used to adjust 'calls' for low-level samples. Thus, SPC may offer a continuous and data-driven process for the evaluation and interpretation of low-level DNA peaks.

DNA, Interpretation, Statistical Process Control

B8 Heteroplasmy Pattern in D-Loop Region of Mitochondrial DNA

Chong Min Choung, Zhe Li, Yoon Seong Lee, Jung Bin Lee, and Soong Deok Lee, Department of Forensic Medicine, SNU Medical School, 28 Yongon-dong Chongno-gu, Seoul, 110-799, Korea*

After attending this presentation, attendees will learn about the heteroplasmy pattern in D-loop region of mitochondrial DNA.

This presentation will impact the forensic community by demonstrating how heteroplasmy pattern in the D-loop would help when interpreting the sequencing results for the mitochondrial DNA.

Mitochondrial DNA (mtDNA) is polymorphic in the D-loop region. This polymorphism is used in various areas, among which individual identification in forensics and confirmation of maternal lineage are the common usuage. The mtDNA is small and circular, and exists as a lot of copy number even within a cell. With these characteristics mtDNA has become a valuable tool in individual identification, especially when the conventional typing for the autosomal STRs are unavailable such as in old degraded samples, bone and nail.

Several may be obstacles when using mtDNA. Heteroplasmy is one of those. There may exist different types of mtDNA within a cell or even within a mitochondrion. When someone performs mtDNA sequencing, heteroplasmy must be considered. It may be difficult to tell case of different origin from case of same origin showing heteroplasmy. Conversely the insight into the heteroplasmy may increase the discrimination power of mtDNA typing or may give some idea for how the polymorphism of mtDNA occurs.

Several have reported about cases of heteroplasmy, but these do not seem to be enough. We have screened 433 maternally unrelated Koreans using DGGE and have found 82 cases of heteroplasmy in HVI. We have sequenced all the samples and decided how heteroplasmy exists. The pattern of heteroplasmy and several related results including heteroplasmy pattern among different organs within an individual or age relationship will be presented.

Heteroplasmy, D-Loop, Mitochondrial DNA

B9 A Comparative Study of Y-STR Loci: How do Different Sets of Y-STRs Fare on a Common Population Panel?

Julie L. Maybruck, BA, BS, The Ohio State University, 484 West 12th Avenue, Columbus, Ohio 43210; Roger Kahn Kahn, PhD, Ohio Bureau of Criminal Identification and Investigation, 1560 State Route 56 Southwest, PO Box 365, London, Ohio 43140; Paul A. Fuerst, PhD, Department of Evolution, Ecology and Organismal Ecology and Department of Molecular Genetics, The Ohio State University, 484 West 12th Avenue, Columbus, OH 43210*

Via this presentation, attendees will be presented with the results of a comparative analysis of several sets of Y-STR loci. A new set of Y-STR loci developed using the human genome sequence is compared with the most widely used Y-STR loci and with other recently identified Y-chromosome loci.

A number of Y-STR loci have been identified and characterized; however, there are concerns associated with some loci. We address these concerns, identify new Y-STR loci, and perform a side-by-side examination of variability of new Y-STR loci with the most widely used Y-STR markers and with a panel of other recently identified Y-STR loci. Since it is important to identify which loci are the most appropriate and informative for forensic applications, this study should have an impact on the forensic community.

Proposition: Additional Y-chromosome microsatellite loci may be needed for adequate forensic analysis for the following reasons: First, the chromosomal distribution of currently available loci is mostly limited to two small regions on the Y-chromosome; second, additional loci may be needed because of potential typing errors caused by duplicated genetic material in the human genome; third, the loci may be needed, as well, because of the relatively low level of variability of the currently available unilocal loci.

Sex specific markers, such as Y-STRs, are highly valuable tools in DNA forensics because men commit the majority of violent crimes. Y-STRs can be used to distinguish the male component in body fluid mixtures. They also aid in the identification of the number of male contributors in multiple rape cases. Y-STRs are also useful in paternity cases; particularly in situations involving a deceased putative father, Y-STRs can identify patrilineage. In population studies, Y-STRs help to identify paternal migration patterns, in contrast to maternal migration patterns identified by mitochondrial DNA.

Six studies involving the identification/characterization of forensically useful Y-STRS are relevant: Kayser et al., 1997, White et al., 1999, Ayub et al., 2000, Iida et al., 2001 and 2002, and Redd et al., 2002. In terms of physical location within the Y-chromosome, loci in the first five studies are mostly limited to two small regions fairly close to the Y-chromosome centromere. Several loci identified by Redd et al., 2002, are also located in these same regions of concentrated loci. In addition to the distribution within the Y-chromosome, a number of loci have additional drawbacks. Examination of information from the human genome project and from the literature indicates that many current loci are duplicated elsewhere on the Y-chromosome or on the X-chromosome. Some of these loci may be highly variable but, for forensics, are less than ideal. Potential problems can occur during interpretation of genotype results. For many forensic applications, the purpose of using Y-STR loci is to preferentially amplify the male DNA contribution in mixed samples and to determine the number of male contributors in multiple rape cases. Duplicated loci defeat these purposes.

Following the identification of loci by the first three studies, various combinations of markers have been used to examine populations, revealing a high number of unique haplotypes within populations. The most widely-used Y-STRs are those of Kayser et al. Given potential drawbacks of some available loci, we have identified new Y-STR loci. About 26 Mb of Y-chromosome DNA sequence has been annotated by the National Center for Biotechnology Information (NCBI). We screened over 17 million bases of Y-chromosome sequence outside the two concentrated regions of existing loci, identifying a library of 465 loci. BLAST searches against the human genome identified those that were unique to one Y-chromosome location. Of 229 loci examined, 63 were determined to be unique to single Y-chromosome locations. The 63 loci were screened in a racially diverse panel of 30 individuals to ensure unique amplification and to determine locus variability levels. Nearly half were found to be highly polymorphic. The loci were further tested for non-amplification in females. As a result, we chose a set of 10 male specific marker loci dispersed across the Y-chromosome. We found 30 unique haplotypes in the 30 individual test population. Two Y-plex kits exist which, together, contain the most frequently used loci. We examined the same 30 individuals with these kits. Several haplotypes occurred multiple times. The OSU 10-locus set had an average of 3 more alleles per locus than the 10-locus Y-plex set. Since we identified over 60 loci by screening the human genome sequence, we expected to find loci in common with other researchers. Examination of the loci identified by Redd et al. 2002, show 7 loci in common between our 63 loci and the 14 Redd et al. loci. The OSU 10-locus set has an average of 2.5 more alleles per locus than the Redd et al. 7-locus set. (Note that only one locus is common to both the Redd et al. 7-locus set and the OSU 10-locus set). Further comparative analyses of the different sets of loci will be presented.

A number of Y-STR loci have been identified and characterized; however, there are concerns associated with some loci. We address these concerns, identify new Y-STR loci, and perform a side-by-side examination of variability of new Y-STR loci with the most widely-used Y-STR markers and with a panel of other recently identified Y-STR loci. Since it is important to identify which loci are the most appropriate and informative for forensic applications, this study should have an impact on forensic science.

Y-STRs, Y Microsatellites, Y-Chromosome

B10 Forensic Analysis of Explosive Residue Background

Steven H. Wise, Olivier Collin, BS, John A. Mathis, MS, and Bruce R. McCord, PhD, Ohio University, 136 Clippinger Laboratories, Athens, OH 45701*

After attending this presentation, attendees will understand the methods for the detection of background levels of high explosives.

This presentation will establish parameters for detection of traces amounts of explosives based on a nationwide, background-levels survey, which will help investigators in eliminating false positives.

The ability to detect trace amounts of explosives is important in forensic investigations. Various analytical techniques are effective for the detection of explosives. In recent years, the sensitivity for the detection of explosives has greatly increased. This often leaves the forensic investigator in a situation where the significance of a result is not just the detection of an explosive residue, but rather its concentration when compared to that normally found in the environment. In order to give the investigator the concentration threshold that minimizes false positives, the background levels of explosive residues and interfering compounds found in public places needs to be determined. The goal of this project is to develop gas chromatography (GC) methods for trace detection of organic residues of high explosives in environmental samples.

This study involves the development of robust analysis methods for trace amounts of the following compounds: ethylene glycol dinitrate (EGDN), 4-nitrotoluene (4-NT), nitroglycerin (NG), 2,4-dinitrotoluene (2,4-DNT), 2,6-dinitrotoluene (2,6-DNT), 2,4,6-Trinitrotoluene (TNT), pentaerythritol tetranitrate (PETN), hexogen (RDX), octogen (HMX), and tetryl. Sampling is done using store bought cotton swabs rinsed with deionized-distilled water and isopropyl alcohol to remove impurities. Samples are collected by a thorough swabbing of the area of interest with dry, sterile cotton. Organic residues from each cotton swab are removed by an acetone extraction followed by a volume reduction under nitrogen flow. The extract is then screened for the presence of organic explosives using an HP 6890 GC with electron capture detection. The separation method involves a split-less injection at 180º C with helium carrier gas and a ten-minute temperature program between 50 and 250º C. To reduce sample degradation during the separation, a megabore capillary column is used; HP-5 (DB5 type, 95% dimethyl 5% diphenyl polysiloxane; 10m length, 0.53mm diameter, 2.65µm film thickness). This separation allows for presumptive identification and quantification of each compound by external standards. Detection limits in the low ng/ml range are possible for all compounds. The samples found to have a positive screening result are then confirmed by GC-mass spectrometry (MS) using negative chemical ionization with methane reagent gas. To verify the presence of the selected explosives, GC-MS is performed using a Finnigan GCQ equipped with a megabore Restek Rtx5MS (DB5 type, 15m, 0.53mm, 1.5µm film thickness) column that is split in the GC by sliding the analytical column over a 0.1mm fused silica transfer line, thus venting part of the flow into the oven. The risk of false positives is reduced by the use of selective detectors and compound identification by mass spectrometry. The analytical methods developed in this study will allow for the creation of a database using samples collected across the United States. To insure an accurate determination of background levels in different environments, sampling will be done in many public places.

Such places include: malls, police stations, airports, taxis, and buses; where door knobs, hand rails, counters, floors, walls, and furniture will be sampled. The compilation of the results obtained from this study will give the investigator a much needed tool for the analysis of organic explosive residue in public places. In addition, this study addresses the issues for the admissibility of explosives analysis results in court under the Daubert ruling.

Explosives, Gas Chromatography, Mass Spectrometry

B11 Development and Validation of a Y-Chromosome STR Typing System Y-PLEX 12, for Forensic Casework

Jaiprakash G. Shewale, PhD, Huma Nasir, BS, Elaine Schneida, and Sudhir K. Sinha, PhD, ReliaGene Technologies, Inc., 5525 Mounes Street, Suite 101, New Orleans, LA 70123*

This presentation will demonstrate to the forensic community the usefulness of Y-STR analysis in forensic casework.

The forensic community will have a better understanding of the usefulness of Y-STRs. The commercial Y-STR kit, Y-PLEX, can help identify a Y-STR profile. Y-STR's can benefit forensic casework and solve even the most difficult sexual assault cases.

Short tandem repeat loci on the Y-chromosome (Y-STRs) have become beneficial in resolving difficult forensic cases such as a sexual assault case. Using Y-STRs, it is possible to obtain an exclusive profile of male DNA in a sample containing mixtures of male and female DNA. Scientific Working Group on DNA Analysis Methods (SWGDAM) has identified a set of eleven loci namely DYS19, DYS385a/b, DYS389I, DYS389II, DYS390, DYS391, DYS392, DYS393, DYS438 and DYS439 for forensic analysis (1).

Two Y-STR typing systems, Y-PLEX™ 6 and Y-PLEX™ 5, for forensic DNA analysis are available commercially (2,3). The two systems working together enable analysis for all 11 Y-STR loci recommended by the SWGDAM. In order to achieve simultaneous amplification and analysis for the 11 Y-STR loci, we have developed a Y-STR typing system Y-PLEX™12. In addition to 11 Y-STR loci, the sex determinant marker Amelogenin is incorporated in the Y-PLEX™ 12 system. Amelogenin provides results for gender identification and serves as internal control for detection of PCR inhibitors in male/female mixture samples. The validation studies were performed according to the DNA Advisory Board's (DAB) Quality Assurance Standards. The minimal sensitivity of the Y-PLEX™12 system was 0.125 ng of male DNA. Amplification of DNA from male primates, domestic and farm animals and microorganisms reveal that the primers present in the Y-PLEX™12 system are specific for human male DNA and some higher male primates. Female DNA, as high as 700 ng, did not provide amplification products for Y-STRs. A database for the 11 Y-STR loci for Caucasian, African American and Hispanic population groups, which is currently available at www.reliagene.com can be used for obtaining haplotype frequency. The results reveal that Y-PLEX™12 is a sensitive, valid and robust multiplex system for forensic analysis. Forensic casework examples demonstrating advantages of Y-STRs will be presented.

1. Budowle B, Sinha SK, Lee HS, Chakraborty R. Utility of Y-chromosome STR haplotypes in forensic applications. Forensic Sci Rev 2003; 15: 153-64.

2. Sinha SK, Budowle B, Arcot SA, Richey SL, Chakraborty R, Jones MD, et.al. Development and validation of a multiplexed Y-chromosome STR genotyping system, Y-PLEX™6, for forensic casework. J Forensic Sci 2003; 48: 93-103.

3. Sinha SK, Nasir H, Gross AM, Budowle B, Shewale JG: Development and validation of the Y-PLEX™5, a multiplexed Y-chromosome STR genotyping system, for forensic casework. J Forensic Sci 2003; 48 (5): In Press.

Forensic Casework, Y-STR, Y-PLEX

B12 Trace Element Profiles of Float Glass Fragments Determined by Laser Ablation Inductively Coupled Plasma Mass Spectrometry (LA-ICP-MS)

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The goal of this presentation is to present a method for forensic glass analysis by LA-ICP-MS for comparison and standardization of this new application.

LA-ICP-MS in forensic science is highly promising new technique for the rapid discrimination of glass fragments by elemental composition. The relatively quick, non-destructive nature of LA, coupled with the sensitivity of ICP-MS makes the method well suited for glass analyses. Development of a protocol for the equipment in this study sets the groundwork for implementing a standard inter-laboratory technique. The results from this study can be compared with those from other laboratories, aiding in the standardization of the method and validating the technique for casework.

The importance of glass as trace evidence, coupled with increasing physical and chemical homogeneity of float glass, has prompted the use of innovative techniques for discriminating between samples. Inductively coupled plasma mass spectrometry (ICP-MS) is becoming a widely used method for elemental analyses of glass fragments, with laser ablation (LA) of solid samples being the most efficient introduction system for forensic applications (Trejos et al., 2003; Watling et al., 1997). LA-ICP-MS requires almost no sample preparation and consumes extremely small amounts of sample, making it a virtually non-destructive technique.

This poster will outline an instrumental protocol for forensic glass analysis developed at the ICP-MS Laboratory at Michigan State University. Using a Cetac LSX 200 Plus Nd:YAG laser (266 nm) attached to a Micromass Platform quadrupole ICP-MS, a certified standard (NIST 612) and six unknown automobile float glass fragments provided by the Michigan State Police were used to optimize ablation parameters for acquiring eight trace elements (^{85}Rb, ^{88}Sr, ^{89}Y, ^{90}Zr, ^{98}Mo, ^{138}Ba, ^{139}La, and ^{140}Ce). The technique was optimized for the smallest spot size (best for forensic applications) that produced adequate signal above background for all isotopes. For both the standard NIST 612 and the unknown, these conditions were met with a spot size of 100 µm and depth profile z-rate of 1 µm/s for 30 s, fixing the crater depth at 30 µm. The detector was initiated before ablation and recorded for a total of 60 s. For each trial, a 1 s pre-ablation burst of the laser was focused at the sample surface to ensure it was free of contaminants. Both the float and non-float sides of the unknown glass fragments were ablated five times to test the homogeneity of the samples and precision of the technique with this experimental setup. Similarly, a cross-sectional analysis of one fragment was conducted using the same parameters, with spot analyses 300 um apart, to ensure homogeneity and precision in the case of fragments without parallel sides.

Data were reduced by a standard gaussian integration of peaks, obtaining the maximum peak height above background for each element. The precision of the technique was evaluated by element using normalized peak heights. Overall, the precision of replicate analyses is very good (<10% RSD), within and between replicates on both the float and non-float sides of samples. Only two elements, Mo and Rb, which had the lowest peak heights, consistently show variation >10% RSD. The results of the experiments can be presented graphically on triangular plots of element ratios after Watling et al. (1997), demonstrating the discriminating power of the method. Using only six elements (^{88}Sr, ^{89}Y, ^{90}Zr, ^{138}Ba, ^{139}La, and ^{140}Ce) from the analyses, out of a total of 15 unique pairs, all glasses were distinguishable by this method.

Laser Ablation ICP-MS, Glass Fragments, Trace Elements

B13 Trace DNA: Casework Experience

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The learning objective of this presentation is to familiarize forensic scientists with the concept and practical applications of trace DNA analysis.

This presentation adds to the developing trace DNA casework analysis body of knowledge. For those in the forensic science community not familiar with the advantages and disadvantages of trace DNA analysis, this presentation will introduce its conceptual and practical applications. Forensic scientists who routinely conduct trace DNA analysis can compare their findings to the data in this study. As this data accumulates, the best methods for analyzing trace DNA can be developed.

Trace DNA is defined as the minute quantities of DNA transferred through skin contact, which can be successfully analyzed and follow the general principles of trace evidence. Polymerase chain reaction (PCR) technology has made the analysis of short tandem repeats (STRs) possible on the most minute and degraded DNA samples, such as trace DNA samples. Trace DNA STR analysis is a relatively new field in forensic science. Similar to the general principles of trace evidence, this type of analysis involves analyzing areas of potential skin contact to determine if an STR DNA profile can be obtained from these areas.

At the time of this publication, the Acadiana Criminalistics Laboratory (ACL) had analyzed 105 potential DNA trace samples over an 11-month period. Typical samples analyzed include steering wheels, cloth and latex gloves, caps/hats, tools, firearms, clothing, latent print smudges, and commercial containers. Using previously validated STR analysis procedures and adhering to the ACL's STR interpretation guidelines, the lab was successful in obtaining DNA profiles from 71% of the samples. 34% of the samples had results at 14 loci (13 STR CODIS core loci and amelogenin) and 37% of the samples produced partial profiles of 13 or fewer loci. 29% of the samples produced no results. Of the samples that produced DNA profiles, 55% were mixtures, 41% appear to have originated from a single source, 3% of the profiles were not interpretable, and 1% was traced to a contaminating source. When compared to reference samples submitted for comparison to the potential trace DNA samples, the reference samples were excluded as the source of the DNA in 31% of the samples. The reference samples were included as a possible source of the DNA in 44% of the samples. No conclusion as to the source of origin of the DNA could be drawn in 23% of the samples. 1% of the samples had contamination that could be traced to a known source.

Specific collection techniques, analytical methods, STR interpretation guidelines, updated information, and case examples will be presented at the meeting.

Trace DNA, STRs, PCR

B14 Increasing the Efficiency of STR Profiles Through Amplified Product Concentration

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This presentation will impact the forensic community and/or humanity by providing an alternative to re-amplification which preserves sample extract and increases the possibility of generating a profile in the absence of any remaining extract.

In forensic nuclear DNA analysis, DNA profiles for unknown case samples are generated using one of several commercially available short tandem repeat (STR) kits. A common occurrence with inhibited or degraded samples is the generation of a partial profile (low-intensity alleles), or no profile at all. However, there may not be enough extract or specimen remaining to re-amplify these samples. The goals of the experiments described in this presentation were to determine if the concentration of amplified STR products by vacuum evaporation could increase the relative fluorescence units (RFUs) of the alleles that were originally below the reporting threshold, and if so, to validate this concentration method for use at the Armed Forces DNA Identification Laboratory (AFDIL).

In order to validate the concentration procedure, 6 samples of 1.0 ng positive control DNA were amplified and analyzed with the ABI AmpFlSTR® Profiler Plus and AmpFlSTR® Cofiler kits on the ABI 377. All of the alleles from these samples were over AFDIL's 50 RFU reporting threshold. One of the positive DNA control amplification products from each kit was serially diluted as follows: (a) 1:4, (b) 1:8, (c) 1:16, (d) 1:32, (e) 1:16, (f) 1:32, (g) 1:64, and the dilutions were analyzed on the ABI 377. Dilutions that generated either no STR results or partial STR profiles (profiles that had allele peaks below 50 RFUs) were used as the standard by which nine of the remaining ten STR amplification products were diluted. Results demonstrated that 120 out of 150 possible allele peaks were below 50 RFUs for Profiler Plus and 104 out of 120 possible allele peaks were below 50 RFUs for Cofiler.

To test whether concentration of the diluted product would increase the allele peak RFUs, the diluted amplification products (described above) were transferred to 1.7 mL tubes and dried down completely in a Jouan HetoVac for 1 hour. The concentrated amplification products were then re-suspended in a loading solution containing 4 uL distilled water and 5 uL formamide loading buffer (formamide, GS500, and Bromophenol blue) and reanalyzed. The resulting STR profiles were compared to their corresponding diluted profiles for increases in peak RFUs. On average, the peak heights for Profiler Plus increased 4-fold and for Cofiler 6-fold. After concentration, 116 out of the 120 Profiler Plus peaks previously below AFDIL's 50 RFU cut off were now above the reporting threshold. Likewise, 96 out of 104 allele peaks that were below reporting thresholds for Cofiler were now above 50 RFUs. In no instance were additional extraneous peaks observed for any sample after concentration.

The concentration method was then applied to non-probative casework reagent blanks, negatives, and substrate controls to determine if any minor contaminates that were not detectable prior to concentration were evident after concentration. A total of 39 controls consisting of 16 Profiler Plus negatives and 19 Profiler Plus reagent blanks and 1 Cofiler negative, 1 Cofiler reagent blank, and 2 Cofiler substrate controls that had no visible peaks prior to concentration were concentrated. After concentration, 32 of the 39 controls had no visible peaks; however, the remaining seven controls exhibited 1 or 2 peaks that Genotyper called as true alleles. The concentrated profiles were then compared to the original sample profiles from their respective cases and in no instance did the concentrated peaks match any of the original case sample profiles, suggesting that these peaks were most likely the result of concentrating a low-level PCR contaminant that was present in the unconcentrated sample.

As the final validation step, twenty-two casework samples from Qiagen BioRobot extracted bloodstain cards that had exhibited partial Profiler Plus profiles were concentrated and analyzed as described above. Results demonstrated that 80% of the peaks, or 74 out of 92 possible allele peaks increased in RFUs after concentration. Of the 74 peaks that increased in RFUs, 52% or 48 peaks were brought above AFDIL's 50 RFU-reporting threshold. The average peak height increased 3.5-fold. In all instances but one, the post-concentration peaks were in concordance with the original STR profiles generated during case pro-

cessing. In one sample, an extraneous peak was observed at the FGA locus. This peak, however, was not present after the sample was reloaded, arguing that the peak was most likely due to a gel artifact.

In conclusion, concentration of STR amplification products has proven to be effective in improving the chance of obtaining an STR profile when no profile or a partial profile was originally generated after amplification. Concentration provides an alternative to re-amplification, which preserves the sample extract and increases the possibility of generating a profile in the absence of any remaining extract. In addition, the baseline background for the samples is not elevated after the concentration process, which suggests that this process does not introduce artifacts into the samples that are not already present at low levels. However, it is recommended that all negatives, reagent blanks, and substrate controls be concentrated along with their corresponding casework samples for comparison on a case-by-case basis.

The opinions and assertions expressed herein are solely those of the authors and are not to be construed as official or as the views of the U.S. Department of Defense or the U.S. Department of the Army.

STR, Partial Profile, PCR Product Concentration

B15 Potential Contamination When Wearing Sterile Gloves During PCR Preparation: Pass-Through Contamination From Skin

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Contamination during DNA analysis based on PCR is a serious concern that usually happen in genetic labs. Although protocols are developed to avoid this issue, it still happen and most of the cases is not possible to find out the source of contamination. This paper present how, even wearing sterile gloves, contamination from the user can happen. It means that some extra-means should be considered in this sense.

This presentation will impact the forensic community and/or humanity by solving some issues regarding to contamination and cross-contamination, and, at the same time, providing knowledge and focus attention to some circumstances that are not frequent, but when they happen can affect the result of a case

1. Introduction: Mitochondrial DNA (mtDNA) analysis has became a routine procedure in human identification and in anthropological studies. One of the advantages of analyzing mtDNA is the enhanced sensitivity afforded with the technique. But this feature must be considered because contamination can affect the final results of a study. Quality control and quality assurance procedures are enacted to minimize and monitor contamination. However, sometimes it is not easy to identify the source of spurious or inconsistent. One vector for contamination is the gloves worn during experimentation. It is imperative to wear sterile gloves and change the gloves as needed. Clinical and epidemiological studies have demonstrated that bacterial and viral contamination can occur on the surface of sterile gloves after being worn for a length of time. Thus, DNA may get on gloves and be transferred during handling (i.e., cross contamination). It also is possible that if gloves are worn for certain periods of time that DNA may leach from the user's hand through the glove (i.e., pass through contamination). While contamination of this nature is not a routine concern, it may explain rare circumstances of undefined contamination. Therefore, we designed a set of experiments to determine if gloves could be conduits of contamination.

2. Material and Methods: To study pass-through contamination gloves were worn for different time periods compatible with labs tasks. Gloves were worn without touching anything for 5, 10 and 20 minutes by different users. Only intermittent gentle rubbing between the thumb and index finger was carried out to mimic general manipulations.

After each time frame a sample was taken from the areas usually in contact with the tubes using a wet cotton swab and a negative control was taken from a zone where no manipulations occur. After the swabbing the gloves were discarded.

All the swabs were extracted using an organic method (PCIA) and amplified for HVIB and HVIIA according to Wilson et al., we also included some nuclear DNA amplification. Post-amplification of the nuclear and mtDNA product was carried using capillary electrophoresis as previously described.

3. Results and Discussion: The experiments show that the length of time gloves are worn is an interesting factor to be considered. In some samples even after five minutes some DNA leached through the gloves, even in the apparent negative controls. These results are compatible with the clinical studies which have shown that after a time, even with careful washing, bacterial and virus contamination on the surface of the gloves can occur related to time and user.

These findings do not suggest that new practices in contamination control are warranted. They do suggest possible sources for contamination when it occurs. If gloves are not changed between cases, cross contamination may occur and explain why DNA types from unknown sources may be observed. However, cross contamination is not a serious concern under current practices. Pass through contamination may explain the presence of the operators mtDNA in a sample. Sensitivity of mtDNA analysis requires special care during the handling of samples and reagents, and particularly in extreme situations where sample manipulation is for prolonged times. If contamination persists, one may consider changing gloves every five-ten minutes or using double gloves. Also, washing the hands prior to putting on gloves could remove dead cells or their products from skin surface.

DNA, Contamination, Gloves

B16 The Effect of Formalin Decontamination on STR Analysis Conducted on Human Remains Submitted for Identification

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After attending this presentation, attendees will be familiar with the use of 10% formalin in decontaminating human remains and the effect of the decontamination on Short Tandem Repeat (STR) DNA analysis of bone and tissue specimens.

This presentation will show the forensic community that storage of human remains in 10% formalin for up to 30 days will have little to no effect on the ability to obtain an STR profile.

The mission of the Armed Forces DNA Identification Laboratory (AFDIL) is to assist the Armed Forces Medical Examiner System (AFMES) in identifying members of the armed services using nuclear DNA methods. The recent war in Iraq raised the specter that biological and/or chemical weapons could be used against American troops. A decontamination scheme had to be developed so that DNA testing could be used to identify fallen service men while ensuring the protection of all people having contact with the biologically contaminated remains. One of the methods examined to potentially decontaminate the human remains was storing human remains in 10% formalin for a period of time. 10% formalin is known to kill biological agents such as anthrax. However, it is also known that formalin can have a detrimental affect on the DNA contained within the sample. To determine if it was possible to obtain a Short Tandem Repeat (STR) profile from biological samples that had been stored in 10% formalin, the middle portion of an index finger or the tip of an index finger from medical cadavers were sub-

mersed in 10% formalin for 5 days, 7 days, 10 days, 15 days, and 30 days. The samples were then removed from the 10% formalin, the tissue was dissected away and stored at –20 ºC, and 0.9 grams – 2.0 grams of bone was immediately extracted using the AFDIL's organic protocol for extracting DNA from bone samples. Quantitation of the samples determined that approximately 100 nanograms of DNA per microliter was recovered. The samples were amplified using the AmpFlSTR® Profiler Plus™ Amplification and Typing Kit. The amplicons were run on an ABI Prism 377 and analyzed using Genotyper version 2.5. Likewise, the tissue samples were extracted following the AFDIL's organic protocol for extracting DNA from tissue samples. The amount of tissue extracted was approximately 5 mm x 9 mm in size. These samples were done in triplicate with the only difference between the extraction sets being a wash step prior to extraction. One set of extractions was conducted as per the protocol (i.e. no wash step). A second set of extractions was conducted after a portion of the tissue had been washed with sterile distilled water. The third set of extractions was conducted after a portion of the tissue was washed with 150mM glycine. The extracted DNA from the tissue samples was amplified and typed as described above. Full STR profiles were obtained in nine (samples stored for 5 days, seven days, and ten days) of the eleven bones extracted. The sample submerged in formalin for 15 days gave results at all loci except D18S51 and D7. The sample submerged in formalin for 30 days gave results at all loci except D7S820. The profiles obtained matched the "expected profiles" and there were no mutations observed in the samples that had been stored in the formalin. It is possible to obtain nuclear DNA profiles from specimens stored in formalin up to 30 days.

The opinions and assertions expressed herein are solely those of the authors and should not be construed as official or as views of the United States Department of Defense or the United States Department of the Army.

[1]Armed Forces DNA Identification Laboratory

[2]Armed Forces Medical Examiner System

Human Remains, STR Profile, Biological Weapons

B17 Laser Ablation/Pulsed-Field Reflection TOF-MS Analysis and Discrimination of Forensic Soil

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After attending this presentation, attendees will learn how to analyze and discriminate forensic soil evidence using Laser Ablation/Pulsed-field Reflection TOF-MS.

This presentation will introduce a new method of analyzing and discrimination of soil samples by using Laser Ablation/Pulsed-field Reflection TOF-MS.

This presentation will discuss how to analyze and discriminate forensic soil evidence using Laser Ablation/Pulsed-field Reflection TOF-MS.

Soils vary with areas and have distinct characteristics due to natural effects and the residues of leaves and living things. Due to complex variations in compositions, several examination techniques and instruments should be used for analyzing soil samples. In most cases, physical examinations of color reaction, a polarization microscope, etc and instrumental analyses of XRF and SEM-EDX have been used to discriminate forensic soil samples.

In this study to discriminate soil evidences, 30 soil samples were collected from 30 different locations in Republic of Korea and were analyzed using Laser Ablation/Pulsed-field Reflection TOF-MS.

All samples were reduced to powders and then were made into pellets (ID 0.8mm). The samples were heated for 5 hours at 500º C before loading on the holder. The Nd:YAG laser light (∧=532 nm) was used to ablate the components of soil. The mass spectrum was obtained by averaging of repeated pulses of 2000 times checked by Oscilloscope. The ablated main elements were sodium (Na), aluminum (Al), potassium (K), titanium (Ti), iron (Fe), copper (Cu) on the Mass spectrum. The ratios, (Al)/(Ti) and (Fe)/(Ti), showed reproducibility and different results with the soils prepared from the different locales. It could confirm that these results can be used for forensic soil examinations and supported to other analyses: data obtained by a polarization microscope and SEM-EDX, and so on. The isotope ratio for Titanium (the ratio of 45.95amu to 46.95amu) also showed another useful criterion to discriminate soil samples. This data gave the same results as the ones analyzed by the ratios of components.

Thus, these could be useful techniques to discriminate forensic soil samples by comparing both the component ratios, (Al)/(Ti) and (Fe)/(Ti), and Isotope ratio of Ti. Applications were also carried out on forensic soil evidence submitted from the police's. It showed much more definite results compared by the ones obtained by routine analyses with a polarization microscope and SEM-EDX.

It was concluded that analyzing soil evidence by Laser Ablation/Pulsed-field Reflection TOF-MS could be a useful technique to identify forensic soil evidence.

Forensic Soil Evidence, Laser Ablation/Pulsed-Field Reflection TOF-MS, Mass Spectrum

B18 The Design and Compilation of a Comprehensive U.S. Y-STR Haplotype Reference Database

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After attending this presentation, the forensic community will learn the design, establishment and statistical analysis of a comprehensive online Y-STR Database.

This project would impact the forensic community because it will provide reliable estimates of Y-STR haplotype frequencies and provide a statistical estimate of the significance of a match.

The establishment of a U.S. National Y-STR reference database from a variety of geographically and ethnically diverse populations is essential to facilitate the generation of reliable estimates of Y-STR haplotype frequencies. Such multi-locus haplotype frequencies are required to provide a statistical estimate of the significance of a match. A U.S. Y-STR Haplotype Reference Database has been created by the International Forensic Y-User Group and is maintained by the Max Planck Institute for Evolutionary Anthropology, Leipzig, Germany. However, this database has been limited to a set of 9 core Y-STRs that limits its operational usefulness, particularly in light of the development of Y-STR multiplexes consisting of additional Y-STR loci. Y-STR loci, unlike traditional STR markers, are not independent of one another and are co-inherited as extended haplotypes of linked markers. The estimation of the frequency of occurrence of a particular haplotype therefore necessitates the use of a counting method which means that the significance of many matches are dependent upon the size of the database.

The NCFS database initially comprised data generated in the laboratory based upon a 19 Y-STR locus extended haplotype. The loci include DYS19, DYS385 (a) and (b), DYS388, DYS389I, DYS389II, DYS390, DYS391, DYS392, DYS393, DYS425, DYS434, DYS437,

DYS438, DYS439, Y-GATA C4, Y-GATA A7.1, Y-GATA A7.2 and Y-GATA H4. Data was obtained from various Caucasian, African American, Hispanic, Native American and Asian populations. A comprehensive evaluation of the data was carried out to determine the allelic distribution and the gene diversity at each locus as well as the multi-locus discriminatory potential. Allelic ladders for the 19 Y-STR markers have been constructed to aid in accurate genotype determinations. Since there are a number of common 19-locus haplotypes additional loci have been included in the database. These loci include DYS426, DYS436, DYS441, DYS450, DYS462, YAP (Alu insertion), Y-GATA-A10, DYS446, DYS435, DYS442, DYS443, DYS444, DYS445, DYS447, DYS448, DYS449, DYS452, DYS453, DYS454, DYS455, DYS456, DYS458, DYS463, DYS464, DYS468, DYS484, DYS522, DYS527, DYS531, DYS557 and DYS588. Although, some data exists for some of these loci in U.S. populations, it is not readily accessible to the crime laboratory community and usually does not contain individual multi-locus haplotype data.

A key component of our strategy is to allow for the continuous updating of haplotype data using the same samples. This ensures that as new markers are developed, the same samples would be re-typed, and a new extended haplotype developed. Thus, any laboratory needing haplotype data for any combination of Y-STR markers would be served. The aid of geographically diverse crime laboratories has been enlisted to obtain the necessary samples. In exchange for the samples the crime laboratories benefit by obtaining a custom built no-cost local Y-STR database.

Our results to date will be presented, and information on community access will be provided.

Y-STR Database, Haplotype Reference Database, Populations Studies

B19 Guidelines for the Interpretation and Reporting of STR Profiles: A Hypothesis-Driven Approach

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After attending this presentation, participants will learn about the adoption of a hypothesis-based testing model for the interpretation and reporting of DNA STR profiles.

We consider it vital to carry out all forensic biology casework processes, including the interpretation and reporting of STR profiles, in consideration of the hypothesis being tested. We will show how we have adapted our guidelines to take various elements of the case history into account in the interpretation and reporting stages of the analysis, and how these in turn lead to clearer reports.

This poster will describe the guidelines used at the Centre of Forensic Sciences for the interpretation and reporting of STR profiles, recently revised and written within the framework of a hypothesis-based approach to forensic casework. This approach can be summarized as a mechanism to test hypotheses, determine if the results support such proposals and to report the conclusions in a manner reflective of the hypotheses being tested.

It is the role of the scientist to address the pertinent questions being asked, relevant to the events recorded in the case history, and to then make a decision as to whether the testing of particular items would allow one to draw valid inferences in relation to the hypothesis. The assumptions that can be made during an interpretation may be based on both the DNA results themselves and/or on elements of the case history. Scientists however must also be prepared to address their conclusions under a different hypothesis with a different set of assumptions.

Examples of the interpretation process will be provided, along with respective supporting rationales. Illustrations of the following steps in the process will be provided:

(1) Deriving constituent DNA profiles from mixtures.

Dual source mixture: one source known or assumed.

Dual source mixture: both sources unknown.

Dual source mixture: equivalent major contributions of 2 unknown sources.

(2) Determining if a DNA profile is suitable for comparison purposes.

When making this determination, factors to consider individually or together include the amount of DNA detected, a lack of peak height concordance, a prior expectation of background DNA (e.g. on clothing) and the total number of contributors. If the determination is made that the DNA profile is not suitable for comparison, the reporting of this finding should reflect the reasons why this is so, for example:

"Due to uncertainty with respect to the number of contributors and/or due to the low amounts of DNA detected, this DNA profile is not suitable for comparison."

(3) Reporting of results when a DNA profile is suitable for comparison.

Once a DNA profile is determined to be suitable for comparison, one of two different formats of reporting will be required depending on whether comparison samples from known individuals are available.

(i) Can an individual in question be excluded as the source? The significance of an individual not being excluded as a source is routinely expressed in the form of a random match probability (RMP) statement (excepting results from familial analyses). For example:

"Mr. X cannot be excluded, at 9 STR loci, as the contributor of the DNA profile from item 1. The probability that a randomly selected individual unrelated to X would coincidentally share the observed DNA profile is estimated to be 1 in Y."

(ii) If no known comparisons are available the DNA profile's suitability for comparison at a later date can be reported in a number of ways depending on its rarity:

"*This DNA profile is suitable for comparison."*

"This DNA profile is suitable for comparison, though it may be of limited forensic significance due to its relatively high frequency of occurrence. * This DNA profile is expected to occur in the population with a frequency of greater than 1 in 1000."*

(4) Assessing the forensic significance of a DNA profile or of one or more constituents in a mixture.

A determination is made as to whether the interpretation of each constituent profile in a mixture is necessary, based on the sample type and case history. Reporting of results are worded to reflect this determination. Examples will be given for the application of this assessment as relevant to:

Intimate samples – DNA analysis of an intimate sample (defined as swabs from body orifices, skin swabs, fingernail scrapings and underwear in certain circumstances) will generally be expected to yield the DNA profile of the donor, in addition to DNA from someone else. The presence of DNA from the person from whom the sample was taken is not of forensic significance (unless the source of the sample is itself questioned). However, given the prior expectation of detecting the donor's DNA, this knowledge can be used in the derivation of any additional contributing DNA in the mixture. Examples of wording such findings include:

"No DNA, other than that which is attributable to Ms X, was detected on a swab of her skin."

"In addition to DNA attributable to Ms X, a male DNA profile was determined at 9 STR loci from a swab of her skin and is suitable for comparison."

Clothing – it is not unusual to find detectable levels of DNA on items of clothing and as a consequence clothing can often be examined to determine if it can be associated to a particular individual at some point in time, in the absence of testing for a body fluid. However, as clothing is often examined solely for the purpose of determining the source of a body

fluid stain there may or may not be significance to any additional DNA coincidentally detected in the background. It should be noted nonetheless that in some instances a minor level of background DNA might indeed be of forensic significance, depending on the hypothesis being tested and the elements of the case history. An example of wording to account for this possibility would be:

"Mr. X cannot be excluded as the source of the bloodstain on the jeans. [insert RMP statement]. An additional minor source of DNA was also detected in the sample. Since it is not unusual to detect low levels of DNA on clothing, this finding may be incidental and of no forensic significance."

It is recognised that the development of guidelines for interpretation is a continually evolving process requiring constant review and that the scientific laboratory itself should play a role in determining how best to provide the results to the clients in a forensically relevant and time efficient format.

Interpretation Guidelines, STR, Hypothesis Testing

B20 The Arab Population Data for 10 Y-Chromosome Specific STRs

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After attending this presentation, attendees will understand the differences and similarities between the studied Arab Population groups and other population groups.

This presentation will impact the forensic community by adding to the Y-Chromosome population database as until now there is no available Arab population data.

Objective: The objective of the present work: 1.to establish basic data base as regards the 10 Y-chromosome STR loci for 6 Arab population groups, and 2. to evaluate the significance of an inclusion with Y-chromosome specific STRs after establishing haplotype frequencies for the examined population groups.

Nature of Study: Population Study.

Materials, Methods and Results: The study was conducted on blood samples which were collected from unrelated healthy adult males from 6 Arab population groups living in Abu Dhabi, United Arab Emirates (U.A.E.) including native population in Abu Dhabi, and from Egypt, Syria, Sudan, Jordon and Oman. DNA was extracted by both the organic phenol-chloroform, and FTA™ paper extraction protocols, After quantitation of the extracted DNA (organic extraction only) amplification was carried out using about 2 ng of genomic DNA in a total reaction volume of 25 µl - one amplifications - for 10 loci - (DYS19, DYS385, DYS389I, DYS389II, DYS390, DYS391, DYS392, DYS393, DYS438 and DYS439) using Y-STR kit from Promega. The amplified product was tested on the ABI 310 genetic analyzer and the obtained profiles were interpreted and analyzed using Gene Scan analysis software (PE Applied Biosystems) and the genotypes were determined by using the Genotyper DNA fragment analysis software (PE Applied Biosystems) with the Power Typer Y Macro. Haplotype frequencies were calculated for each STR locus for U.A.E. population and other population groups, frequencies were calculated through the gene counting method, haplotypes and gene diversity was calculated. The obtained results were compared with relevant Arab and other ethnic groups database.

Forensic DNA, Y-Chromosome STRs, Arab Population

B21 Population Data on 9 STR Loci in Crete (Greece)

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After attending this presentation the attendees will learn data on CSFPO D7S820 D13S317 D16S539 F13A01 FESFPS THO1 TPOX and vWA STRs in the population of Crete and their validity for the use of forensic analysis.

This presentation will impact the forensic community by providing reliable STR data for probability calculations in cases where Cretan population is involved

Crete is the largest of the Greek islands and is located in the South East of the Mediterranean Sea. It is 260 km long and 60 km at its widest point. Being an island, it is considered to be fairly isolated and since geographically well separated, gene frequency differences were expected. There is a lack of population genetic data from most of these STRs despite the fact that the commercially available amplification kits are increasingly being used in forensic casework. Therefore we aimed to evaluate the data for the above-mentioned polymorphic loci, for an effective use in Crete and the suitability of the system for forensic applications.

Four hundred samples from unrelated individuals were tested for the systems as for their gene and phenotype frequencies. The sampling was done considering the population distribution in the four main residential areas of the island.

Following the DNA extraction and quantitation, the PCR amplification of the nine STR loci (CSFPO D7S820 D13 S317 D16S539 F13BA01 FESFPS THO1 TPOX and vWA) was performed using the commercially available triplex amplification kits provided by Promega, and the application was done according to the manufacturer's instructions.

Allele frequencies were estimated by gene counting. The expected genotype frequencies were calculated on the basis of estimated allele frequencies under the assumption of Hardy-Weinberg equilibrium. Accordance with Hardy-Weinberg equilibrium was checked using the software package Popgen32. Observed and expected heterozygosity, power of exclusion, power of discrimination, probability of match and paternity index was also calculated.

The observed genotype distributions of the nine STRs showed no deviations from Hardy-Weinberg expectations. The obtained results were compared to the present data for Greek population from different geographical areas and to the data for the rest of the Europe. No significant differences were observed between the populations for any of the STRs analysis.

In no cases the observed heterozygosity is less than that of expected. The discriminatory power and exclusion probability values for all the analyzed markers are significantly high and thus reveal high forensic significance. This allele frequency data will be useful for human identity testing in Cretan population.

STRs, Crete, Greece

B22 Development of a Y-STR Megaplex and Its Comparison to A Y-STR 10-Plex

Cassie L. Johnson, MS, Robert C. Giles, PhD, Joseph H. Warren, BA, and Rick W. Staub, PhD, Orchid Cellmark, 2600 Stemmons Freeway, Suite 133, Dallas, TX 75207*

After attending this presentation, attendees learn about new Y-STR multiplexes that are being developed for use in forensic and paternity laboratories.

This presentation will demonstrate that Y-STRs are being used increasingly more in forensic and paternity laboratories. The Y-STR multiplexes being developed at Orchid are able to quite effectively discriminate among male lineages, and thus, will have a significant impact in the field of human identification.

Y-chromosome STRs (Y-STRs) have gained interest in the forensic community because of their ability to identify the male component of a sample. Y-STR testing is especially valuable in sexual assault cases in which little male DNA is present, as well as in deficient paternity, immigration, and estate cases. Orchid Cellmark has developed a megaplex for use on the ABI PRISM® 3100 Genetic Analyzer that examines many Y-STR markers in a single amplification reaction. The Y-STR megaplex includes all of the European minimal haplotype and U.S. Y-STR haplotype loci, as well as additional, highly discriminating loci. The results of studies aimed at optimizing the amplification and analysis conditions for this multiplex will be presented. Validation studies demonstrating the effectiveness of the Y-STR megaplex as a forensics tool will also be discussed. In addition, Orchid Cellmark has optimized a Y-STR 10-plex which has amplicons less than 200 base pairs in length, making it an ideal system to use with degraded samples containing male DNA. The present study compares the Y-STR 10-plex and Y-STR megaplex to determine their ability to effectively discriminate among male lineages.

Y-STR, Forensic, Multiplex

B23 Whole Genome Amplification of Limited Quantity Samples

Nana Yaa S. Lamouse-Smith, BA, MS, Robin L. McDowell, MFS*, Robert E. Wenk, MD, and Francis A. Chiafari, MS*, BRT Laboratories, Inc., 400 West Franklin Street, Baltimore, MD 21201*

After attending this presentation, attendees will learn about a new technique they may want to incorporate into their SOPs for handling limited biological samples.

This presentation will impact the forensic community and/or humanity by describing the technique which can be used on challenging samples to obtain DNA profiles. This may help to obtain DNA profiles (either complete or partial) from limited samples where before this may have not been feasible or results achieved did not provide enough information.

This study investigated the utility of Whole Genome Amplification (WGA) as a method to enhance the sensitivity of current STR technology for samples with limited cell quantity. WGA uses Phi29 DNA polymerase and random hexamer primers to amplify eucharomatic DNA by highly processive strand displacement. Our initial experiments involved determining the minimum number of cells necessary to yield successful WGA, followed by phenotyping with Profiler Plus and Cofiler to measure fidelity. Epithelial cells were collected, counted, and lysed prior to WGA, with the yield determined by Pico Green. Serial dilutions with as few as 10 total cells yielded WGA product, and produced accurate profiles with Profiler Plus and Cofiler. Initial experiments indicate that this technology may improve the production of profiles from minimal samples in a cost-effective manner. Applications of this technology to mock and non-probative samples will be discussed.

Whole Genome Amplification, Limited Sample, DNA

B24 Guessing the Race From an STR Profile

Charles H. Brenner, PhD, Consulting in Forensic Mathematics, 6568 Sobrante Road, Oakland, CA 94611*

After attending this presentation, attendees will understand the routine DNA profile – the CODIS STR loci for example – properly evaluated, usually provides strong information about the ancestry of the contributor.

Calculation of probable racial origin of a crime stain can occasionally be a helpful hint and is extremely easy and cheap to compute. Therefore, this presentation will impact the forensic community and/or humanity by providing a tool that the investigator may as well have.

The routine DNA profile – the CODIS STR loci for example – properly evaluated, usually provides strong information about the ancestry of the contributor.

It can be useful to know the race or population group of origin of a crime stain. For example, in April 2003, the Louisiana serial killer Derrick Todd Lee was arrested based on a tip from a citizen who had, according to the newspapers, long been inclined to be suspicious of him. However, the informant decided his hunch was worth acting on only when and because the authorities, in about March, issued a statement contradicting the earlier incorrect public assumption that the killer was Caucasian. Lee is an African-American.

The March announcement (in substance, it was that no race should be eliminated from consideration) came shortly after a racial analysis by DNAPrint based on their specially developed set of markers. However, such a high-tech approach was not essential in this case. In fact I had been consulted on the case in January and on the basis of the STR locus profile obtained by the Lafayette and Baton Rouge crime labs provided essentially the same information. A dragnet, operating on a racial assumption based perhaps on a profiler's analysis or perhaps on some vague witness account, had methodically extracted DNA samples from 800 Caucasians in an attempt to match the crime stain. After calculating likelihoods for several races – Caucasian, African-American, Japanese, Korean, Chinese, Hispanic, Vietnamese – I said, "Caucasian is the last race I'd look at." (This was a little glib – on the numbers it is really second last, before Vietnamese.)

The DNA criminalist commonly calculates several "frequencies" corresponding to the Caucasian, African-American, etc., population groups. "Frequency" is the wrong word though, since the number is invariably so small that if it were really interpreted as a frequency it would imply a fraction of a person. What the number actually represents is expected frequency, or probability: The probability that a random e.g., Caucasian person unrelated to the crime stain would have the crime stain type. That is, it would if instead of making the customary conservative computation, we try to be as accurate as possible. To that end, the right procedure is simply to include (temporarily) the crime stain in the population sample – note that this avoids ever having a probability of zero – and then use the consequent sample frequency for each allele as a good estimate of its random match probability. The product rule, perhaps elaborated by the NRC homozygote and heterozygote theta correction (but with a realistic, i.e., very small, value of theta), is then used to combine the individual allele probabilities to form a profile probability.

The profile probability assuming Caucasian origin and the profile probability assuming African-American origin are two probabilities of the same thing under different hypotheses. As such, their ratio is by definition the likelihood ratio supporting Caucasian over African-American origin for the source sample. In the Baton-Rouge case, the likelihood ratio favored African-American over Caucasian by about 6:1. Testing Caucasians is thus quite inefficient. Curiously, the likelihood for Japanese, Chinese, and especially Korean populations was even higher, the likelihood for Koreans exceeding that for Caucasians by a factor of 200. That does not, of course, mean that a Korean was probably the culprit, only that any single random Korean would be a more plausible suspect than any single random Caucasian or anything else. Hence

lacking some reason to the contrary (such as knowledge that Koreans are improbable serial killers), the most efficient dragnet would begin with Koreans. As few Koreans as there are in Baton Rouge – about 0.1% of the population – the net chance that a Korean would be the killer was 6%. Disproportionately large, but still small. Caucasians and African-Americans, each of which represent about half the people in Baton Rouge, figured as 11% and 67% respectively to include the killer.

The 6:1 likelihood ratio favoring African-American over Caucasian seems like a strong clue, but in fact it was a little unlucky it was so small. On average we can expect to do better. This table shows the typical likelihood ratio that can be expected when comparing various population groups:

	Cau	His	AA	Jap	Vietnamese
Caucasian		5	40	30	300
Hispanic			30	10	200
African American				300	5000
Japanese					8

In the long run forensic STRs will certainly not be the most accurate tool for assessing racial origin. However, they do offer a number of advantages. The typing is routine; it doesn't cost extra. Extensive population data is available, for a large number of populations, whereas for a specialized test the data will need to be gathered at considerable expense just for that test. Once it is appreciated that we are dealing with probabilities and not frequencies, it is apparent that large population studies are not necessary. Small ones generally are somewhat less informative, but their smallness does not inhibit inferring a probability. Probability is, after all, a summary of whatever information we may posess. Finally, the method of analysis of STR data conveniently gives a likelihood ratio which means that though it may not always give a definite answer it will rarely be misleading; when it is not sure, it tells you it is not sure.

Racial Attribution, DNA Typing, Likelihood Ratio

B25 A Review of Mixture Profiles in the CAP Forensic Identity Proficiency Testing Program

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The goal of this presentation is to review the reported mixture profiles of human spermatozoa with epithelial cells and white blood cells in proficiency DNA testing results from the Forensic Identity proficiency testing program.

This presentation will impact the forensic community and/or humanity by demonstrating to the forensic DNA community is doing an excellent job in the interpretation of mixed samples.

Learning Objective: to review the reported mixture profiles of human spermatozoa with epithelial cells and white blood cells in proficiency DNA testing results from the Forensic Identity proficiency testing program.

In 1993, the College of American Pathologists first offered the Forensic Identity (FID) proficiency testing program. The FID program distributes two (2) mailings per year. A combination of specimens consisting of reference bloodstains, mock vaginal swabs, crime scene bloodstains and/or semen stains, and other biological material are provided in each survey. Since a significant percentage of submitted cases to the crime laboratories contain mixed specimens such as vaginal swabs, oral swabs, anal swabs, or stains from sexual assault cases where human spermatozoa are present, the College includes such specimens in the surveys. In every mixed sample to date in the FID program, the contributor of the "cell" fraction has been from a female victim.

One major advantage of DNA testing over traditional serological testing is the ability to separate the spermatozoa (hereafter referred to as "sperm") from the epithelial and white blood cells (hereafter referred to as "cells"). The first survey of this program contained a mock vaginal swab sample. The swab was prepared from isolated white blood cells from the same donor of the victim. The leukocytes were isolated in a LeucoPrep tube and the leukocytes were counted on a Coulter counter. Approximately one million white blood cells were spotted onto a sterile SOLON cotton-tipped applicator and allowed to air dry. Semen from the suspect was mixed 1:1 semen:1X PBS. 50µL of this mixture was spotted onto the cotton-tipped applicator. Variations of this original procedure are still used in this program today. Other mixed specimens have included a mixture of whole blood and semen on a swab, an undergarment, and filter paper.

In the earlier surveys, participants reported results mostly for restriction fragment length polymorphism (RFLP) analysis, with some laboratories reporting results for AmpliType™ HLA DQ-alpha, D1S80, and a couple short tandem repeat (STR) loci. Today, approximately 150 laboratories are reporting results with STRs in the CAP Forensic Identity program. The forensic community has standardized the reporting of PCR STR technology over the years; in-so-much, the survey has evolved in the reporting of mixed specimens.

Since STR technology is the current standard in forensic laboratories, an evaluation of the separation of these mock mixed specimens and the reporting of the discrete alleles has been conducted. Not surprising, the "sperm" fraction contained less minor contribution of DNA from the "cells" due to the ability of the DNA analysts to successfully separate the spermatozoa from the cell fraction. This presentation will examine the different combinations of discrete alleles and portray the combinations of mixtures reported. For example, with >10 participants reporting, 96.1% to 100% of the participants reported the profile of the sperm fraction only, representing excellent separation. Of those systems with 100% of the participants not reporting a mixture, the victim shared one or more alleles with the suspect and had no alleles different than the suspect. Further, upon close examination of the "cell" fraction, the different combinations of reported results for this sample demonstrated a greater range of variation depending on the combination of shared and non-shared alleles. This combination of alleles will be closely examined. Pattern interpretation of such mixtures from the most recent surveys using STR results will be presented.

Proficiency Testing, Mixture Interpretation, College of American Pathologists

B26 A Safe Methodology to Identify Biologically or Chemically Contaminated Evidence

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After attending this presentation, attendees will understand the efficacy of a protocol designed to safely identify, through PCR DNA testing, the source of blood, semen, and saliva stains, and epithelial cells recovered from biologically or chemically contaminated evidence.

This presentation will demonstrate how irradiation provides a safe method of decontamination while preserving the integrity of the evidence for PCR DNA testing. Specifically, the methodology limits the exposure of the evidence collection team to the contaminant and obliterates the risk to laboratory personnel.

In an event that involves weapons of mass destruction, biologically or chemically contaminated evidence may require PCR DNA analysis for criminal investigations or body identification. Since most forensic science laboratories operate at biosafety level two, protocols must be designed that ensure the safety of forensic examiners, while preserving the integrity of the evidence. Irradiation at doses adjusted to destroy the structure and functionality of a pathogen, likely leave identifying DNA sequences intact. Therefore, evidence samples were irradiated and analyzed by PCR DNA testing, and compared to identical non -irradiated samples. Most samples, with the exception of low copy number DNA samples, generated full DNA profiles, although the amount of DNA produced was reduced.

Two identical sample sets were assembled. Samples such as blood, semen and saliva stains at various concentrations and combinations, cigarette butts, clothing, hair, lip prints on tape, and toothbrush bristles were equally divided. Alternatively, duplicate samples were obtained from the same sources for cookie crumbs, cosmetics, ear and eye swabs, razors, swabs of fingerprints on glass, a metal doorknob, a metal file rack, a stapler, and a tackle box, and swabs of touched objects such as bottles, cell phones, credit cards, cups, jewelry, keys, and wallets. Evidence was packaged within two sealed envelopes or containers and stored within two boxes that were irradiated intact with 32kGy of energy from an LX 2 High Power X-ray, courtesy of Titan Inc. Control non-irradiated samples were similarly stored at room temperature in the laboratory.

Samples from both sets were processed simultaneously. Semen and mixed epithelial cell samples were extracted by differential lysis using Chelex beads. According to a modified DNA IQ™ (Promega) protocol for degraded samples, blood and saliva samples were extracted on the Biomek 2000. Low level DNA samples, for example swabs of fingerprints and touched objects, were digested with 0.01% SDS and Proteinase K at 56º C for two hours, incubated at 100º C for 8 minutes, and following the addition of 1mg of Poly A RNA, were purified and concentrated with a Microcon 100. Samples were quantitated with either the Quantiblot® kit (Applied Biosystems) or with an ALU based PCR method with an endpoint determination using a fluorescent plate reader. 1ng or 19.2 µL of each sample were amplified with Promega's PowerPlex® 16 kit for 32 or 35 cycles, as needed, and separated on an ABI 3100 Prism® Genetic Analyzer.

Irradiation reduced the yield of DNA for the majority of the samples. For example, irradiated blood, semen and saliva stains and swabs of fingerprints and touched objects contained 68.8%, 64.4%, 97.5%, 54.1%, and 33.4% less detectable DNA than non-irradiated samples, respectively. Despite this decrease, blood, semen, and saliva stains were still robust and produced full DNA profiles. However, DNA profiles for the minor components of blood stain mixtures were compromised. Although 93.8% of the alleles could be deduced correctly for the minor components in the control samples, only 21.1% of the alleles were apparent in the irradiated samples. Similarly, 55% of the alleles were called correctly for control swabs of touched objects whereas only 7.2% of the alleles were designated for the same irradiated swabs. Samples that have very low copies of DNA, fingerprint swabs, generated at least 400% less accurate DNA profiles following radiation.

The decrease in DNA yield suggests that irradiation degrades DNA. Samples with low amounts of DNA are significantly compromised by radiation, and thus produced partial or no PCR Nuclear DNA profiles. These low copy number DNA samples would be better candidates for SNP analysis. However, irradiation does not affect allelic calling when the DNA recovered is sufficient. Therefore, our study demonstrates that irradiation may be employed to decontaminant most forensic samples for PCR Nuclear DNA testing. Implementing this described irradiation process to decontaminate evidence would limit the exposure of the evidence collection team and obliterate any risk to laboratory personnel.

Decontamination, Degradation, Low Copy Number DNA

B27 Separation of Spermatozoa and Epithelial Cell Mixtures by Laser Microdissection for Forensic DNA Analysis

Christine T. Sanders, BA and Daniel A. Peterson, PhD, FUHS/The Chicago Medical School, Department of Neuroscience, 3333 Green Bay Road, North Chicago, IL 60064; Nick Sanchez, BS, Los Angeles Police Department, Scientific Investigation Division, 555 Ramirez Street, #270, Los Angeles, CA 90012*

After attending this presentation, attendees will learn a method for the selective separation of sperm and epithelial cell mixtures in sexual assault evidence using Laser Microdissection such that the retrieved cells can be individually typed for Short Tandem Repeat (STR) analysis.

This presentation will offer the forensic community a new method for cell separation in challenging sexual assault casework samples.

The goal of this presentation is to present to the forensic community a method for the selective separation of sperm and epithelial cell mixtures in sexual assault evidence using Laser Microdissection such that the retrieved cells can be individually typed for Short Tandem Repeat (STR) analysis.

PCR and STR analysis has become a valuable tool in identifying the source of biological stains particularly in the investigation of sexual assault crimes. Difficulties in analysis arise primarily in the interpretation of mixed genotypes when cell separation of multiple donors is incomplete or when only a small number of target cells are available in a mixed sample following the application of traditional preferential lysis procedures.

A typical rape evidence swab may comprise of sperm cells from the assailant and vaginal epithelial cells from the victim. The differential extraction has been the most commonly used method to separate sperm cells from epithelial cells in sexual assault evidence. It can preferentially lyse epithelial cells and/or blood leukocytes cells releasing the DNA, which can then be removed from the sperm cell pellet. Although this method can generally provide two cellular fractions, one comprising of sperm cell DNA and the other of epithelial cell DNA, the separation is not always complete, and there may be carryover from one fraction to another making eventual genotype interpretation and further statistical analysis challenging. This challenge is frequently encountered in cases where the ratio of vaginal epithelial cells to sperm cells is large or there are very few numbers of sperm.

Laser Microdissection technology (LMD) has emerged as a method to capture single cells or a group of cells of interest from heterogeneous tissue. This technology is typically employed on histological tissue cryosections to collect specimens for further DNA, RNA or protein analysis. The purpose of this research is to use LMD on biological smears to identify both stained and unstained sperm and epithelial cells while selectively dissecting and recovering the cells of interest for forensic DNA analysis.

Slide smears comprising of sperm and oral epithelial cell mixtures were prepared on glass foiled PEN microscope slides. Smears were processed both stained (Hematoxylin & Eosin or Nuclear Fast Red & Picroindicocarmine) and unstained.

Automated laser microdissection was performed on the Leica AS LMD System. The instrument comprises of a Leica upright microscope with a motorized stage and a single-handed xyz control. Coupled with a camera and computer software, target cells can be visually identified and selected on the computer screen for microdissection. The microscope is integrated with a UV laser of 337µ which performs the laser

ablation of the plastic PEN film around the cell(s) of interest. The cut material is then deposited automatically into one of the designated PCR tubes. An inspection mode allows the confirmation and image documentation of the targeted cells in the PCR tube before further molecular analysis.

The Laser Microdissection method presented physically dissects target cells without the contamination of adjacent foreign cells in a mixture then collects the target cells for direct DNA isolation. This bypasses the multi-step process of a preferential lysis procedure, which can reduce yield through loss by liquid transfers and premature lysis of target cells. Unsuccessful analysis of sexual assault evidence due to low numbers of sperm cells or a large epithelial/sperm cell ratio could instead be subjected to LMD to provide effective cell separation and maximal cell yield.

Laser Microdissection, Forensic DNA Analysis, Sexual Assault Evidence

B28 Development of a Microfabricated Device for Separation of Sperm and Vaginal Epithelial Cells: A Significant Step Toward Circumventing Conventional Differential Extraction

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The goal of this research presentation is to introduce microchip technology to the forensic community and demonstrate its potential for the separation of sperm and vaginal epithelial cells in rape kit analysis.

This presentation will introduce the forensic community to microchip technology and its potential for rapid analysis of rape kit DNA evidence, thereby, reducing the DNA analysis backlog.

Differential extraction, the conventional method for isolating male and female fractions of DNA, is a time-consuming sample preparation step in the forensic DNA analysis of rape kit evidence. Therefore, our goal is to develop a means to reduce the time associated with isolation of the male and female DNA fractions, while maintaining or improving the percent recovery and purity. The means through which we are attempting to achieve this goal is the use of microfabricated glass devices.

The brief record that exists for microminiaturization of analytical processes on microchip platforms has demonstrated that reduction in analysis time (versus conventional methods) is often a benefit, as well as the potential for integration of multiple processing steps in a single device and for automation of these processes. Since differential extraction is only one of a number of processes that constitute forensic DNA analysis, replacing it with a microdevice method provides a distinct advantage with the possible integration of several sample preparation steps, including DNA extraction, DNA quantitation, and PCR amplification on a single device. In addition, microchips can be designed to accommodate parallel processing of both the male and female DNA fractions as well as the necessary positive and negative controls. While an integrated microdevice including all sample preparation steps is advantageous in many respects, the cell separation methodology is amenable to a modular system in which separate devices are developed for each processing step, depending upon the needs of the forensic community.

The conventional differential extraction methodology is not easily translated to the microchip format because of the centrifugation and filtration steps. Therefore, a novel method for obtaining isolated male and female fractions of DNA on a microfabricated device was developed. This new technique involves first separating the sperm cells from the cell mixture, then extracting the DNA from each fraction independently, allowing separate male and female DNA fractions to be obtained.

The cell separation step is the focus of the research presented here. The separation developed exploits the differential physical properties of the two cell types such as buoyant density, size, shape, and proclivity for adhesion to the microchannel surface. In an etched microchannel, a flow rate of approximately 1 nL/sec was obtained using a mechanical pump, directing the sperm cells to a collection reservoir while retaining the epithelial cells in the inlet reservoir. Preliminary experiments employed digital video microscopy to visualize the cell separation and demonstrate the purity and efficiency of the process. Methods have been established to selectively separate free DNA (from the more easily lysed epithelial cells) from the sperm cell fraction. The movement of bacteria during the cell separation has been characterized, although the presence of bacteria is not particularly concerning because of the lack of amplifiable human STRs. In addition, the movement of white and red blood cells must be characterized, because of DNA contamination and PCR inhibition issues, respectively.

Using mock post-rape vaginal swabs, the cell separation product obtained on the microdevice resulted in a clean sperm cell fraction. The DNA from isolated cells was extracted with a commercial extraction kit, amplified with a Profiler® PCR kit, and analyzed on an ABI 310 commercial CE, yielding the profile of the male sperm donor. DNA extraction from the isolated cells was also performed using a microdevice method before amplification and analysis to demonstrate the potential of integrating these two steps into a single device to circumvent conventional differential extraction.

Differential Extraction, Cell Separation, Microchip Technology

B29 Decontamination of Human Autopsy Specimens by ^{60}Co Gamma-Photon Irradiation and Human DNA Identification by Short Tandem Repeat Analysis of Irradiated Tissues

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After attending this presentation, the participant will understand 1) the use of Cobalt 60 (^{60}Co) gamma-photon ionizing radiation for decontaminating human autopsy specimens and 2) the effect of decontaminating doses of gamma radiation on Short Tandem Repeat (STR) DNA analysis of tissue and bone specimens.

This presentation will impact the forensic community by demonstrating irradiation as a way to decontaminate human remains found in an incident involving contaminating weaponized microbial agents prior to submission the laboratory for human identification by STR DNA analysis.

Short Tandem Repeat (STR) DNA typing has been the primary tool for identification of human remains in military and mass disaster incidents. The majority of the military specimens submitted to the Armed Forces DNA Identification Laboratory (AFDIL) include fresh tissues and bones collected by medical examiners during autopsies.

The potential use of military force in nations that may have biological weapons of mass destruction, such as weaponized *Bacillus anthracis* spores, and the potential for large numbers of fatalities from inhalation anthrax in these nations suggested that we study a method for decontaminating human remains. We investigated ^{60}Co gamma-photon irradiation as a method of decontamination.

In this study, 11 different human cadaveric finger specimens were collected from 6 female and 5 male deceased donors. DNA was organically extracted and then quantitated using the Quantiblot® method. STR profiles were obtained from a 3- to 5-mm piece of tissue from each of the donor fingers for a known DNA STR typing control prior to gamma irradiation. The organic DNA extraction and Profiler Plus™ STR profiling methodologies are rapid, reliable and robust technologies that have been validated for casework at AFDIL, accepted in the forensic community, and published in the forensic literature.

A STP-350 biological shipment container (SAF-T-PAK, Edmonton, AB, Canada) was chosen to safely contain biological specimens, endure the rigors of transport from a military theater of operation and the process of irradiation, and meet the biohazardous materials transportation regulations. The large orange suitcase-like shipment container has the internal capacity to fit eight biohazard canisters in a fitted polystyrene holder. The biohazard canisters can hold up to five specimen transport tubes and absorbent paper.

Each of eight specimen transport tubes contained 0.5 g of dry, free-flowing *Bacillus subtilis* var. *niger (B. globigii*) spores, i.e., biological indicators (BI), as a surrogate for *B. anthracis*, at a concentration of 5.5×10^{11} colony-forming units (CFU) per gram. A radiation dosimeter (D-alanine pellets) was placed in three of these tubes with the spores. Each of the 11 donor fingers was placed in a specimen tube containing 99.99% isopropanol. The BI's and the tissue specimens were then distributed in the eight canisters in mapped locations within the case.

Gamma irradiation of the shipment container and dosimetry were performed in the Cobalt-60 Irradiation Facility at the Armed Forces Radiobiology Research Institute. Electron paramagnetic resonance (EPR) dosimetry measurements of irradiated alanine pellets were performed at the National Institute of Standards and Technology (NIST, Gaithersburg, MD) using published procedures to determine the dose delivered. The case and contents were given three fractionated doses of gamma-photon radiation at a constant rate in order to achieve a decontamination assurance level (DAL) for the BI. The DAL is the dose of gamma radiation required to kill all spores in 99% of the BIs. Before and after irradiation, BI spore viability was determined by standard microbiological methods as defined in the 2002 United States Pharmacoepia 25th edition (USP25).

The gamma-photon radiation dose, which was delivered inside of the case, was an average of 51.7 kGy as measured by alanine dosimetry and was sufficient to kill all spores in test BI samples. DNA isolated from 2-gram bone specimens and 3- to 5-mm cubed tissue specimens from each of the irradiated fingers yielded full Profiler Plus™ STR profiles that were consistent with the STR profiles obtained from the original non-irradiated donor source fingers. Mutations, extraneous alleles, and allelic dropouts were not observed in the Profiler Plus™ STR DNA profiles from the irradiated finger tissues and bones.

Conclusions: This study shows that gamma-photon irradiation decontaminates potentially contaminated human specimens and that the process does not adversely affect STR DNA analyses for human identification purposes.

Short Tandem Repeat DNA, Human Identification, Radiation

B30 Real-Time PCR Methods for Analysis of Forensic Samples

Eric Buel, PhD and Janice A. Nicklas, PhD, Vermont Forensic Laboratory, 103 South Main Street, Waterbury, VT 05671*

After attending this presentation, attendees will understand rapid quantitative and inexpensive tests for determination of sample DNA quantitation and gender determination

This presentation will demonstrate that new methods will be a valuable addition to DNA analysis by saving time and money and improving the quality of human DNA quantitation.

DNA isolated from crime scene samples must be quantitated to determine the amount of human DNA present. Recently the forensic community has become interested in developing faster, cheaper and more quantitative methods than the widely used slot blot method utilizing a D17Z1 probe. In most molecular diagnostic laboratories, PCR techniques have almost completely replaced Southern and slot blot methods. Thus, development of quantitative PCR methods to measure the amount of human DNA in the forensic setting is a logical extension of this progression. Obviously the sequence chosen must be human or at least primate specific and if present in multiple copies would allow more sensitive quantitation. Alu sequences are primate-specific and are found in ~800,000 copies in the human genome and make an excellent marker for human DNA.

Our initial assay used endpoint PCR quantitation with SYBR Green I dye in a fluorescence plate reader. We then turned to a real-time PCR assay using SYBR Green I. This assay has the advantage of a wider range, 16ng down to 1pg, a turnaround time of ~87min (with less hands-on time than the plate reader assay) and a cost of $0.50 per sample. Both of these methods were optimized by adjusting primer concentration, annealing and extension time and temperature, SYBR Green concentration and polymerase concentration. The assay was validated by comparison with usual slot blot method on mock and real crime samples and by STR analysis based on assay quantitation results. The studies indicate that the SYBR Green Alu method is at least as cost effective and sensitive as the slot blot method, as well as much simpler to perform and with a greater analytical range.

PCR quantitation methods that use probes (oligonucleotides with fluorescent dyes attached) have the advantage that plateau effects are lessened and a greater dynamic range can be achieved. We have also investigated and compared the use of LUX primers (Invitrogen), MGB-Eclipse (Epoch Biosciences) and TaqMan (ABI) probes for readout. The LUX system has a low fluorescence output and appears not to be sufficiently reproducible. The Eclipse system has been optimized and validated with case work samples and can detect from 256ng down to 1pg of DNA at about the same cost as the SYBR™ Green assay. The TaqMan assay can also detect from 256ng down to 1pg DNA; optimizations and validations are underway.

In addition to simply quantitating the total human DNA in a sample, it is often of importance to determine whether and how much male DNA the sample contains. In crimes involving violence against women perpetrated by men, blood may be shed by the both the victim and attacker; a method that could quickly identify which stains are male or female could allow the examiner the chance to be selective in the stains that are analyzed further by STR analysis. Another important use of sex typing would be in the STR analysis of sexual assault cases where the percentage of male DNA in differential extractions can vary widely. A method that could determine the amount of male DNA present in a sample could allow the forensic scientist to decide if a sample has ample male DNA for autosomal or Y STRs, respectively. We have tested LUX primers, MGB-Eclipse and TaqMan based Y satellite (Y specific) assays. These assays are able to discriminate male and female DNA over 100,000 fold and accurately quantitate male DNA. Experiments are underway to optimize these assays and pick the best assay from among these methods. The plan is then to develop a multiplex system of gender determination in conjunction with human Alu DNA quantitation. Such an assay will greatly reduce the work and expense in analysis of crime scene samples by quickly determining which samples are important and which contain sufficient DNA of the correct gender to yield valuable and conclusive STR results.

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Human DNA, DNA Quantitation, Real-Time PCR

B31 Extraction and Quantification of Human DNA and the Amplification of Human STRs and Amelogenin From Fly Larvae Found on Decomposing Tissue

George J. Schiro, Jr., MS, Acadiana Criminalistics Laboratory, 5004 West Admiral Doyle Drive, New Iberia, LA 70560*

After attending this presentation, attendees will learn that fly larvae found on decomposing human tissue could be an alternative means of identifying human remains.

This presentation will provide support of the forensic science community and the popular media hypothesis that human nuclear DNA can be recovered from fly larvae found on human remains.

The purpose of this experiment was to determine if human deoxyribonucleic acid (DNA) could be extracted, quantified, and amplified from fly larvae that had fed on decomposing human tissue.

Blowfly (Diptera: Calliphoidae) eggs were collected and placed on donated human skin, muscle, or liver tissue in rearing chambers. After two to twelve days, the larvae were collected in 70% ethanol, 2-propanol, acetone, or by freezing. One to sixteen larvae were washed and dissected by mincing, splitting, or bisecting the larvae. The DNA was extracted using digest buffer and either phenol: chloroform: isoamyl alcohol (PCIA)or by using silica spin columns. The human DNA was quantified using a biotinylated primate specific probe. The DNA extract was then amplified using the polymerase chain reaction (PCR) for 28 cycles and primers for 13 specific Short Tandem Repeats (STRs) and the sex identification marker amelogenin. An additional seven PCR cycles were used on extracts that failed to produce any amplified human DNA. Washes from the exterior of the larvae that produced amplifiable human DNA were also analyzed. Finally, the PCR product was separated and characterized using capillary electrophoresis.

Out of the 30 DNA extracts, one sample had approximately 4.5-9.0ng of human DNA. The remaining 29 extracts were either void of human DNA or the amount of human DNA fell below the test detection limits. Three of the thirty extracts produced amplified products for the sex identification marker and seven to eight STRs. The STR profiles produced by these three extracts matched the STR profiles of the corresponding positive controls. Some of the extracts subjected to the seven additional PCR cycles provided limited and often inaccurate identifying information. The experiment also provided evidence, but not conclusive proof, that the human DNA originated from inside the larvae.

The following conclusions were drawn from the experiment: Human tetranucleotide STR analysis is highly sensitive and selective. Macromolecules survive larval ingestion. Three to four larvae are required for this type of analysis. Muscle and liver tissue are the best feed tissues from which to collect the larvae. Digest buffer and PCIA are more suitable than silica spin columns for recovering human DNA from fly larvae. 2-propanol is a better collection medium than 70% ethanol, acetone, or by freezing for this type of analysis. Mincing or splitting the larvae provided better results than bisecting the larvae and using the anterior portion of the larvae. The drawbacks of additional PCR cycles outweighed any additional benefits.

Larvae, DNA, STRs

B32 The Comparison of Drug Chemistry Training Programs of the Illinois State Police, University of Illinois at Chicago Residency and the National Forensic Science and Technology Center

Richard A. Paulas, BS, Illinois State Police, 1941 West Roosevelt Road, Chicago, IL 60608*

This paper describes the programs and goals of each program and provides some measurable data for comparison of their effectiveness.

This presentation will provide a description of various chemistry training programs and their financial impact upon the host.

The Illinois State Police Forensic Sciences Command has conducted training for its forensic scientists for more than 25 years and has earned an excellent reputation. Their program is recognized nationally as providing both the theoretical and practical knowledge necessary to conduct quality forensic analysis before they are required to work actual cases. The Chemistry Training program recently had the opportunity to compare the results of training from two other training programs with its own. In January of 2002, six individuals were hired by the Illinois State Police, Forensic Sciences Command to be trained in Drug Chemistry analysis. Two individuals were asked and agreed to be trained by the National Forensic Science and Technology Center (NFSTC) in Largo. Florida. Three individuals proceeded in the normal drug chemistry training program at the Forensic Science Center in Chicago. The final individual was completing his residency requirement as part of his Masters of Forensic Science from the University of Illinois at Chicago. This paper describes the programs and goals of each program and provides some measurable data for comparison of their effectiveness.

Chemistry, Training, Residency

B33 Institutional Support for Forensic Science Educational Programs: A Survey

Jay A. Siegel, PhD, Michigan State University, School of Criminal Justice, 506 Baker Hall, East Lansing, MI 48824*

After attending this presentation, attendees will learn how forensic science educational programs are supported by their institutions and learn ways to help improve the funding situation

This presentation will offer to the forensic science community, for the first time, information about how our forensic science education programs are faring financially and where the gaps are and what can be done to help in the future.

There has been a lot of discussion at AAFS meetings and at other forums about how poorly forensic science education programs are funded relative to other science based programs at US colleges and universities. There is not enough money for faculty, instrumentation, graduate assistants, grants, research, etc. But what is the real situation? How are forensic science educational programs funded and how well? A survey was conducted among 46 colleges and universities that self identified as having a bachelors degree or masters degree program. The survey looked at staffing levels, graduate student support, equipment, travel and grant and research support. The results are presented along with implications and suggestions for the future.

Education, Research, Funding

B34 Premarital Sex, Schizophrenia, and Other Rape Victim Hazards

Karolyn L. Tontarski, MS, Montgomery County Crime Laboratory, 2350 Research Boulevard, Rockville, MD 20853*

After attending this presentation, attendees will recognize scenarios that may be preventing the submission of physical evidence in rape and assault cases

This presentation will impact the forensic community by demonstrating how to recognize investigative practices that may be limiting effective sexual assault investigations, the value of utilizing forensic biology evidence to identify cases needing further investigation, and educating forensic biologists on the important role they can play in these potentially compromised investigations

Given the nature of the crime, rape is often seen as difficult to investigate and prosecute. Typically, rape victims fall into one of two categories – stranger assault victims or acquaintance assault victims. Society seems to sympathize with victims of stranger rape more. Indeed, once the perpetrator has been identified there is typically little, if any, reluctance to prosecute these cases. Acquaintance assault cases can be a bit more problematic – as can stranger assault cases with "compromised" victims. Victims who have affected their personal safety often put off investigators, prosecutors, and jurors, as do victims who are perceived to be problematic. It is not uncommon to hear that a case won't be prosecuted because the victim is a prostitute, mentally ill, used drugs, etc. Nor is it uncommon to hear that a defendant was found not guilty because a victim "left the bar willingly with him" or "should not have been drinking so much."

It is specifically because of these sorts of issues that all forensic biologists need to understand, at the very least, the dynamics of rape. Without foundational knowledge regarding the nature of sex crimes, the somewhat negative environment that is associated with rape can adversely affect forensic biologists. If the forensic scientist is to remain impartial, he or she must be able to understand the context within which these comments are made. While it should be possible for forensic biologists to be insulated from some of these issues, the reality is that sexual assault investigators and attorneys often look to forensic biologists for guidance with regard to what evidence should or should not be examined. Examiners with a lack of understanding as to what rape is can potentially be confused as to what evidence needs to be processed. In the worst case scenario, they may advise that evidence they perceive to be non-probative should not be processed.

Given the premise that some women are more easily victimized (such as prostitutes, mentally ill persons, etc.), it stands to reason that certain types of rapists will hone in on them. Typically, these women are less likely to report the crime, or if they report it, they are less likely to be believed. When these victims are discounted by the system, we are making it easier for these sorts of crime to continue. It is not only possible, but is highly probable, that these women are included amongst many serial rapists' victims. This issue has become relevant to the unsolved case DNA backlog reduction project.

With the advent of DNA testing, there has been a push to test backlogged rape evidence. In cases where this evidence has been examined and data bank hits have been obtained, there can be a failure of cases with "compromised" victims to move forward in the criminal justice system. In some cases, decisions are being made to not even conduct testing on cases with "compromised" victims. This presentation will address the need for educated forensic biologists to actively participate in defining what cases should be processed. In addition, some discussion will center on working with investigators and attorneys to encourage them to fully consider these difficult cases, and the value of prosecuting these crimes.

Rape, Sexual Assault Investigation, Victims

B35 Unique Solutions to Addressing the Backlog of Criminal Casework

Michael L. Cariola, MFS, Todd Bille, MS, James Schumm, PhD, and Mitchell Holland, PhD, The Bode Technology Group, 7364 Steel Mill Drive, Springfield, VA 22150*

By attending this presentation, attendees will learn of solutions developed to effectively address the backlog of cases requiring DNA analysis.

This presentation will impact the forensic community and/or humanity by demonstrating the combination of a growing backlog of cases requiring DNA analysis and the severe budget constraints that states are facing requires novel approaches to the analysis of casework. The authors want to share with the community the processes developed to help address this problem.

Crime labs across the country face a growing backlog of cases requiring DNA analysis. This includes not only an increased demand for DNA-testing on current cases but also the testing of older cases which were either never submitted due to the lack of a suspect or were tested prior to the adoption of the 13 CODIS STR loci. This has left many crime labs with hundreds of 'no-suspect' cases requiring analysis but no increase in the number of analysts available to do the work. New York City alone had a backlog of greater than 15,000 no-suspect sexual assault kits. From October 2000 to July 2003, we analyzed over 6000 of these kits for the New York City Police Department. During this time, we initiated work with many other crime labs with different requirements requiring customized solutions to their problems. In order to process these cases in the most efficient manner and meet the demands of various users, we have developed processes addressing the primary bottlenecks encountered during the analysis of these cases. The primary areas covered here include 1) the screening of the kit to identify male component DNA, 2) quantitation of DNA extracts and 3) final generation of a CMF file and a court-ready allele table.

One of the primary bottlenecks to the analysis of sexual assault cases is the initial screening of a case for the presence of seminal fluid. Typically, this entails a combination of Acid Phosphatase (AP) screening, microscopic searches for spermatozoa and/or P30 testing. In a typical sexual assault evidence collection kit containing multiple vaginal, anal, oral and various body swabs, it can take over an hour to screen a single kit. Rather than use a traditional serology approach to screening, we have developed a DNA-based procedure in which we differentially extract one sample of each type without any pre-screening. Following DNA extraction of case samples, we employ a Y-Marker Screen (YMS) to screen samples for the presence of male DNA. The YMS test gives a greater level of profile sensitivity than the STR multiplexes used for DNA analysis, so false negative results are eliminated. The YMS test consists of the Amelogenin primers as a control to ensure that either X-chromosome or both X and Y-chromosome DNA are identified (if only X-chromosome DNA is observed, then only female DNA is present). Primers for two monomorphic Y-Sequence Tagged Sites (STS) are co-amplified with the Amelogenin primers. The STS's are only diagnostic for the presence of Y-DNA, and do not require STR-like analysis. As a result, quantification is not required prior to YMS-amplification. Additionally, the amplitude of the STS product is diagnostic for the approximate quantity of male DNA in the sample extract, providing value to the scientist when attempting to troubleshoot complex STR analysis results. Given these characteristics, the YMS test provides a simple and efficient way to determine if male DNA is present and if an STR profile can be generated from a sample. Samples that test negative for the presence of male DNA at this point can be reported as negative and not processed further. This system has been used on over 3500 cases and our data suggests that it has resulted in a higher percentage of foreign profiles for eventual CODIS upload than traditional screening approaches.

Once positives have been determined, all samples must be quantified using a primate-specific assay. Rather than using a traditional approach such as a hybridization assay, we have developed a PCR-based assay which amplifies a defined region of the human TH01 locus with subsequent detection using PicoGreen on a fluourometer. This gives a precise representation of human DNA present in the sample in an output format (Microsoft Excel) that allows for rapid calculation of dilutions before amplification. Equally important, because the system uses simple commercially-available primers and a low-cost detection system, the cost for quantitation is much lower than other commercially available methods. To date, the method has been used successfully on more than 30,000 samples.

The ultimate goal of no-suspect cases differs from traditional casework. Rather than the generation of a profile for comparison to known individuals, profiles are generated primarily for upload to CODIS. While Genotyper is well-equipped for reference samples to export data in a CMF-ready format, evidentiary samples often contain mixtures that must be interpreted or partial profiles that must be analyzed locus by locus and across numerous amplifications. Following analysis of STR data by two independent reads and final review, the data is traditionally summarized by the hand-entering of an allele table in a report or the hand-entry of a profile for upload to CODIS. This allows for potential transcriptional errors and, in the process, creates a tremendous review burden for the crime lab. To address this problem, we have written a program for generating CMF files and allele tables which converts Genotyper table data into both a court-ready allele table (in Microsoft Word format) and a CMF file (in Microsoft Excel format) for upload to CODIS. It is customized to the individual laboratory to meet their review and upload requirements.

The backlog of no-suspect cases across the country is currently estimated at over 300,000 and growing. As states face increasing budget constraints, the time required to train more analysts will delay our ability to solve these crimes. By addressing existing bottlenecks in the processing of cases with effective high-throughput solutions, we have successfully increased the overall efficiency of the laboratory while also increasing the quality of the work. The processes outlined above will be discussed.

DNA Backlog, No-Suspect Casework, CODIS

B36 2002 Forensic Crime Laboratory Survey Results

Joseph L. Peterson, DCrim, Criminal Justice Department, University of Illinois at Chicago, 1007 West Harrison Street, Chicago, IL 60607; Susan H. Johns, MA, Illinois State Police, Division of Forensic Services, 630 East Washington Street, Springfield, IL 62701-1304; Matthew Hickman, Bureau of Justice Statistics, 810 Seventh Street, NW, Washington, DC 20531; Tiffany Vasquez, University of Illinois at Chicago - Forensic Science Program, 210 West Eugenie Street #1N, Chicago, IL 60614*

After attending this presentation, attendees will have received an updated overview of management, caseload, and resource needs of the nation's crime laboratories.

This presentation will provide laboratories and policy makers with current management and resource needs information about the nation's publicly funded crime laboratories.

The Center for Research in Law and Justice and the Survey Research Laboratory at the University of Illinois at Chicago (UIC), in concert with the American Society of Crime Laboratory Directors (ASCLD), were funded by the Bureau of Justice Statistics (BJS) to undertake a census of all publicly funded crime laboratories throughout the United States. In addition to gathering baseline statistical information on operations and workload, BJS also wanted us to assess where added resources were needed. In addition, unlike earlier surveys, the goal was to reach 100% of the nation's publicly funded crime laboratories. UIC and ASCLD received funding to undertake this research, given their experience in conducting surveys and studies of crime laboratories over the past twenty-five years.

Staff worked extensively with ASCLD and the community of crime laboratories to develop a comprehensive listing of laboratories. A draft version of the survey was designed and pre-tested in selected jurisdictions. All names and addresses were verified via telephone contacts. The survey itself had six primary areas: Organization, Budget, Staff, Workload, Outsourcing, and Quality, Training, & Research. The first section was designed to determine the political entity and population of jurisdictions served, and types of forensic functions performed in each laboratory. Next, we examined the budget breakdown of each laboratory, and sources of funding. To gain a greater sense of the crime laboratory workloads, we queried labs about the number of cases received and backlogged, and the volume of requests received, worked, and backlogged in 2002. We also asked about the performance expectations that laboratories had of various examiner specialists, and what added resources would be needed to reduce backlogs. Questions were asked about the number of requests outsourced (e.g., controlled substances, toxicology, DNA/CODIS), as well as the cost and funding sources for such testing. Lastly, we asked if laboratories were accredited, the types of proficiency tests in which they were engaged, and the dedication of resources to training and research.

UIC will provide BJS with a documented, formatted, and archivable data set, and BJS will publish and disseminate a Bulletin describing results. Project staff, as well as BJS and ASCLD representatives, will be available to answer questions.

Crime Laboratories, Survey, Management and Resources

B37 Where Are the Scientists?

John J. Lentini, BA, Applied Technical Services, Inc., 1190 Atlanta Industrial Drive, Marietta, GA 30066*

After attending this presentation, attendees will understand the need for scientists on the crime or fire scene. This will be one of five presentations in a two-hour discussion on this topic.

This presentation will stimulate some thought about how to solve the problem of fire investigations being conducted by individuals with little or no scientific training, and to stimulate some interest on the part of forensic scientists in becoming involved in fire investigations.

Fire investigation is a forensic science that is a world unto itself. The investigator who ventures here risks exposure not only to a unique and possibly dangerous physical environment, but to scientific, professional and personal challenges not found in any other field of forensic science. Scientists from traditional forensic science laboratories may feel overwhelmed and unprepared for the analytical challenges, many of which make mastery of a laboratory analysis seem like child's play. At first blush, it seems like nothing we learned in our study of chemistry or physics will explain the chaos that presents itself after nearly every fire, but with patience, and practice, and a careful application of the scientific method, the truth can usually be teased out of the ashes.

Unlike a homicide or a robbery or almost any other incident that requires investigation, a fire is unique in that the first major task, and often the most daunting one, is to determine whether a crime has taken place. It is necessary to look pretty carefully to find another field of investigation in which this is true. Unexplained death comes to mind, but in that case, there is a clearly defined set of protocols, the forensic autopsy, that will usually resolve the question unequivocally. The medical analogy is a useful one because the fire investigator is called upon to perform a forensic autopsy of a structure or vehicle to determine the cause of the fire. The deviations from the analogy, however, are what make it interesting.

The medical examiner performing the autopsy has an undergraduate degree, usually in a natural science, a four-year medical education, and several more years of internship and residency in pathology and/or forensic medicine. The fire investigator, on the other hand, may have no education beyond high school, and a forty-hour "basic arson" school, followed by an eighty-hour "advanced arson" school, and continuing education taught by people with the same training, and more experience. Certainly there are many skilled fire investigators who can and do perform careful, science-based investigations, even without the benefit of formal scientific training, but that is certainly not the rule.

The methodology of the medical examiner is also likely to be very predictable, in that he or she will follow a written, peer-reviewed protocol, and will feel no discomfort at publishing and sharing the results of the autopsy with colleagues. The methodology of the fire investigator, on the other hand, depends almost entirely on who the investigator is and by whom he or she is employed. There is a constant, and frequently fierce debate on what standards, if any, fire investigators should be held to, on whether fire investigation is an art or a science or a mixture of both, and on the level of training and certification required to do this difficult job.

How did this situation come about? How is it possible that an individual with no formal scientific training in chemistry and physics, and no certification, filled with misconceptions about the phenomenon he professes to have expertise in, is allowed to opine before a jury on issues of life and death? More importantly, what can be done about it?

This situation arose, quite simply, by default. Comfortable in clean, air-conditioned laboratories, only occasionally venturing out into a crime scene, forensic scientists, with few exceptions, have left the field of fire scene investigation to the non-scientists. They have been content to participate in the modest task of determining whether a sample of debris contains ignitable liquid residue. While proper chemical analysis is important, and improper analyses have "verified" otherwise unsupportable hypotheses, the bulk of the hypothesis formation and testing (when the investigator chooses to follow the scientific method) takes place in the field, in the dark, dirty, smelly burned out hulks of former residences, offices and factories. One of the purposes of this session is to encourage interested scientists to overcome their aversion to disorder and bring their scientific talents and knowledge to a field sorely in need of it.

But stepping into the field without proper training in the investigation of fire may have worse results than going forth without the benefit of a scientific education. The current occupants of the fire investigation community do not yield their territory gladly, and a scientist not affiliated with a federal agency may find actual hostility from local law enforcement investigators. If scientists are to take over the lead in the determination of fire causation, they need to be at least as thoroughly trained as those whom they would replace. They need to go to "arson school," to light fires and watch them burn, and to conduct experiments. The forensic science community needs to find the will to do this job that has so far been left to non-scientists. It needs to find the money to provide the necessary training. It needs to find the scientists willing to get their hands dirty, and it needs to introduce those scientists to the field in such a way that they are welcomed as legitimate and necessary participants in the investigation.

Fire Investigation, Scientific Method, Training

B38 Forensic Scientists at the Crime Scenes—Past, Present, and Future

Richard E. Tontarski, BA, MFS, Bureau of Alcohol, Tobacco, Firearms and Explosives, Fire Research Laboratory, 6000 Ammendale Road, Ammendale, MD 20705*

After attending this presentation, attendees will understand that what may be eroding the role forensic scientists could be playing in the criminal justice system.

This presentation will demonstrate how to begin thinking about the implications to crime scene processing and forensic scientists' criminal justice role

The Bureau of Alcohol, Tobacco, Firearms and Explosives has utilized scientists at major fire and explosion scenes since the late-1970s. They are an integral part of ATF's National Response Teams (NRT) and have played important roles in major investigations ranging from the recent DC sniper investigation to overseas terrorist bombings.

At these major scenes the scientist, often a chemist, plays many roles. He/she assists in the scene processing, provides technical information about materials at the scene and most importantly is an advisor to the team supervisor and a consultant to the team members. Examples of these roles will be discussed.

ATF's NRTs are continually evolving to incorporate new technologies that include crime scene mapping, and other technical and scientific specialties. One of the newest additions to the NRTs has been engineers with a variety of specialties…fire protection, mechanical, and electrical. The Fire Research Laboratory's mission is to support fire investigations in the field, as well as the laboratory. The FRL scientists approaches will be discussed and illustrated.

What about the other 99% of the cases? What is the role of the laboratory scientist versus that of the crime scene technician? One does not replace the other. What is the appropriate quality assurance standard required for scientists working in the field? To which field role do the standards apply?

Are we inadvertently restricting the role that forensic scientists play? Misinterpretation or misunderstanding of accreditation and certification standards may be restricting the effective use of forensic scientists. Laboratory management may be unintentionally eroding scientists' roles, both in the laboratory and in the field, and reducing highly skilled examiners to technicians. Once there is a perceived limitation about what role the laboratory examiner should be playing an insidious erosion in what the scientist is able or qualified to perform begins.

How do we maximize the role of the forensic scientist to provide bulletproof evidence in court, as well as provide forensic intelligence to support investigations in a way that only a scientist can?

Crime Scene, Forensic Scientist, Laboratory

B39 Private Consultants for the Prosecution—Are They Really Necessary?

Peter R. De Forest, DCrim, Professor of Criminalistics, John Jay College of Criminal Justice, 445 West 59th Street, New York, NY 10019*

After attending this presentation, attendees will have increased awareness concerning the essential role that comprehensive physical evidence interpretations play in a complete forensic science service.

The author has served as a private consultant for the prosecution (and defense) for more than three decades. On a significant number of occasions this was critical for, or contributed to, the case solution. The question arises, why was this involvement of a private expert necessary? The primary answer is that very often the forensic science laboratory or laboratory system available to the prosecutor in the area did not develop and maintain a full-service forensic science delivery system. The laboratory system operated in a reactive mode. Such a system carries out tests and reports results. The attention is focussed narrowly on "items and tests" rather than on the scientific interpretation of a larger physical evidence picture. Over this period of time spanned by my observations the situation has worsened. It needs to be addressed. The interpretation of scientific data and findings is a scientific problem. It is critically important that this interpretation be done by scientists. It should not be left to prosecutors, defense attorneys, or judges to make scientific interpretations. Once appropriate scientists have rendered the scientific interpretation, investigators, members of the legal profession, and the finders of fact can then use it. Laboratory systems that do not address this need

are not supplying a full forensic science service. A void or empty niche is left. This default by the forensic science service can lead to an even more disturbing and insidious problem than that just described. It may lead scientifically naive prosecutors to seek outside expertise from individuals who have established reputations as "good witnesses" but who lack appropriate scientific credentials. This phenomenon is experiencing alarmingly rapid growth. The desirability of scientists integrating the information and rendering overall conclusions is great. However, there are possible pitfalls. It is important to recognize that certain overarching conclusions may not call for scientific expertise. There is a danger of scientists wrongly giving common sense conclusions the imprimatur of science. This must be recognized and avoided. A balance must be struck between ignoring the need for scientific interpretations and the excesses of over interpretation. Appropriate interpretation is at least as important as the laboratory work.

The situations justifying the use of an outside expert should be relatively rare. However, such needs do arise. Some areas of trace evidence can be very arcane and beyond the experience of many trace evidence experts. Ideally, when an outside expert is brought into a case, it should be at the suggestion of the forensic science laboratory system or at least in consultation with it. If this is not the case, it is cause for concern. This suggests that there is a problem with the relationship between the laboratory and the prosecutor's office, that there is something wrong with the proposed "expert," or that there is a problem with the laboratory itself. The problem could be some combination of the three. When such a situation arises, it constitutes a warning sign that should be heeded. The perils are ineffective case solutions on the one hand, or worse, pseudoscientific testimony and the possibility of a miscarriage of justice on the other.

Public Laboratories, Private Consultants, Physical Evidence Interpretation

B40 Forensic Scientists at the Crime Scene: Lab Directors' Perspective

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After attending this presentation, attendees will understand that science does not start at the laboratory door. From a laboratory director's point of view there is a need for scientific assessment of physical evidence from the scene until trial.

This presentation will impact the forensic community by helping to bring into open discussion the need for the scientist at the crime scene.

For too long the crime scene has been viewed as an entity unto itself that can be properly handled as a separate issue from laboratory analyses. This is a regrettable abridgement of the scientific continuum (crime scene to trial testimony) that has existed for a number of reasons that are primarily bureaucratic or political.

Almost all physical evidence generated in casework is dependent on the competency of the process used for this purpose. Since this is, in essence, the foundation for which all the other case examinations are built, how can it occupy a less important position in the hierarchical ladder of evidence? The reliability of all analyses that are conducted subsequent to the crime scene can be no more reliable than the work done at the scene. How important are the things that are not detected at the crime scene? What impact could these items have on the outcome of a case? The evaluation or interpretation of all data generated by all the lab analyses cannot be of any more value than that gleaned from the crime scene, i.e., the crime scene is the limiting factor in all cases. Simply stated, the best of laboratory work cannot compensate for a crime scene inadequately handled.

Historically, police department administrators have decided who shall be responsible for processing crime scenes or for conducting crime scene reconstructions. Traditionally, this responsibility has been placed with police officers, acting as evidence technicians, because they are plentiful in number, are readily supervised in quasi-military fashion, and have other built-in advantages for scene security and so forth. Much of this philosophy or approach of utilizing technicians in place of scientists stems from many naive administrators and even forensic scientists incorrectly believing that technology and science are synonymous. It is a common misconception that if technological prowess is achieved or modern gadgetry used that this equates to competent science. It clearly does not.

The use of a scientific approach in investigating major cases crime scenes is critical. It has been stated in a noteworthy forensic journal that the scientific method must be used for crime scene reconstruction. However, it has also been stated incorrectly, in the same journal article, that crime scene reconstruction is not science itself, since it is the application of science to matters of law. Forensic science itself is commonly defined in essentially the same way. Would anyone in the AAFS be willing to admit that forensic science is not science because it is the application of science to matters of law? Can non-scientists be allowed to define forensic science? Can a non-scientist be expected to skillfully employ the scientific method at crime scenes? How do you become skilled in the use of the scientific method and its application to crime scenes? Don't some cases require follow-up experimentation? How are experiments designed properly in the crime scene context by untrained personnel that boast of workshops as the core of their so-called scientific training? What about the philosophy of science? The questioning of one's own findings? Can this be taught effectively in a workshop setting by non-scientists? How can a non-scientist adequately determine what scientific examinations need be done in a forensic science lab in a complex major case.

The above questions will be explored in detail. Several cases will be presented that illustrate and underscore the above concepts. An ideal model for the investigation of crime scenes will be proposed and key recommendations made.

Forensic Scientist, Scientific Assessment, Crime Scene

B41 So Where Do We Go From Here? Defining Roles for the Forensic Scientist in Criminal Investigations

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This presentation will illustrate the changing role of the forensic scientist in criminal investigations and discuss how the forensic scientist can influence this change.

This presentation will draw attention to the changing role of the forensic scientist in criminal investigations and illustrate how we can influence our future.

Never before has forensic science enjoyed the exposure that it currently receives. Dramatic depictions and televised trials have increased the public's awareness of the value of physical evidence. Increasingly, juries influenced by these forces are expecting more from criminal investigations, often to what seems like unrealistic extremes.

Yet if we look critically, are these extremes so unrealistic? Who would have imagined the level of discrimination that we now regularly obtain with biological evidence? The significance of this advance cannot be understated. Nor can the jarring effect that this advance has had on the rest of the field.

Forensic science has changed in response to this new individualizing potential. Data basing systems have converted DNA results, formerly only useful once a suspect had been identified, to a valuable investigative tool. Unfortunately the change was not always a positive one. Juggling already limited budgets, laboratory administrators have been forced to reevaluate their priorities. Some even choosing to forgo

conventional trace analysis altogether.

The nature of the scientist performing the analysis has also changed. As tools of our trade become more complex, it is becoming increasingly difficult to resist the slippery slope toward specialization. Some would argue that this natural phenomenon represents the evolution of the field. If left unchecked, this change would be better classified as erosion. This is not to say that the specialist does not play an essential part in contemporary analysis, only that the specialist must be used in conjunction with a generalist to maintain the necessary perspective. This combined scientific approach will allow us to lay the root-system which will ultimately change how forensic science is practiced.

Nowhere is the generalist viewpoint more important than at the inception of the investigation. Here at the scene of the crime, critical information can be recognized, documented, and collected. Failure at this stage will prevent any subsequent laboratory analysis, no matter how sophisticated. Even the staunchest opponents will concede this point. Yet still, forensic scientists have gladly abdicated their role at the crime scene.

Our investigatory process is fundamentally flawed when non-scientists are charged with posing the scientific questions that will dictate all subsequent analysis. This error is further compounded when laboratories are relegated to solely a reactive role. Much like the proverbial "black box," investigators and prosecuting attorneys will indicate the testing they require as a case progresses and the laboratory will just be a mythical place where the answer is generated.

While this is our present, it does not have to be our future. More so now then ever, we have the ability to change how science will be practiced in criminal investigations. What better way can forensic scientists serve as a counterbalancing weight between truth and justice than through charting a team approach, and by ensuring that investigator and scientist work side-by-side with scientific assessment of the evidence at every stage of the process?

This paper will focus on current realities of the situation and outline a systematic approach for implementing these much-needed changes to our role as forensic scientist in criminal investigations.

Scientific Assessment, Crime Scene, Future Role

B42 Development of a Portable X-Ray Fluorescence Instrument for Forensic Applications

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After attending this presentation, participants will understand the critical design features and operational parameters of a new, portable x-ray instrument for assisting in the recognition of trace evidence for crime scene and laboratory applications.

This presentation will impact the forensic community by: 1) describing the development of a portable x-ray fluorescence instrument; 2) demonstrating the operational performance of the instrument for trace residua of forensic importance, including primer residue, blood, and semen; and 3) discussing the future use of this instrument at crime scenes or in the laboratory to develop investigative leads by assisting in the recognition and recovery of such trace evidence.

A ruggedized x-ray fluorescence instrument has been designed to investigate trace element content at crime scenes. The initial focus is to identify possible materials of interest such as gunshot residue (GSR) and bodily fluids. The instrument has been designed to be part of a system to aid crime scene investigation and transmit the data to locations requiring it. This portable instrument was designed to meet the obvious constraints of weight, battery operation, and ruggedness. A number of special design features, however, were needed to allow for the detection of microgram quantities of the trace elements of interest. The instrument makes use of a custom-designed x-ray generator and a new type of Shottky-barrier cadmium telluride x-ray detector.

This instrument is part of a teleforensics program jointly funded by NIJ and NASA. This collaboration seeks to develop cost-effective instrumentation based on technology developed for the space program to benefit crime scene investigation, and to develop advanced instrumentation for planetary missions for NASA. A critical factor at crime scenes is the collection of evidence for analysis at forensic laboratories. The friable nature of evidence requires rapid recognition, to avoid losing the probative information contained therein. Some evidence is invisible to normal investigation techniques, either because it involves trace quantities not visible to any investigation technique, or because it is covered or hidden from view. Many types of potential evidence can be indicated by crime scene detection through in situ trace element analysis.

We show data that supports possible use of an x-ray fluorescence instrument through detection of gunshot residue, blood (through the detection of the iron in hemoglobin) and semen (through the detection of zinc protoporphorin). To detect the low levels of trace element concentrations, advanced technology has been incorporated including the unique x-ray generator and a recently developed Shottky cadmium telluride x-ray detector. The design of the internal structure of the instrument minimizes the background due to coherent scattering. It was also necessary to select the x-ray tube anode material to ensure that the tube's x-ray line production does not interfere with the detection of elements of forensic interest.

Results of experiments to date realistically characterize the expected performance of the instrument for detecting trace element concentrations that are useful for investigating crime scenes and in laboratory applications.

X-Ray, Trace Evidence, Criminalistics

B43 Visualization of Bloody Fingerprints at Violent Crime Scenes

Ellen J. Bishop, BS, Toby L. Wolson, MS, and Gilberto Tamez, Miami-Dade Police Department Crime Laboratory Bureau, Forensic Biology Section, 9105 NW 25th Street, Miami, FL 33172*

After attending this presentation, attendees will have a better understanding of the causes of bloody fingerprints that are frequently observed at violent crime scenes and the significance of the visualized bloody fingerprint.

This presentation will provide the analyst with a better understanding of how bloody fingerprints may be visualized at violent crime scenes. It will assist in the interpretation and presentation of bloody fingerprints when doing bloodstain pattern analysis evaluations and expert witness testimony.

Fingerprints were deposited on a variety of substrates that may be encountered in the home or workplace. The substrates that were used for the research were pieces of glazed ceramic tile, glass, melamine bookshelf, wood (pine and poplar), acrylic plastic, residential vinyl floor tile, commercial vinyl floor tile, and galvanized sheet metal. The substrates were cleaned prior to use and several of the pieces of wood and galvanized sheet metal were painted using either oil-based glossy, oil-based matte, latex glossy, or latex matte paint. Each of the painted substrates was also tested in an unpainted condition. After preparation of the

substrates, fingerprints were deposited on them using either light or heavy pressure. The fingerprints were made by coating a finger with motor oil, WD-40® spray lubricant, floor wax, skin oils, hair oils, or silicone lubricant. Fresh human blood mixed with citrate phosphate dextrose anticoagulent obtained from the South Florida Blood Bank was then dripped, spattered, or flowed over the fingerprints. The interaction of the blood with the fingerprint was recorded; fingerprints that became visible upon interaction with the blood were photographically documented. The photographs of the bloody fingerprints were examined by a Latent Print Examiner to determine if the fingerprint was a positive or negative image and if it was of comparison value.

A second study examined the visualization of bloody fingerprints as the result of touching a blood drip. Blood was deposited on the substrates in volumes of 50µl. A finger was then pressed into a pool of blood at 0, 15, 30, 45, and 60 minutes. The results were photographed and examined by a Latent Print Examiner.

The third study examined bloody fingerprints that resulted when the substrate was touched by a finger that had been coated with blood. The results of the experiment were photographed and examined by a Latent Print Examiner.

The substrate characteristics, as well as the method used to deposit the blood on the substrate, affected the formation of visible bloody fingerprints. The less porous, smooth, polished, and/or glossy substrates resulted in the visualization of a higher number of bloody fingerprints. Flowing or dripping the blood onto the substrates resulted in bloody fingerprint images more often than the test substrates that were spattered with blood. The fingerprints made from oils interacted more often with the blood to leave a visible fingerprint than the fingerprints made from silicone lubricant or wax. These visible bloody fingerprints were negative or reversed images. The fingerprints became visible because the blood flowed into the areas that were not oily. These non-oily areas correspond to the furrows of the fingerprint and the oily areas represent the ridge pattern of the fingerprint. All of the bloody fingerprints that were visualized by interaction with the human blood during the first and second studies were negative images and none were of comparative value. The bloody fingerprints from the third study were all positive images and were of comparative value.

Bloody fingerprints are frequently identified at violent crime scenes. It is frequently argued that the fingerprint was there prior to the bloodshed event and that the blood interacted with the fingerprint to make it visible. Another argument is that the defendant entered the crime scene after the bloodshed event and accidentally touched a pool of semi-dried blood, leaving a bloody fingerprint in its place. This research demonstrates that it is difficult to obtain bloody fingerprints as a result of a pre-existing fingerprint interacting with blood being deposited on it or because a finger was pressed into a pool of semi-dry blood. When bloody fingerprints are visualized due to these interactions, the resulting fingerprint is a negative image of no comparative value. The only mechanism that will consistently produce a positive image of comparative value is when a finger coated with blood contacts a clean substrate and transfers the blood onto that substrate.

The research provides the analyst with a better understanding of how bloody fingerprints may be visualized at violent crime scenes. It will assist in the interpretation and presentation of bloody fingerprints when doing bloodstain pattern analysis evaluations and expert witness testimony.

Bloodstain Pattern Analysis, Bloody Fingerprints, Latent Print Examination

B44 Burnin' Down the House: Predictive Cadaver Models in Structural Fires

Elayne J. Pope, MA, University of Arkansas, 330 Old Main, Fayetteville, AR 72701; Robert Fenton, Hickory Creek Volunteer Fire Department, Lowell, AR 72745; O' Brian C. Smith, MD, Regional Forensic Center, 1060 Madison Avenue, Memphis, TN 38104; Jody Fenton, BA, University of Arkansas, 330 Old Main, Fayetteville, AR 72701*

After attending this presentation, authors will have: 1) demonstrated benefits of collaborative research with Arson Investigation, Anthropology, and Pathology, 2) established how burn patterns are influenced by structural conditions within the fire, 3) illustrated scene reconstruction using patterns and condition of burned human remains, and 4) interpreted body patterns as part of the scene.

This presentation demonstrate the importance of how identification and recovery of fragmentary bone are valuable specimens when reconstructed and provide specialized information about personal identification or preexisting trauma of human remains.

Discovery of human remains in structural or vehicular fires presents many challenges to the investigative process. Traditionally, expedient removal of human fatalities precedes the comprehensive structural analysis of the scene. Ideally, the independent examinations of burn patterns at the scene and on the body should correlate with reconstructed events surrounding the fire. However divorcing analyses of the two types of physical evidence invites the potential for information loss when examined in isolation. This presentation demonstrates how a contextual analysis of human remains in situ strengthens the fire death investigation as burn patterns of the body are interpreted within the unique conditions of the scene.

Similar to charred patterns on walls, burn patterns on the body readily disclose information about its orientation to heat, position within the fire, exposure, and presence of preexisting trauma. When human remains are examined as an integral part of the original fire scene this context additionally provides relative proximity to exits, entrapment or protection by collapsed debris, and spatial orientation within the structure. However, in most fire death cases human remains are often removed in haste, leaving valuable fragments of soft tissue, bones, or teeth camouflaged among debris as overlooked and permanently lost specimens. An awareness of how the body burns in response to different spatial and structural conditions aids in reconstruction since complete recovery of these fragmentary remains is not always accomplished.

Collaboration with the Hickory Creek Volunteer Fire Department, Anthropology Department, and Shelby County Medical Examiner conducted field experiments creating predictive cadaver models within structural fires to improve reconstruction techniques for arson investigation. Actual research using unembalmed human bodies from anatomical gift donations and condemned residential structures were the primary research materials. Bodies were strategically placed in known locations and positions within different types of structural settings. Variable selected conditions include direct placement upon carpeted concrete foundation slab, elevated floors over crawlspace or basement, and placed upon the second level of a multiple story house to examine burn patterns and spatial distribution of associated fragmentary remains for each situation during the post burn recovery phase.

Fully ignited structures were documented for the entire duration: recording known conditions of materials, times, and temperatures until natural extinguishment. Remains of the structure and body were left to smolder and excavated the following day. Collaboration of archaeological and arson investigative techniques were employed to interpret the contextual position, condition, and spatial patterns of human remains and associated fragmentary pieces camouflaged among debris. In most cases fragmentary remains of extremely incinerated bodies fell within close proximity beneath the resting position. Relative differences in

ventilation access and variable height correlated with the distribution and extent of burning for each body. Fragmentary remains lying directly on the concrete foundation were larger, easily identified, and predictably positioned compared to conditions with increased distances between the body's vertical position and ground level. For the latter combinations of vertical descent, impact with architecture (flooring and joists), and dimensional collapse of debris contributed to morphological differences for surviving remains of elevated cadavers, producing smaller fragments and wider dispersal area.

The use of different residential structural types generates predictive models to help arson investigators recognize how the body burns in response to environmental conditions and effectively identify expected distributional patterns of fragmentary human remains during recovery. In addition to examining physical evidence of the scene, burn patterns of soft tissue and bone are equally valuable tools used to reconstruct events of the fire. This presentation stresses how identification and recovery of fragmentary bone are valuable specimens when reconstructed and provide specialized information about personal identification or preexisting trauma of human remains. Results from these experimental burns demonstrate the fruits of collaborative multidisciplinary field research and offer new information for effectively investigating fire fatalities.

Fire Investigation, Burned Bodies, Burned Bone

B45 Self-Cleaning Window Glass: Breakage Transfer Process Validation and Subclass/Brand Characterization

*Corrie D. Maggay, MFS*and Robert D. Blackledge, MS, Naval Criminal Investigative Service, Regional Forensic Laboratory, 3405 Welles Street, Suite 3, San Diego, CA 92136-5018; Faye Springer, BS, Sacramento County District Attorney Crime Laboratory, 4800 Broadway, Suite 200, Sacramento, CA 95820*

Via high-speed videos filmed at 1000 frames/sec. attendees will be witness to the process of window glass breakage and to the forces producing numerous fragments going back towards the breaker. The goals of this presentation are to graphically validate this process of glass fragment transfer, to qualitatively assess the likelihood that transferred particles tend to originate from the glass surface towards the breaker, and to present results from tests on recovered glass fragments that permit brand identification.

This presentation will study a breaking and entering entrance commonly gained through breaking a window. Although glass does not break back onto the perpetrator, explaining it to a jury can be a trying task. A jury is composed of twelve people, many of whom do not have a background in science. Forensic scientists' ability to explain work and examinations to a jury takes great precedence over the work itself, for it is the jury who is judging the defendant. 90% of all people are visual learners. The videos shown in this presentation will be available to the forensic community with hopes that they will one day be of some use in the courtroom.

Via high-speed videos filmed at 1000 frames/sec. attendees will be witness to the process of window glass breakage and to the forces producing numerous fragments going back towards the breaker. The goals of this presentation are to graphically validate this process of glass fragment transfer, to qualitatively assess the likelihood that transferred particles tend to originate from the glass surface towards the breaker, and to present results from tests on recovered glass fragments that permit brand identification.

Self-cleaning window glass, a new type of glass intended solely for exterior use, was introduced to the AAFS audience in a presentation by one of the authors last year. One side only of these panes (the exterior facing side) is rich in titanium dioxide (TiO_2), the catalytic ingredient that in concert with the sun's ultraviolet rays acts as an oxidizing agent and breaks down organic dirt and grime. Since only glass at or very near the exterior surface is rich in TiO_2 it is possible to not only discriminate this new subclass from ordinary window glass, it is also possible to identify tiny fragments originating from this surface.

Window breaking tests were conducted at the U.S. Army Proving Ground, Yuma, Arizona, utilizing available high-speed cameras. Under identical conditions, 1' x 1 ' x ¼" glass panes mounted at approximately shoulder height were broken by swinging a crowbar. Panes broken included ordinary window glass, and the two available self-cleaning brands, Activ™ glass by Pilkington and SunClean® glass by Pittsburgh Plate Glass. The self-cleaning panes were mounted with the treated side towards the breaker.

With the exception of different colored hoods, the breaker wore identical outfits for each glass-breaking event. Subsequent to each breakage the breaker moved over to an area where clean butcher paper was laid down, and the breaker's outer clothing (hood, gloves, sweater, sweat pants, and sneakers) were separately removed and packaged as evidence. Later, these items were searched for glass fragments. Glass fragment recovery data and results of characterization examinations (fragments originating from the surface towards the breaker, from the middle, and from the side opposite the breaker) will be presented.

Trace Evidence, Glass Breakage and Analysis, Self-Cleaning Window Glass

B46 A Validation Study of Physical Associations of Duct Tape Ends

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By attending this presentation, attendees will learn how a study to evaluate the validity of conducting physical associations (end-matches)we designed and administered. Although we looked at duct tape, a common consumer item submitted to forensic science laboratories, the study can be used as a model to evaluate other materials (such as glass, wood, metals, paper) submitted to forensic laboratories. The results of the study can be used by other forensic science laboratories that conduct end-match examinations on tape to support their test results in court challenges.

This presentation will impact the forensic community by demonstrating that although tape end-match examinations have been conducted in forensic science laboratories for decades, there are no published validation studies on this technique. Presentation at this conference will be the first opportunity to inform the forensic community of the results of the study. The design and administration of the test will be presented so other laboratories may use the study as a model to evaluate other types of materials commonly submitted to forensic science laboratories for physical association (end match) examinations such as metal, wood, glass, etc.

Although tape end-match examinations have been conducted in forensic science laboratories for decades, there are no published validation studies on this technique. In the era of Frye and Daubert where a forensic examiner must demonstrate to the court the scientific soundness of their examinations, we undertook a study to address this concern.

The purpose of the study was to determine the validity of conducting physical association (end match) exams on duct tape evidence and to evaluate the error rate associated with such an examination. The study was also designed to address the following: the number of associations/end matches identified correctly and incorrectly; the ability to identify associations/end matches for both torn and cut pieces of duct tape; and whether the grade of tape influences the ability to identify associations/end matches.

Three rolls of duct tape were used, representing different manufacturers and grades of tape. Each participant received five sample sets, three sets with hand-torn ends and two sets with scissor cut ends.

The sample sets were prepared as follows: ten (10) strips of each tape were either cut or torn and adhered sequentially onto a plastic surface. Each strip of tape was randomly labeled alphabetically and then numbered sequentially (1-10) on the plastic surface to which the tape was adhered. Each test set was digitally documented and the order of tape within each test was verified by a second person. The pieces of tape were then separated from one another by cutting the plastic substrate. The substrate was cut in such a way to remove the sequential number and so that end-matching of the substrate was not possible. For each test set, the ten (10) strips of tape were shuffled together and three (3) strips were randomly removed. The three (3) randomly removed strips were placed into a properly labeled plastic bag. The remaining seven (7) strips were placed into individual plastic bags and labeled appropriately.

A total of 20 sample sets were administered to four analysts with directions to evaluate whether or not physical associations (end matches) existed among the strips of tape in each set following the standard operating procedure.

The results of the initial study were evaluated by the test administrator. In cases where there was a failure to report a physical association by the original test participant, the test set was evaluated independently by the three remaining test participants and each rendered their opinion.

The results of this study will be presented in detail addressing each of the aforementioned objectives. Discussion will include the number of correctly identified tape end-matches, whether the manner in which the tape is separated (hand-torn versus cut with scissors) and whether the grade of tape has an effect on the ability to conduct these examinations.

Duct Tape, End-Match, Validation Study

B47 Frequency of Occurrence Data for Textile Fibers

Harold A. Deadman, PhD and Tara A. Scully, BS, George Washington University, 2036 H Street, NW, Washington, DC 20036*

After attending this presentation, attendees will learn that most textile fibers have considerable evidential value as associative evidence

This presentation will demonstrate the importance of considering the evidential value and meaning of associative evidence using textile fibers as an example.

The question, "What does the evidence mean?" is obviously an important question in a criminal trial. Determining the value and meaning of evidence is one of the most important factors that go into forensic analysis. However, it is often one of the most difficult questions for the forensic scientist to answer objectively and to provide objective support for that answer in the courtroom. Because of this, the question is often ignored in laboratory reports and in testimony at a trial. Assessing and presenting evidential value is especially difficult with respect to trace evidence. Evidential value of a particular type of evidence can vary tremendously depending on the specific evidence available in a case. Forensic scientists must consider the evidential value and be able to present and support their assessment in the courtroom as a jury will not have the knowledge necessary to correctly evaluate the evidence.

Assessing evidential value generally occurs after matching evidence from two objects or locations has been found to exist, resulting in an association. For example, textile fibers recovered from a homicide victim's body are matched to a carpet in a suspect's residence linking the victim to the suspect's residence. However, since it is possible that these carpet fibers came from a similar but different carpet, it could be a coincidental match and, therefore, the probability of a coincidental match must be addressed. To simply say that the fibers on the body are consistent with originating from the suspect's carpet does not address the evidential value and is likely to downplay the significance of the fiber evidence.

There are many factors that go into the assessment of the evidential value of fiber evidence. One of the most valuable pieces of information the fiber examiner could use in assessing evidential value is the frequency of occurrence of the probative fibers in textile materials or in debris from textile materials. This type of information may be difficult if not impossible to determine for a fiber type involved in a specific case, however, it is possible to determine an average or relative frequency of occurrence for particular fiber types, which can then be equated with the fibers of interest in a particular case.

Over the past 20 years there have been many "target fiber" and "population studies" that have addressed the issue of the frequency of occurrence of specific fiber types in clothing and in debris collected from various locations. These studies have shown that, although there are some very common fibers which would have little value as evidence, a fiber that is not one of the very common types will have a very small frequency of occurrence. Most of these studies have been conducted outside the United States, primarily in Great Britain, Germany and Australia. Although these studies would likely apply to fiber analysis in the United States, it would be helpful to conduct similar studies in the United States.

This project is designed to provide data useful in assessing the evidential value of fiber evidence by providing information on the frequency of occurrence of particular fiber types. It consists of three component parts: first fibers have been collected from items of clothing. The clothing sampled came from university students as well as from office staff wearing both casual and business dress. These fibers are being classified initially based on microscopical characteristics such as color, fiber type and diameter. This data can be used to address the frequency of occurrence of different fiber types in clothing. A second component of the project is the collection of fibers from 50 seats and 50 seat backs located in a University auditorium. After using tape to collect the fibers, approximately 10% of the recovered fibers have been mounted and searched until 40 dissimilar fiber types have been identified from each taping. A total of 4000 fiber types will have been identified and classified in approximately 1000 possible classes at the completion of the project. Fibers within a class will then be compared. This data will also address the frequency of occurrence of fiber types from clothing and debris from clothing that has been transferred to the seats and seat backs. A third component of this research is to search the debris from the auditorium seats and seat backs for several fiber types that are present in the composition of three sweaters. The three sweaters selected as targets are various shades of red and at least 50 red fibers were recovered from each taping. The more than 5000 red fibers from the auditorium seats are being compared with the rayon, acrylic, polyester, nylon and cotton fibers in the composition of the three sweaters.

The data obtained thus far support the conclusions that have been reported in the literature in studies outside the United States. While there are some common fiber types, there is tremendous variety in the world of textile fibers. As long as a fiber is not one of the common fiber types, the probability of finding a particular fiber type in a particular location or in the composition of a particular item of clothing by chance is very small. This is particularly true with respect to man-made fibers and especially with colored man-made fibers.

Textile Fiber Evidence, Evidential Value, Fiber Frequency of Occurrence

B48 Application of Principal Components Analysis in the Individualization of Gasolines by GC/MS

Jeremy P Wintz, BS and J. Graham Rankin, PhD, Forensic Science Program, Marshall University, 1401 Forensic Science Drive, Huntington, WV 25701*

After attending this presentation, attendees will understand the usefulness of multivariate statistics to forensic applications in particular GCMS.

This presentation will impact the forensic community by demonstrating the usefulness of multivariate statistical analysis to large data sets especially in comparisons between GCMS data in gasoline individualization.

Gasoline is an accelerant frequently used by arsonists. Identification of gasoline in fire debris is relatively easy even when greatly evaporated. When a suspect is apprehended with gasoline residue on his clothes or a gasoline can in his vehicle, the question arises if the gasoline residue from the fire debris can be matched with that found with the suspect. This has proven to be a more difficult challenge. Further recent legal challenges to comparison evidence have stressed the necessity of establishing a statistical probability for that match.

Julia Dolan (ATF National Research Lab, Ammendale, MD), at the Atlanta meeting of AAFS, presented a high-resolution GCMS method for comparing gasolines based on 20 sequential area ratios of 34 target compounds from 3-methylpentane through the 1-methylnaphthalene. Her data set included 36 different gasolines, including both regular and premium, mostly from around the Washington, DC area. In addition to neat gasolines, 25% and 50% evaporated samples were analyzed.

We have applied principal components analysis (PCA) to her data set as well as our own collection of over 60 gasoline samples from across the US that we analyzed by her method. Most of the sequential ratios are reproducible in triplicate analysis to less than 5% relative standard deviation. The ratios show little, if any, change between un-evaporated and 50%-evaporated gasoline. However, based on our PCA results, of the 20 ratios, only a few show a significant contribution to the between-gasoline variation thus being able to distinguish one gasoline from another. Because some of these distinguishing ratios are in the light petroleum distillate range, they may be lost in higher evaporated gasolines.

Gasoline Analysis, Principal Components Analysis, Fire Debris

B49 Determination of Hand Deposited GSR Obtained From Shootings Carried Out With a Pistol and Cartridges Produced by TMCF Using SEM/EDS Method

Ismail Cakir, PhD, Council of Forensic Medicine, Turkey, Adli Týp Kurumu, Cerrahpaþa, Istanbul, 34246, Turkey; H. Bülent Üner, PhD and Salih Cengiz, PhD, Institute of Forensic Sciences, Istanbul University, Adli Týp Enstitüsü, Cerrahpaþa, Istanbul, 34301*

Shooter identification is of importance in criminal firearm cases in order to reveal the manner of death or injury (murder, suicide, accident). Scientifically, shooter identification is possible by analyzing the gunshot residues (GSR) obtained from the suspects' hands.

When a weapon is fired, GSR are discharged at high velocity from the muzzle and are expelled from ejection port. Some of the GSR that are expelled from the ejection port are deposited on the firing hand.

There is no scientific study about the analyses of GSR on firing hands of Turkish made ammunitions. For this purpose experimental shootings were carried out using 9mm Parebellum type cartridges, all produced by Turkish Machining and Chemistry Foundation (TMCF) and a Atmaca 53 pistol performing one, two, three and four shots with the right hand.

Firing hands were sampled by using aluminum stubs coated with double-sided adhesive. Shooter's hands were washed and dried after each test firing.

SEM/EDS analyses for GSR particles were carried out using a JEOL 5600LV scanning electron microscope equipped with a LINK-ISIS 300 X-ray analyzer.

The results obtained in this study indicate that elemental composition of the GSR of the studied cartridges were found compatible with the elemental composition of the original chemicals of them. The GSR results showed the following elemental distribution to TMCF cartridges: unique particles (PbSbBa, SbBa), indicative particles (PbSb, PbBa, Pb,CuZn, CuZn, Cu, Zn, Fe, Pb).

Gu Shot Residue, SEM/EDS, Turkish Machinery and Chemistry Foundation

B50 Comparison of DNA Stability Stored on Treated and Untreated Papers

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After attending this presentation, attendees will have knowledge of DNA stability over time on FTA treated paper v untreated filter paper. The attendee will make an informed decision of how to store DNA for long periods of time.

This presentation will impact the forensic community and/or humanity by providing data on the various options of long term DNA storage.

In forensics, the integrity of the sample DNA is crucial for successful analysis. Often, DNA is collected by applying samples (blood, saliva, tissue, etc…) to chemically treated papers such as FTA® or untreated papers such as 3MM or 903®. These papers are a convenient medium for collecting DNA: cells are lysed on contact with the paper and DNA is bound to the matrix. Sample DNA on the treated paper is stabilized and protected against degradation. Samples may be kept at room temperature for long periods of time and are easily made ready for analysis by PCR based amplification. Up to this time, there has been no systematic analysis of the integrity of DNA samples stored on the treated vs. untreated papers.

Here we present data showing that FTA®-treated paper provides greater protection of genomic DNA from degradation than untreated papers. This increased protection was consistent and was observed within hours of application and up to 180 days after sample application. This protection is seen in samples whether stored at room temperature, at -20 °C or at 37 °C with high humidity. These results demonstrate that DNA stored on FTA is safe for long-term storage thus increasing the probability of obtaining reliable testing results.

DNA Stability, Treated Filters, FTA

B51 Evaluation of the Least Square Deconvolution Approach in Interpreting DNA Mixtures

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The goal of this presentation is to present the use of mathematical models to resolve DNA Short Tandem Repeat profiles.

This presentation will provide a mechanism for interpreting DNA mixtures in forensic casework including but not limited to sexual assault evidence, trace or low copy number samples, product of conception cases, and commingled remains from mass disasters.

Introduction: DNA samples containing mixed profiles are often encountered in forensic DNA casework, stemming most often from sexual assault cases. Characteristic peak height imbalances and disproportionate intensity seen in short tandem repeat (STR) analysis indicate that DNA contributions may originate from different individuals. The U.S. Supreme Court established under *Daubert v. Merrell Dow Pharmaceuticals, Inc*. that scientists are required to show the reliability, reproducibility and validity of their scientific results. Current mixture resolution methods do not rely on all available empirical data. Mixture statistics such as the probability of exclusion fail to differentiate between the victim and suspect profiles and do not take into account the ratio of mixtures. Other statistical measures such as likelihood ratios take into account major and minor peak levels but fail to provide a measure of differing mass ratios. Least Square Deconvolution (LSD) algorithms strengthen the reliability, reproducibility and validity of mixture interpretations required by *Daubert* standards by providing a systematic mathematical approach to resolving mixtures. All available data generated in electropherograms are evaluated. LSD software computes a mass proportion for each two contributing genotypes by comparing their relative peak height and/or area measurements assuming 1) relative mass ratio is approximately preserved during PCR amplification across all loci and all alleles within a locus, and 2) allele peak heights and areas are proportional to its relative DNA mass. The software takes into consideration all possible combinations of the two contributing genotypes and computes the corresponding fitting errors. The higher mass profile is normalized against the lower mass proportion to calculate the mass ratio. The profile with the smallest fitting error is determined to be the most likely genotype scenario. Hypothesis/Methods: Evaluate the effectiveness and precision of the LSD software. Different male to female DNA ratios were PCR amplified and separated by capillary electrophoresis. Corresponding peak height and area data were entered into the LSD Software. In addition, different PCR and electrophoresis parameters were examined. Results: Preliminary results indicate LSD software can separate profiles between 10:90 and 30:70 mixture ratios. Adjusting PCR and electrophoresis parameters enhances ability to separate profiles at a mixture ratio of 5:95. Conclusion: LSD could prove beneficial to the forensic community in the future by evaluating mass ratios in mixture samples. In time this analysis system may be used to strengthen statistical measurements for mixture evidence to satisfy *Daubert* standards.

Least Square Deconvolution, DNA Mixtures, Short Tandem Repeats

B52 Evaluating the False Parentage Rate and CPI Cut-off of CODIS 13 STR for Seven Populations

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After attending this presentation, attendees will be able to recognize that false parentage determination after DNA test is possible.

This presentation will impact the forensic community and/or humanity by demonstrating the cutoff value of CPI for parentage could be established to avoid false parentage, especially important for unidentified body recognition on immigration blood relative testing.

We report on the use of STR typing for the genetic linkage of unidentified human remains and the problems associated with false paternity results. STR loci are chosen and used on based upon their power of discrimination and ability to multiplex with other STR loci. Most of the STR loci used in forensic science both for criminal and civil investigations. The CODIS 13 core STR systems has an average power of paternity exclusion (PE, to exclude a random man) larger than 0.9999(in trio cases) in many populations. In the identification of unidentified bodies only one relative (either of parents or either of son/daughter) is available for testing. This results in duo cases for parentage building. When allele sharing is found in all the 13 loci, the probability of parentage could be determined preliminarily. However it is hard to avoid a false confirmation of the alleged father or false identification of the unidentified bodies. In Taiwan, the national unidentified bodies CODIS 13 STR database has approximately 680 bodies and 200 families. Sometimes a body matches to more than one individuals (from different families) and cases with extremely low Cumulated Paternity Index (CPI) were found. It is necessary to evaluate the false parentage rate and set a cut-off value of CPI for avoiding false determination of parentage.

The CODIS 13 population data of 177 African American, 194 US Caucasian, 202 Southwestern Hispanic, 153 Bahamian, 157 Jamaican, 76 Trinidadian and 1,000 Chinese in Taiwan was collected from published websites of FBI USA or by authors. The cumulated power of exclusion (PE) for duo for African America = 98.31%, US Caucasian = 98.23%, Southwestern Hispanic = 97.97%, Bahamian = 98.48%, Jamaican = 98.32%, Trinidadian = 98.61% and Chinese in Taiwan = 98.13%. The data showed that about 1.4 % to 2% of random men could not be excluded from being an alleged father for the studied populations. A matching test model was designed to evaluate the practically possible false parentage rate.

All the collected individuals were paired resulting in 15,576, 18,721, 20,301, 11,628, 12,246, 2,850, and 499,500 pairs for each population respectively. Each pair was checked for allele sharing locus by locus and the CPI for those pairs with 13 loci sharing was also calculated. Microsoft Excel Macros controlled by a program written by the authors were used to handle the comparison and calculation. CPI calculations were based on the distribution frequencies for the respective populations. These were 8(0.0514%), 10(0.0534%), 9(0.0443%), 3(0.0258%), 7(0.0572%), 3(0.1053%) and 250(0.0501%) pairs found with 13 allele sharing loci for the seven populations. False parentage was noted when the CPI for pairs ranged from 1.76 to 1,950,430. These were 4.48% CPI lower than 100, and 78.27 % lower than 1,000. If the suitable CPI cut-off value were used such as CPI=1,000, there would be less of false parentage.

Though we could reduce the false positive rate by increasing the cut-off value, the false exclusion rate (a real father excluded as a random man) would be increased accordingly. In this study many duo paternity

cases in Taiwan were found with CPI lower than 1,000 when only CODIS 13 STRs were typed. If CPI=1,000 was suggested as the cut-off value these low CPI cases could be classified as false parentage cases. More real paternity cases have to be observed to set an optimum range of value for CPI cut-off, or more STR systems are required when matches were found with low CPI. This is especially the case for mass and open matching operation of STR database for the unidentified bodies. If less than 13 STR typing were obtained from the unknown skeleton owing to degradation of DNA, the CPI would be much lower, and the risk of false identification would be much higher. In such cases mtDNA sequencing and other investigating techniques should be added to enhance the discrimination.

Short Tandem Repeat, CODIS 13, Parentage Test

B53 Macro-to-Micro Interfacing of a Swab Receptacle With a Microchip for Total DNA Analysis

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After attending this presentation, attendees will learn of the importance of a microfabricated device that has the power to dramatically reduce the time associated with DNA analysis of a sample taken from a victim of sexual assault.

This presentation will impact the forensic community by demonstrating the fabrication of a micro-total analysis system for the forensic analysis of DNA, the time associated with the extraction, separation, and PCRamplification of such material will decrease dramatically.

Learning Objective: The goal of this project is to develop a macro-to-micro receptacle system that will accept a cotton swab from a rape kit and allow for collection of desorbed cellular material. The receptacle is to be integrated with a microchip cell separation apparatus to circumvent conventional differential extraction.

This presentation addresses the considerable backlog of rape kit evidence awaiting DNA analysis. Analysis of both perpetrator and victim DNA by gel electrophoresis has been the keystone technique utilized in the investigation of cases involving sexual assault and rape, and is a well established practice. Unfortunately, the procedures involved in a typical DNA analysis can result in hours, even days, of laboratory time spent on a single case, particularly in the sample preparation stages. As a result of the time constraints involved in the analysis of such cases, and insufficient funding, a large backlog exists in many large-volume DNA analysis laboratories.

Microfabricated devices that utilize microchannel electrophoresis as a DNA separation technique have been shown to greatly reduce the time needed for analysis. The speed and efficiency of such separations are due largely to the increased area-to-volume ratio of the etched-channels over conventional slab gels, and the fact that high voltages can be utilized. In addition to the aforementioned advantages, these devices allow integration of all necessary processing steps; this provides for complete analysis, from cellular desorption to complete DNA assessment, onto a single microchip. Extraction of DNA from separated sperm and epithelial cells, PCR amplification of the DNA, and separation and detection of the amplified DNA are steps that are now incorporated into single microfabricated devices. There is little doubt that such integrated devices will transform the arena of forensic DNA analysis.

A major component of such an integrated device is the macro-to-micro swab receptacle that must interface the "macro-scale" of the cotton swab with the "micro-scale" of a channel used to separate epithelial cells from sperm cells. The current protocol utilized by the FBI for the elution of cellular materials from the cotton matrix is a time consuming step that involves significant sample handling, which directly increases the chances of sample contamination, as well as human error. It is not unusual for a cotton swab taken from a victim of sexual assault to be incubated for hours (overnight) in order for the cells to elute from the cotton fibers. Additionally, the extraction solution utilizes a protein lysis buffer containing SDS and proteinase K, which aid in the removal of the cellular material, but lyse the fragile epithelial cells in the process. A cell-desorption process that greatly reduces extraction time while leaving cells intact would be advantageous in that it might be easily incorporated into a cell separation (CS) channel on a micro-total analysis system (□-TAS).

The focus of the research presented here is the development of a swab receptacle that provides an interface for a cotton swab taken from a victim of sexual assault, with a □-TAS on a microfabricated glass device. Through the microscopic examination of a cotton swab containing a dry semen sample, it was discovered that the major component leading to sperm adhesion was entanglement of the tails with the polysaccharide cellulose strands. Preliminary studies have shown that the enzyme cellulase, which digests cellulose to produce glucose, greatly reduced the time needed for cells to elute into solution. The desorption of cellular material has been optimized in an aqueous solution at a temperature of 37° C in a borosilicate glass microcentrifuge tube. Eluted sperm and epithelial cells from a cotton swab were counted hourly using a hemacytometer, showing an approximate 2:1 ratio of sperm cells in the presence of the enzyme in comparison with the same sample without the enzyme. Optimum cellular elution conditions using cellulase, showing that sperm cell desorption surpasses the current method utilized by the FBI, as well as specifics on the integration of the receptacle with a □-TAS device will be presented.

Microchip Technology, Macro-to-Micro Interface, Cellular Desorption

B54 Transporting or Tracking Ignitable Liquids in Fire Scenes

Andrew Armstrong, PhD, Armstrong Forensic Laboratory, Inc., 330 Loch'n Green Trail, Arlington, TX 76012; Vytenis Babrauskas, PhD, Fire Science and Technology, Inc., Issaquah, WA; Douglas Holmes, MA and Cory Martin, BS, INTROSPECT, 1023 3rd Street, League City, TX 77573; Ray Powell, BS, The Public Agency Training Council, Indianapolis, IN; Steve Riggs, The Public Agency Training Council, Indianapolis, IN*

The goal of this presentation is to evaluate the extent to which transporting or "tracking" of identifiable ignitable liquids into fire scenes occurs and offer the results of the evaluation for those conducting scientific evaluations of fire incidents.

In the investigation of fire scenes, it is often important to determine if ignitable liquids or liquid accelerants, e.g., gasoline, have been used. The procedure involves collecting of debris samples and submitting them to an analytical laboratory. If positive results are found, it may later be necessary for the investigator to defend in court the collection procedure used. It is occasionally claimed by individuals accused of incendiarism that the gasoline residues found by the laboratory were not, in fact, present initially at the fire scene but comprise an artifact. Specifically, it has been claimed that fire investigation personnel may have entered the fire scene having first walked through some ground surface which was contaminated with gasoline, for example, a driveway on which a gasoline spill had taken place. This type of claim has never been subjected to scientific examination, thus the purpose of this work was to create spills, have fire investigation personnel walk through these spills, then take samples at various locations to determine if sufficient residues can be found to obtain positive laboratory results. The locations sampled corresponded to the footprints of the investigator directly upon leaving the spill area. Furthermore, claims have also been made that canines used for fire accelerant detection may also either themselves

track in sufficient contamination to cause false-positive response, or to incorrectly alert on material that was tracked in and not originally present. Thus, trained canines were also used in the same series of tests.

Tests have been performed to determine whether the boots or shoes of individuals on the fire scene can track sufficient contaminants into a fire scene to obtain a false-positive laboratory result for presence of gasoline at the fire. Questions about the validity of forensic laboratory results have sometimes been raised on the basis that gasoline residues found in the laboratory samples could have been due to transport by footwear contaminated from walking over contaminated areas. The laboratory results establish that this will not lead to false positives being reported. Canines trained for detection of trace ignitable liquid residue were also utilized in the test work. The results indicate that properly trained canines show a higher sensitivity than do standard laboratory techniques for fire debris analysis.

The results obtained in this study disprove that claim that false-positive results are likely to obtained from laboratory testing of fire-debris samples due to contamination from the footwear of personnel. In the present study, large quantities of fuel (and in some cases, exceedingly large) were poured into the stepping area through which the investigator walked prior to entering the test area. In two of the four tests, furthermore, the fuel was "raw," that is, it was neither burned nor given time to evaporate. Yet laboratory results were uniformly negative, apart from samples taken from the pour location itself. The laboratory correctly identified the Test 1, 3, and 5 samples as "raw" and Test 2 and 4 samples as "weathered" gasoline. Consequently, it is concluded that even significant carelessness by a fire investigator in entering the fire scene with contaminated shoes will not track in sufficient gasoline that false-positive results would be obtained.

Boots and Shoes, Contaminants, Fire Accelerants

B55 Analysis of Nuclear STR Markers Using Pyrosequencing Technology

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This presentation will present a new rapid, reliable and robust technology for DNA identification in forensics.

DNA analyses in forensic investigations have made a great contribution to the possibility to convict a perpetrator or free an innocent suspect. With the help of rapid developments in molecular technology new methods are becoming faster and more sensitive to allow effective and accurate DNA analyses to aid criminal investigations.

Forensic analysis has traditionally been performed using nuclear STRs (short tandem repeats) due to the high number of alleles at each locus. The genetic diversity of STRs makes these markers highly discriminating and suitable for individual identification in forensic investigations. DNA in forensic samples as well as in ancient DNA, however, is often subjected to a harsh environment of degrading agents, which might affect the ability to amplify longer fragments of nuclear DNA. Therefore, we selected loci harbouring the shortest repeat units and designed a PCR assay to amplify short fragments between 70-200 base pairs. Another advantage is that the STRs were selected from the STRBase web site, which represents markers that have been extensively investigated for their usage in forensic applications with well-known allele frequencies from different populations. The use of these markers can thereby easily be transformed to new technology platforms remaining their large informative property.

Although fragment analysis commonly used for nuclear DNA analysis is well established and reliable, it also requires larger fragment sizes that may be difficult to amplify on materials of poor quality and limited amounts. In this study we have used Pyrosequencing to analyse 11 different STRs (CSF1PO, TH01, TPOX, D2S1338, D3S1358, D5S818, D7S820, D8S1179, D13S317, D16S539 and Penta D). The Pyrosequencing technology is based on an indirect luminescent detection of organic pyrophosphate (PPi) released from each dNTP upon DNA chain elongation. The four nucleotides are added stepwise and following base incorporation, PPi is released and used as a substrate for ATP sulfurase, which results in formation of ATP. The enzyme Luciferase uses ATP to convert luciferin to its oxi-derative, which creates a light output detectable by a CCD camera. Prior to each cyclic addition of nucleotides, the excess of dNTPs is degraded by apyrase. The results are shown in a pyrogram where each peak height is proportional to the number of incorporated nucleotides.

This new technology provides a faster turnaround time of the analysis and is highly robust. The post-PCR handling takes about 2 hours and represents a flexible platform for different types of analysis such as; mutation detection, sequencing of short fragments, SNP and STR analysis. The pyrosequencing method also generates a more easily interpreted and reliable scoring of simple and complex repeats due to the higher resolution obtained by actual sequence analysis of the repeat and absence of common gel artefacts like stutter bands. As the peak heights are proportional to the incorporated nucleotides, the decrease in signal intensity by half and the specific pattern that arises after the end of the repeat makes it possible to resolve different alleles of a heterozygous genotype.

In this study we describe the first system for analysis of STRs using Pyrosequencing. Eleven STR loci were analyzed among 100 Swedish individuals to generate allele frequencies for the Swedish population. The system has also been tested for analysis on several forensic materials from previously analyzed forensic case works.

DNA, STR, Pyrosequencing

B56 Population Data on the Short Tandem Repeat Loci Penta D and Penta E in Taiwan

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After attending this presentation, attendees will understand that it is better to add the Penta D and Penta E test to the paternity test with low CPI or add these two systems to confirm if mutations exist.

The STR loci Penta D and Penta E were observed as low-stutter and highly polymorphic pentanucleotide repeat loci, they were thought to add a lot portion of exclusion probability to the paternity disputes and also to increase the discriminating probability for forensic identification, the population data and forensic parameters of these two systems needed to be to be studied.

Whole blood was obtained in EDTA vacutainer tubes by venipuncture from 532 unrelated Chinese individuals and from routine paternity cases in Taiwan. DNA was extracted by using BioGene-Fast™ 30 Minute DNA extraction kit (Texas BioGene, Inc., TX, USA) and quantitated by a Fluorometer (DyNA Quant 200, Hoefer Pharmacia Biotech, San Francisco, CA, USA). PCR amplification was performed by using 5ng genomic DNA in a 15£gl reaction volume comprising STR buffer (Gold ST*R, Promega, Madison, WI USA) and 0.5 U Tag Gold Polymerase (Applied Biosystems, Foster City, CA, USA), 1£gM PowerPlex™ 16 primer. PCR cycling conditions followed the protocol provided by the manufacturer. Alleles of each locus were determined according to the ladder also provided by the manufacturer.

Aliquot of PCR products was processed by using ABI 310 Genetic Analyzer (PE Applied Biosystems, USA). The raw data was analyzed by the resident software (Data Collection software, version 1.0.2), Genotypes were determined by comparing the length of the unknown fragments to the allelic ladders provided by the manufacturer. A software provided by POPGENE was used to analyze the data. In this study only

data for Penta D and Penta E were presented.

No significant deviation from Hardy-Weinberg equilibrium was found in these systems. The most frequent allele types for each locus were Penta D: 9(34.15%), Penta E:11(16.51%). The mean exclusion power(MEP) for Penta E(81.92%) was larger than that of Penta D(60.16%), and the DP for Penta E(98.6%) was also larger than that of Penta D(93.7%). When processing paternity test and only the alleged father were willing to be tested, the CPI was found not high enough sometimes, but if typing results of Penta D and Penta E were added, the CPI would increase accordingly, cases were presented with the increase of CPI from about 7 to 17 times. We also used these two systems without any modification on 26 Chimpanzee blood samples from Taipei Zoo(Taiwan), there were 3 families according to the first generation male in this group, the typing of these two systems was in accordance with the pedigrees established by using some other 13 STR systems, the alleles found in Penta D system were 3 and 4, the most frequently found allele for Penta D was 4(96%), alleles 5, 7, 8, 10, 11 and 13 were found in Penta E, and the most frequent one was 5(31%). The two Penta STR loci described here with high MEP and PD are highly suitable for forensic individualization and paternity tests even for the Chimpanzee.

Penta D Penta E, Population Study, Paternity

B57 Population Data on the X Chromosome Short Tandem Repeat Loci AR, DXS10011, DXS101, DXS6789, DXS7132, DXS8377, DXS9895, and HPRTB in Taiwan

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After attending this presentation, attendees will understand the usage of X STR.

This presentation will demonstrate the application of X STR on special paternity cases or forensic cases.

The major applicable commercial kits for STR typing in forensic testing are only for genomic STRs and Y chromosome linked STRs, the typing for X chromosome linked STRs has not well developed yet, but the forensic DNA scientists are beginning to recognize that X STRs are powerful auxiliary systems to genomic STR, they are helpful for the identification of female such as for differentiating if two women had the same father directly, avoiding some of the ambiguity generated from sibship calculation. This report contains the results of population studies on the X chromosome STR AR, DXS10011, DXS101, DXS6789, DXS7132, DXS8377, DXS9895 and HPRTB for Chinese living in Taiwan. The numbers of unrelated individuals were 416 for AR, 273 for DXS10011, 414 for DXS7132, 413 for DXS9895, 448 for DXS101, 447 for DXS6789, 450 for DXS8377 and 428 for HPRTB. The common alleles of each locus were sequenced and used in a control ladder for typing population samples. The primer sequences and annealing temperature were modified and optimized for designing two multiplex amplification reactions to obtain typing of all the 8 loci. For each locus 6 to 28 alleles were noted.

Heterozygosity in females ranged from 0.700 to 0.953. The Chance of Exclusion(CE) for these 8 loci were 0.835, 0.905, 0.594, 0.562, 0.469, 0.761, 0.449 and 0.531 respectively. Among the 140 father-daughter or mother-child pairs examined, 1 case of mutation were found at AR locus, among the 172 father-daughter or mother-child pairs examined, 1 case of mutation were found at DX10011, among the 216 father-daughter or mother-child pairs examined, 1 case of mutation were found at DXS7132.

In a deficiency case, two women claimed that they were from the same father, the sibship index for 15 genomic STR was 1,443, and both of the two girls had the same X STR typing AR=23/25, DXS10011=24/30, DXS101=23/24, DXS7132=13/15, DXS8377=48/51 and DXS=14/15, further confirmed that they were from the same father, in another immigration case, a grand-daughter had to be confirmed was blood related to a grandmother(father side) to get the citizenship of Taiwan. Because the X chromosome linked STRs would pass from grandmother to the granddaughter, so these 8 systems were used on that, after matching the typing of X STRs and calculating the index of genomic STRs, their blood relationship was confirmed, this was the first case that X STRs were used on immigration samples. These STR polymorphisms will be useful markers for parentage testing especially when disputed child is female.

Short Tandem Repeats, X Chromosome, Population Study

B58 Validation of the Gold-Plated Silver Sample Block on the GeneAmp® PCR System 9700 Thermal Cycler

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After attending this presentation, attendees will understand that the use of the gold-plated silver sample block is validated for use interchangeably with the silver sample block on the GeneAmp(R) PCR System 9700 thermal cycler, and can be used for forensic casework.

This presentation will demonstrate the validation of new equipment which is required by DAB standards. The gold-plated silver sample block used with the GeneAmp(R) PCR System 9700 thermal cycler has now been validated for use in forensic casework, and can be used interchangeably with other available sample block formats.

The GeneAmp® PCR System 9700 Thermal Cycler has been introduced with interchangeable silver and gold-plated silver sample blocks. To validate the new gold-plated silver sample block on the System 9700, amplifications were performed on both the gold-plated silver and the previously validated silver sample blocks. PCR amplifications using the AmpFISTR® Profiler Plus *ID*™, COfiler®™, Identifiler®™ and SGM Plus®™ typing kits (Applied Biosystems, Foster City, CA) were performed. Electrophoretic characteristics such as allelic profiles, peak heights, and peak height ratios were used to discern differences in the amplification capabilities of the two sample blocks. There was 100% concordance in the genetic profiles generated on each sample block. Peak height and peak height ratio data demonstrated no differences between the two sample blocks. These results demonstrate that the PCR reactions on both silver and gold-plated silver blocks are equivalent. The results of this study validate the interchangeability of the silver and gold-plated silver sample blocks on the GeneAmp® PCR System 9700 Thermal Cycler.

Validation, STR, PCR

B59 Evaluation of Applied Biosystems' RT-PCR Quantification Assays

Dixie L. Hybki, BS, MS and John V. Planz, PhD, UNT Health Science Center, 3500 Camp Bowie Boulevard, Fort Worth, TX 76107*

After attending this presentation, attendees will understand an improved method for quantitating DNA extracts.

This project presents a vastly improved method of DNA quantification. Additionally, one of the assays is specific for human male DNA. This provides the ability to detect mixtures of male and female DNA which can be beneficial in identifying samples that will be difficult to analyze. Using these assays allows for subsequent analysis decisions (STRs verus mitochondrial DNA sequencing).

Molecular techniques that utilize DNA require an accurate measurement of the quantity of extracted DNA. Currently, quantitation methods include spectrophotometry, fluorometry, and hybridization assays. Not only can some of these methods be subjective, but several lack the ability to differentiate human versus non-human DNA templates. In a forensic setting, the DNA Advisory Board requires that a laboratory have and follow a procedure for evaluating the quantity of human DNA in an extract. Applied Biosystems has developed human specific and Y-chromosome specific quantification assays using Real-Time Polymerase Chain Reaction (RT-PCR). We hypothesized that human DNA could be objectively quantitated from various tissue sources for use in forensic work. We also hypothesized that in case of mixtures, the male component could be quantitated independently from the female fraction.

Comparisons were made between the total human specific RT-PCR quantification assay and three other quantification methods: spectrophotometry, PicoGreen® fluorescent dye, and QuantiBlot™ using genomic DNA extracted with a variety of methods and from several biological sources. Additionally, experiments were conducted to quantify low copy number samples using the human specific RT-PCR quantification assay. To determine the sensitivity of the Y-chromosome specific quantification assay, female and male DNA extracts were mixed in ratios ranging from 50:50 to 95.5:0.5 (female:male). This was followed by quantification of DNA extracted from female epithelial fractions of vaginal swabs and of fetal material with both the human specific and the Y-chromosome specific RT-PCR quantification assays to determine if male DNA carry-over could be detected.

Results show that DNA quantitations using ABI's human specific and Y-chromosome specific RT-PCR quantification assays are more sensitive and specific than current methods. Additionally, low levels of male DNA can be detected in suspected mixture samples. We conclude that this assay will prove valuable in quantitating human DNA and male DNA for forensic work. This approach could prevent repeating downstream applications due to excess or minimal DNA inputs and also provide an estimate of the extent of mixed samples.

Quantification, RT-PCR , Mixtures

B60 XTC Characterisation Using ICPMS

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After attending this presentation, attendees will the participant will appreciate the possibilities and limitations of ICPMS for XTC comparison investigations.

This presentation will demonstrate new interesting forensic applications of ICPMS elemental and isotopic techniques which are presently developed and promise to result in much more strongly discriminating methods for forensic applications. The subject in the present presentation is just one of these applications but is very useful in demonstrating the relevance of these techniques. The relevance is also recognized by the international NITECRIME forensic network that has become active in this field. More information on this network can be submitted if requested.

Introduction. XTC (3,4-methylenedioxymethamphetamine or MDMA) is presently one of the most favored illegal party drugs. Important illegal production facilities are situated in the Netherlands. At the NFI, new analytical chemical methods are being developed to characterize and compare XTC materials. Results will be presented on the development and application of an ICPMS (Inductively Coupled Plasma Mass Spectrometry) method for this purpose. It is expected that such methods can be used to assist in discrimination between XTC materials from different producers and perhaps even between different production batches. Results from this technique will be combined with results from other techniques such as GC-MS and XRF to maximize discrimination.

Project goal. The goal of this project was to develop a validated forensic method and not so much to build a comprehensive collection of XTC data. However, as part of the validation process about 100 different XTC materials were investigated to obtain an indication of the variation in composition and the discrimination power of the method. Almost 100 apparently unrelated XTC samples from different seizures were supplied.

Method development. Early on in the project, it was decided to focus method development on sample digestion and ICPMS analysis of the resulting solutions. For method development and validation purposes, a large supply of homogeneous XTC powder was prepared by crushing and pooling a number of XTC tablets from one seizure. These tablets were selected on the basis of availability and their anticipated homogeneity.

Individual XTC tablets were crushed inside polythene bags, rather than being milled, to prevent contamination from metals present in milling equipment. The resulting powder was homogenized by coning and quartering. 200 mg of the resulting material was placed inside precleaned quartz microwave digestion vessels into which concentrated nitric acid (5 ml, 65% *m/m*) and hydrogen peroxide (1 ml, 30% *v/v*) were then pippetted. These are typical ICPMS digestion reagents suitable for many sample types and bring the elements present in the samples into solution. The nitric acid dissolves the inorganic components whilst the hydrogen peroxide oxidizes any organic material.

Sample digestion. Samples were digested in a closed vessel microwave digestion unit (Multiwave, Anton Paar, Austria). The digestion scheme was based on a published scheme used by Comment *et al*. but simplified since in our system we have pressure and temperature regulation feedback. Step 1 was a linear ramp from 700 watt to 1000 W over 15 min., step 2 was 1000 W for 10 min. and step 3 a cooling down period of 30 min. During step 2 the irradiation power is controlled by a feedback loop such that a pressure of 75 bar was maintained. Under these conditions, the temperature during step 2 was typically 280°C. The digestion was optimized by varying the length and irradiation power of steps 1 and 2. The concentrations of selected elements (Mg, Al, Ca, Mn, Fe, Zn, Sr, Ba) were determined by ICP AES to arrive at the final digestion conditions. After cooling, the samples were transferred to 50 mL plastic vessels (Sarstedt tubes) and diluted gravimetrically to volume with Milli-Q water. Just prior to analysis, an aliquot of each sample was diluted 10x to a final acid concentration of 3 % m/m HNO3. An internal standard mixture (Sc, Rh, Re) was added to these final dilutions.

Literature on the inorganic composition of illicit drugs is relatively small and even more limited for XTC. Two particularly invaluable sources are Comment et al. [1] and Goldmann (thesis ref) [2]. From these and other sources, the following initial list of elements, potentially present in XTC, was derived (with isotopes to be measured): ^{23}Na, ^{24,25}Mg, ^{43,44}Ca (likely present at high concentrations); ^{27}Al, ^{29,30}Si, ^{39,41}K, ^{47}Ti, ^{52,53}Cr, ^{57}Fe, ^{63,65}Cu: (v possibly present at high concentrations); ^{7}Li, ^{11}B, ^{55}Mn, ^{58,60}Ni, ^{64,66}Zn, ^{81}Br, ^{85}Rb, ^{88}Sr, ^{96,98}Mo ^{106,108}Pd, ^{121,123}Sb ^{132}Cs, ^{137,138}Ba, ^{194,195}Pt, ^{197}Au ^{202}Hg, $^{203, 205}$Tl, ^{208}Pb: (likely present at low concentrations). The anticipated concentrations are based largely on work carried out at the University of Lausanne. The presence of these elements can be attributed to catalyst residues, excipients, colourants etc. This list is not as extensive as for the multi-elemental analysis of heroin or cannabis where the soil composition influences the elements found in those drugs. The synthetic nature of XTC can be expected to preclude the kind of variation (especially rare earth elements) found in natural drugs.

ICPMS conditions. All ICPMS experiments used a quadrupole instrument (6100 DRC, Perkin-Elmer). Relevant instrumental parameters were: 1250 W rf forward power, 1.15 L/min nebulizer gas flow,

glass concentric spray chamber with a Meinhard nebulizer (sample uptake rate ~ 1 or 0.4 mL/min depending on conditions). Daily performance and calibration experiments were performed to verify adequate instrumental performance. The ICPMS method was developed and refined in stages, the most important of which are described; e.g, some of the elements in the above list were not found in any of the samples so that a modified list was used. The influence of various other experimental parameters were investigated to result in a reliable analysis method. The absence of matrix effects was demonstrated by standard addition calibrations yielding the same gradients as external calibrations. Quantification was by external calibration with internal standardization.

Results. Preliminary results of the statistical analysis of the ICPMS data showing possible relations between the samples are presented.

References. [1] Analyse élémentaire de pilules d'ecstasy par ICP-AES et ICPMS, Stéfane Comment, Université de Lausanne, mai 1998.
[2] These de doctorat "l'Analyse des colorants presents dans les comprimes illicites," Till Goldmann, Licencie en Sciences forensiques de l'Université de Lausanne, 2000.

XTC, ICPMS, ICP AES

B61 The Identification of Human Saliva

Arthur W. Young, BS and Jennifer Regalia, MSFS, National Medical Services, 3701 Welsh Road, Willow Grove, PA 19090*

After attending this presentation, attendees will understand a rapid, specific, and sensitive test that can be used to identify human saliva.

This presentation will a method allowing forensic scientists a single conclusive test for human saliva rather than only presumptive tests for saliva.

For many years, there has been no easy and conclusive test for human saliva. In forensic practice, the test for amylase has been a commonly used method as a presumptive test for the indications of saliva. Unfortunately, under certain circumstances, amylase can be detected in semen, blood, and plant sources, as well as saliva from other mammalian species, hence, the need for a more conclusive test. This study shows a method of testing using anti-human salivary amylase that is specific to human saliva. The test utilizes the classic antibody-antigen reaction which results in a precipitin band. It can be run in an agarose gel using either double immunodiffusion or crossed-over techniques. Several species have been tested including commonly found domestic animals such as feline and canines with no cross-reactivity. Other body fluids and purified plant sources also show no cross-reactivity with this test. The research in this study indicates that by using a specific anti-human amylase antibody, a rapid, specific, and sensitive result confirming human saliva can be obtained.

Saliva, Amylase, Antibody

B62 Internal Validation of the AmpF*l*STR® Identifiler PCR Amplification Kit for Casework Use With the ABI Prism 310 Genetic Analyzer

Steve O'Dell, MSFS, Carl Mauterer, MSFS, Debbie Dodd, MSFS, and Angelo Della Manna, MSFS, Alabama Department of Forensic Sciences, 501 12th Street South, Birmingham, AL 35233*

After attending this presentation, attendees will be presented with a summary of the appropriate measures taken to implement the use of a new capillary electrophoresis platform, the ABI Prism 310 Genetic Analyzer, in combination with validating a new single amplification kit, AmpF*l*STR® Identifiler, for the development of the 13 core CODIS STR loci for use in forensic casework.

This presentation will demonstrate a complete and thorough internal validation study according to the quality assurance standards set forth by the Forensic DNA community for the adoption of both a new instrument platform and multiplex kit to increase forensic DNA casework productivity.

The ABI Prism 310 Genetic Analyzer is a single capillary automated electrophoresis platform capable of processing approximately 48 DNA samples per 24 hour period depending on the run parameters (i.e., sample run time, sample injection time, etc…). The AmpF*l*STR® Identifiler™ PCR Amplification kit is a 5 dye short tandem repeat (STR) multiplex assay that amplifies 15 tetranucleotide repeat loci and the Amelogenin gender determining marker in a single PCR amplification. Prior to casework implementation of the AmpF*l*STR® PCR amplification kit on the ABI Prism 310 Genetic Analyzer, internal validation studies must be conducted. In accordance with section 8.1.2.2 (developmental validation), and sections 8.1.3.1 (a) and (b) (internal validation) of the FBI's Quality Assurance Standards for Forensic DNA Testing Laboratories, the Alabama Department of Forensic Sciences completed the forensic validation of a capillary electrophoresis system in conjunction with the AmpF*l*STR® Identifiler™ single amplification kit. Results of validation studies conducted at the Alabama Department of Forensic Sciences Birmingham DNA Laboratory showed: sensitivity down to 100 picograms when analyzed with a 75 RFU threshold; mixture studies exhibiting a full minor component profile at a 1:4 ratio and a partial minor component profile at a 1:19 ratio; reproducible allele results over 20 separate amplifications and injections conducted over a 3 day period with the 9947A positive control; and a precision of <0.13 base for all alleles. These results support the adoption of the ABI Prism 310 Genetic Analyzer for use in forensic casework with the AmpF*l*STR® Identifiler™ PCR Amplification Kit at the Alabama Department of Forensic Sciences Birmingham DNA Laboratory.

Forensic Science, Identifiler™, Internal Validation

B63 Missing Persons: Genetic Tools That Can Help Identify Remains

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After attending this presentation, attendees will learn the way we're succesfully using a DNA database to identify missing persons, and the best ways to implement it with the maximum benefits for society and forensic sciences.

This presentation will impact the forensic community by demonstrating the importance of non-criminal genetic databases can be of great interest to solve social problems.

The Spanish Ministry of the Interior has implemented a National Program to attempt to identify cadavers and bones from missing persons. The program was named "Phoenix Program" and it began in 1999. It is comprised of two independent genetic databases. One of the databases is known as the Reference Database (RD). The RD initially contained mtDNA sequences from maternally related relatives of missing persons. The reference samples are provided voluntarily. The second database is known as the Questioned Database (QD). The QD is comprised of mtDNA sequences obtained from bones or cadavers that cannot be identified or that were not identified by routine and traditional procedures, such as fingerprints, anthropology, odontology, x-rays, etc.. In all cases,

the analysis and storage of mtDNA profiles from unidentified remains requires authorization from a judge, as mandated by Spanish law. After mtDNA analysis provides a link (or a match) and if possible, the 13 STR loci included in the US database (CODIS) are analyzed. Recently, samples in the RD have begun to be analyzed for Y chromosome STR loci (to provide paternal lineage references for analysis).

The standard operating analytical protocol is similar to that described by Wilson et al (1995) and the nomenclature is that recognized by the ISFG with modifications as described by Wilson et al (2002). Once placed in the databases, DNA sequences (both nuclear and mitochondrial) automatically are compared to identify matching or related profiles (i.e., family reconstructions), so that identifications of unknown remains may be possible.

This process for molecular biology identification to augment other identification procedures has been used in a number of cases in Spain, Colombia, Chile, Peru, Mexico and the USA, with positive results. A number of cases that could not be resolved just a few years ago by traditional anthropological means has now been solved with the use of DNA analysis. Exemplar cases and interesting issues related to genetic identity will be presented at the meeting.

DNA, Missing Persons, Human Rights

B64 The Missing of the Former Yugoslavia – The Evolving Role of DNA in the Identification Process

Edwin F. Huffine, MS, Rijad Konjhodzic, BS, Jon M. Davoren, MS, Adnan Rizvic, MS, and Daniel Vanek, PhD, International Commission on Missing Persons, Alipashina 45a, Sarajevo, 71000, Bosnia and Herzegovina*

After attending this presentation, attendees will understand the development, incorporation, and impact of a high throughput DNA testing system on the identification efforts in the former Yugoslavia will be detailed.

This presentation will highlight the role of DNA testing in the identification of mass disasters victims and the rapid improvement of such technology.

During the 1990s breakup of the former Yugoslavia during, several hundreds of thousands of people were killed, of which up to 40,000 remained unaccounted for after the end of the armed conflicts. The International Commission on Missing Persons (ICMP) was created at the G-7 conference in Lyon, France in 1996 with the mission of aiding in the identification of these. As the exhumation of mass graves began in 1996, it became apparent that the use of 'classic' forensic identification techniques, i.e., those not utilizing DNA testing, would frequently be unable to establish the identity of recovered bodies. This problem was especially pronounced in identifying the bodies from secondary mass graves and by 1999, thousands of bodies had been recovered that could not be identified.

The loss of life in Slovenia required only minimal DNA testing. In Croatia, thousands of individuals lost their lives and a system was developed in which DNA testing is an option for those cases in which classic forensic techniques prove insufficient for identification. However, it was for the tens of thousands of missing in Bosnia and Herzegovina for which the evolution of the DNA process had has the greatest impact in terms of the number of individuals identified. Initially, no cases from Bosnia and Herzegovina were DNA tested and the identification process was based wholly upon classic methods. Since virtually no medical records existed in Bosnia and Herzegovina, the accuracy of such identifications was a source of debate. Beginning in 1998, samples from a few presumptive cases were sent out of country for DNA testing. The results obtained were used to either confirm or refute the presumption of identity, and it was not uncommon for more than a year to pass before DNA results were returned. The application of DNA on such a small scale had only a minimal impact, but it did demonstrate that DNA testing had the potential of giving answers to the families of the missing.

In order to help address the identification process of thousands of missing, the ICMP developed a state-of-art DNA testing system within the former Yugoslavia, consisting of four DNA laboratories located in Sarajevo, Tuzla, Banja Luka and Belgrade. These four DNA laboratories must work together as a system in order to bring answers to the families of the missing. All data obtained from these four DNA laboratories is submitted to the central computer system in Tuzla, Bosnia and Herzegovina. Additionally, eight blood collection centers were established and a comprehensive, centralized computer system was created in which all data relating to the missing is stored. All blood and bone samples collected in Bosnia and Herzegovina as well as the Serbia, including Kosovo, are submitted to ICMP's central Identification Coordination Center (ICC) located in Tuzla, Bosnia and Herzegovina. (It was in early 2002 when large number of bone samples began to be submitted to the ICMP from Kosovo and later that year when bone samples were sent to the ICMP from Serbia proper.) All samples are bar coded at the ICC and then distributed throughout the ICMP DNA laboratory system according to the type of sample and DNA testing required. Once a DNA report has been generated, it is given to the pathologist in charge of the case, who is usually the person who submitted the bone sample. It is the legal responsibility of this pathologist to contact the family and officially close the case.

By the summer of 2003 this system was generating between 300 – 400 DNA reports per month. Once a DNA match report has been returned to the pathologist, he/she will review ante mortem records, articles of clothing and personal effects, and the body to ensure consistency between these 'classic' forms of evidence and the alleged identity of the individual as developed by DNA testing. The magnitude and success of this DNA testing system has altered the role of DNA testing in the former Yugoslavia where DNA testing is now frequently used to produce the initial lead with other identification methods assuming the confirmation role. As a result, names are being returned to thousands of missing.

Human Identification, ICMP, DNA

B65 Mutations in the DNA Matching Reports of Persons Identified Throughout the Former Yugoslavia

Ana Milos, BS, Arijana Pozder, BS, Dijana Kadric, BS, Jon M. Davoren, MS, Rijad Konjhodzic, BS, and Edwin F. Huffine, MS, International Commission on Missing Persons, Alipasina 45a, Sarajevo, 71000, Bosnia and Herzegovina*

This presentation will discuss the apparent mutations that have been observed during the course of matching the STR profiles of blood reference samples to that of bone samples.

This presentation will impact the forensic community and/or humanity by presenting data to describe the mutations that have been observed during the process of identification of missing persons from throughout the former Yugoslavia.

This presentation will discuss the apparent mutations that have been observed during the course of matching the STR profiles of blood reference samples to that of bone samples.

The International Commission on Missing Persons has developed a DNA led system for the identification of the estimated 30,000 – 40,000 missing persons from throughout the former Yugoslavia. This DNA led system involves typing of both family reference and bone samples as one of the first steps in the identification process. Following DNA testing, results are stored in databases and software looks for matches between

bone and family reference samples. This approach accelerates that identification process for samples as it uses the DNA matches as the first piece of evidence in the process. Traditionally DNA testing has been used to confirm identifications performed by a pathologist.

Although the identification process is accelerated by using DNA matches as the initial lead in the identification process there are some limitations of such a system. One limitation is the requirement to produce reliable STR profiles from bone samples. A second limitation is that there is a need for at least 15 STR loci in order to provide strong statistical significance to the DNA match. A third limitation is that STR loci can mutate and thereby reduce the statistical significance of the match. The ICMP has been able to overcome the first limitations through the development of extraction technique. The second limitation has been overcome by the amplification of up to 19 different STR loci from the Promega PowerPlex® 16 kit and the ABI SeFiler® kit. The third limitation is much more difficult to overcome however if enough loci are amplified they will eventually show that the suspected match is real or just a random chance occurrence.

The ICMP has generated over 4000 DNA matching reports related to missing persons from throughout the former Yugoslavia and is currently matching samples at a rate of 300 – 400 per month. In these reports there have been a number for which it has been observed that the STR profile in a parent is different from that of a child. The presence of a single difference between related people has been observed to occur between reference samples as well as between bone samples and the family relatives.

STR, Mutations, PowerPlex16

B66 A Comparison of the Sensitivity of the Power Plex®16, Identifiler®, and SeFiler® Kits for the STR Testing of 9 – 12-Year-Old Bone Samples Throughout the Former Yugoslavia

Edina Omerovic, BS, Lejla Smajlovic, BS, Jon M. Davoren, MS, Rijad Konjhodzic, BS, and Edwin F. Huffine, MS, International Commission on Missing Persons, Alipasina 45a, Sarajevo, 71000, Bosnia and Herzegovina*

The goal of this presentation is to compare the sensitivity levels of the Power Plex®16, Identifiler®, and SeFiler® kits for producing STR profiles on DNA from bone samples. These three kits have differences in the quality of profile that is produced when used to amplify DNA from 9 – 12 year bone samples. Optimizations, of a number of parameters, have been performed for each of these kits and will be discussed.

The breakup of the former Yugoslavia left approximately 30,000 – 40,000 missing persons. For most of these people there were no medical records that could aid in the identification process so that left DNA testing as the only method for identification of mortal remains. One of the difficulties of mass testing of bone samples is that DNA isolated from virtually every bone exhibits significant levels of degradation, contamination by microbial DNA, and inhibition of PCR amplification.

In an attempt to overcome these limitations the ICMP has optimized the Promega PowerPlex® 16, the Applied Biosystems Amplf STR Identifiler® and the Amplf STR SeFiler® kits for the amplification of DNA from 9-12 year old bone samples. Each of these kits has been optimized for cycling parameters, amounts of *taq* polymerase and magnesium concentration. Initial findings show that on average the PowerPlex16 system amplifies the most loci however it also produces more non specific amplification products that the other two kits.

DNA, STR, PowerPlex® 16

B67 Population Study on 20 Intronal SNP's as a Guideline for Use in Forensics

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The goal of this presentation is to discuss the results of a SNP population study using the Applied Biosystems Taqman® assay. This study is part of a larger project aimed at the development of a rapid and inexpensive SNP tests that provides enough discrimination to be useful as a tool in forensic casework.

This presentation will impact the forensic community and/or humanity by demonstrating the potential of using of SNPs in terms of identification of victims of mass diasters.

There are currently a number of methods available for SNP testing including Taqman®, Snapshot®, pyrosequencing, and GC-MS. Each of these techniques has been developed for different purposes and each has advantages and disadvantages for different uses. For forensic testing an ideal technique would ideally be inexpensive, robust, allow high throughput and have low requirements for DNA quantity and quality.

For some time, testing of Single Nucleotide Polymorphisms, or SNPs, have been used as a molecular biology method, mainly for medical research, although there have been implementations in forensics, with various degrees of success. However, the very nature of a SNP, as a potential single base difference, makes it attractive for forensic scientists, who in their work are forced to deal with not only very low quantities of DNA template, but also a degraded ones.

As a first step, the feasibility of the Taqman® assay was evaluated as a potential forensic testing method. Twenty tested SNP's, located in intronal sequences and with the a lesser allele having a frequency of above 40% were selected from the Applera SNP database. The 20 SNPs were genotyped by 5' nuclease reactions using TaqMan MGM probes. The amplification, which is very simple, and allows preparation of large numbers of samples in short periods of time. Amplifications were performed done on an Applied Biosystems 9700 master cyclers, and a post PCR read for allelic discrimination was performed done on an Applied Biosysytems SDS 7700.

SNPs, ICMP, DNA

B68 A Comparison of the Statistical Significance in the Loci of the Promega Powerplex® 16 System From Identified Remains

Sinisa Nacic, BS, Edina Omerovic, BS, Lejla Smajlovic, BS, Jon M. Davoren, MS, and Edwin F. Huffine, MS, International Commission on Missing Persons, Alipasina 45a, Sarajevo, 71000, Bosnia and Herzegovina*

After attending this presentation, attendees will get a idea of the statistical significance of each of the Promega PowerPlex® 16 loci when used for identification of missing persons from the former Yugoslavia.

This presentation will impact the forensic community and/or humanity by providing useful information for people using STR systems for large scale identification work.

The ICMP has developed a DNA-led identification effort to assist in the identification of the estimated 30,000 – 40,000 missing persons who remain missing as a result of the breakup of the former Yugoslavia. Due to the conditions of the recovered bodies, coupled with a relative lack of medical and dental records, the vast majority of bodies currently being recovered cannot be identified without the use of DNA testing. Currently more than 10,000 bone samples and 43,000 blood samples have been successfully tested with the Promega PowerPlex® 16 system. The process of matching STR profiles from the reference database to profiles in the missing person database is challenging, especially considering the large number of samples in these databases.

The vast majority of the missing has either a parent or a child as a blood donor. Because of this fact, the ICMP has developed software that performs an initial search based upon half-band sharing patterns. Due to the large size of the database, random half-band sharing matches are relatively common for any given bone sample. In order to determine a random match from a true match, additional factors are addressed. First, blood samples are taken from multiple donors for each missing person, and the DNA profiles from all blood donors must correspond to the potential match with the bone sample. On average the ICMP collects three blood references for each missing person. Once a match is found to exist between a bone sample and multiple donors from the same family, the statistical significance of the match is determined using DNAview software. The DNAview software gives a likelihood ratio (LR) for the significance of the match at each locus. Following the LR analysis, matches that produce a posterior probability of 0.9995 or larger are considered strong enough to generate a matching report. For the matches where the posterior probability is less than 0.9995, additional family reference samples are sought, which can strengthen or exclude the match. When there are no additional family relatives available to donate a blood sample, additional loci can be tested. It should be noted that the DNA report does not stand alone in the identification process. After the pathologist in charge of the case receives the DNA report, they combine all other forensic evidence together in order to make the identification.

To examine the effectiveness of the alleles in the Promega PowerPlex® 16 system the LR produced by each locus in the matching reports generated by ICMP have been examined. Initial results show that Penta E produces, on average, the strongest LR. Other loci such as TPOX and CSF1PO produce much lower likely hood ratios in matching reports. The substitution of the loci that produce relatively low LR ratios for ones that produce greater discriminating potential could simplify the identification process by reducing the number of random half-band sharing matches that occur upon initial screening.

DNA, DNAview, Statistics

B69 The Analysis of Gamma-Hydroxybutyric Acid (GHB) and Gamma-Butyrolactone (GBL) in Forensic Samples Using Gas Chromatography/Mass Spectrometry (GC/MS) and Proton Nuclear Magnetic Resonance (1H NMR)

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After attending this presentation, attendees will be presented information on the interconversion between GHB and GBL in solution at different pH's and time before analysis. Also, a method for the analysis of GHB will be presented which does not cause inadvertent conversion between GHB and GBL during sample preparation and analysis and still maintains the sensitivity, precision and linearity of other methods currently employed.

This presentation will facilitate a more thorough understanding of the relationship that exists between GHB and it's lactone, GBL, in solution. This understanding is necessary to ensure the full characterization of the sample and accurate interpretation of results. A method for analysis of GHB is presented which does not cause inadvertent conversion between GHB and GBL and still maintains the sensitivity, precision and linearity of other methods currently employed.

Gamma-Hydroxybutyric Acid (GHB) is an endogenous compound found in the central nervous system (CNS) and peripheral tissues. GHB, a CNS depressant, is abused recreationally for its purported euphoric and relaxation effects and for the purposes of drug facilitated sexual assault (DFSA) due to its sedative and amnesic effects. The dramatic increase in the abuse of GHB over the past decade has created the need for analytical methods to detect GHB in a variety of matrices. Specifically, the growing use of GHB for the purposes of drug facilitated sexual assault calls for the development of a method to determine if GHB is present in a drink that is suspected of having been spiked.

The analysis of GHB has presented some analytical difficulties in forensic laboratories due to the equilibrium that exists between GHB and its lactone, GBL, in solution. Many methods currently employed may inadvertently cause conversion between GHB and GBL during sample preparation and analysis. A thorough understanding of the relationship that exists between GHB and GBL under different conditions in solution can be used to guide analytical methodology so that unintentional sample manipulation does not occur.

In an effort to determine the effect of pH and time before analysis on the interconversion between GHB and GBL, a study was conducted using 1H NMR. Solutions of GHB and GBL were buffered to different pHs (2.2, 3.1, 4.5, 6, 7.1, 8, 10) using a 1M phosphate buffer prepared in deuterium oxide. Solutions of GHB and GBL in pure D2O were also analyzed. The samples were stored under ambient conditions and analyzed at time zero and at selected time intervals thereafter for several months using 1H NMR. Each solution was prepared and analyzed in triplicate. The area of resonance lines known to originate exclusively from GHB and GBL were ratioed to each other to determine the percentages of GHB and its lactone in solution at a particular pH and time.

pH was found to have a significant effect on the interconversion between GHB and its lactone in solution. With this information in mind, a method was developed that avoids sample manipulations such as pH adjustment that could cause inadvertent conversion between GHB and GBL. In the method developed, solid phase microextraction (SPME) which is a fast, simple and solvent free method for the extraction of drugs directly from aqueous samples was used for extraction and preconcentration of GHB. Extracted GHB was then derivatized on-fiber using a silylating agent (BSTFA/TMCS). Derivatization offers several advantages: It imparts thermal stability so that conversion of GHB to GBL in the heated injection port of the gas chromatograph will not occur. Also, by derivatizing GHB, a less polar and more volatile compound with better chromatographic properties is analyzed. Gas chromatography-Mass spectrometry (GC/MS) was then used for the separation and detection of derivatized GHB.

The method detects GHB in aqueous based matrices with good sensitivity, high precision, excellent linearity from 0.01 mg/mL to 0.25 mg/mL and without the need for sample manipulation that could cause interconversion between GHB and its lactone. The method was successfully applied for detection of GHB in water as well as in several alcoholic and non-alcoholic beverages.

Gamma-Hydroxybutyric Acid, Interconversion, Solid Phase Microextraction

B70 DNA – STR Analysis of Blood Reference Samples From Throughout the Former Yugoslavia

Izet Eminovic, PhD and Edwin F. Huffine, MS, International Commission on Missing Persons, Alipasina 45a, Sarajevo, 71000, Bosnia and Herzegovina; Nijaz Tihic, MD and Vesna Hadziavdiael, MS, International Commission on Missing Persons, Alipasina 45a, University Clinical Centre of Tuzla, Sarajevo, 71000, Bosnia and Herzegovina; Jon M. Davoren, MS and Rijad Konjhodziael, BS, International Commission on Missing Persons, Alipasina 45a, Sarajevo, 71000, Bosnia and Herzegovina*

After attending this presentation, attendees will be given an overview of the International Commission on Missing Persons (ICMP) high throughput blood testing facility.

This presentation will impact the forensic community and/or humanity by presenting the lessons learned in developing a high throughput blood STR processing lab

Attendees of this presentation will be given an overview of the International Commission on Missing Persons (ICMP) high throughput blood testing facility.

The International Commission on Missing Persons in the former Yugoslavia (ICMP) has been charged with the task of identification of an estimated 30,000 – 40,000 missing persons that remained following the breakup of the former Yugoslavia. For almost all of the missing persons from the former Yugoslavia the only practical approach to begin the identification process involved DNA testing. The only feasible currently feasible approach for this was to develop DNA STR profiles from bone samples and match those to family reference blood samples.

To date ICMP has collected, processed, and databased more than 50,000 blood samples from family references. The DNA was extracted from the blood samples using the S&S ISOCARD protocol. Extracted DNA was amplified using the Promega PowerPlex 16® system and analyzed on an ABI 3100 Genetic Analyzer. Over 98% success rates were observed for the procedure when using 50% of the recommended amount of the Promega PowerPlex® 16 kit in 12.5 il reactions.

DNA, STR, Blood

B71 Purification of DNA From Sperm Cells for Forensic Analysis Using a Sol-Gel Filled Microfabricated Device

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The goal of this research presentation is to demonstrate the utility of sol-gel microchip technology for extraction and purification of DNA from sperm cells for subsequent forensic analysis.

This presentation will describe efforts to improve conventional extraction of DNA from sperm to both improve the efficiency of the protocol and also decrease the amount of time needed to accomplish the assay. In addition, this work contributes to the overall goal of a fully-integrated, microchip based DNA analysis protocol to help eliminate the current backlog of casework.

Current techniques for DNA analysis require labor-intensive and time-consuming processes. These methods, though effective, have led to a dramatic backlog of casework, overwhelming crime laboratories at this time. In addition, data-basing efforts are hindered by this backlog of cases and, in the current condition, many cases simply go unanalyzed. As such, research efforts in forensics have focused on improving the methods associated with the analysis of DNA to develop a more rapid and efficient assay for casework profiling.

The application of microdevices to bioanalytical analyses has drastically reduced the time required to perform a wide variety of assays. As such, microdevices are currently being designed to improve the efficiency of processes associated with forensic casework analysis. A fully-integrated, microchip capable of performing the steps normally carried out on the bench-top would not only reduce the time required to perform these tasks, but would also eliminate user intervention and potential sources of contamination, as well as preserve more of the sample for future analysis. PCR and high-resolution DNA separations can currently be carried out on-chip, as well as solid-phase extraction of DNA from a variety of clinical and biohazardous samples. In addition, current research efforts are being directed to an on-chip differential separation of sperm and vaginal epithelial cells, with the ultimate goal of integration of all of these processes into one, fully-functional device.

The focus of the research presented here is the extraction of DNA from sperm cells, either directly from semen or removed from other evidentiary materials, such as vaginal swabs. Nucleic acid extractions from biological material have historically been a laborious process, requiring phenol-based extractions and other time-consuming methods. Recently, a shift to solid-phase extractions on silica or ion exchange resins has not only made DNA extractions more efficient, but these methods are also more amenable to incorporation into microchip-based devices. We have previously demonstrated the use of thermally-bonded borofloat glass microchip devices packed with silica beads for the purpose of DNA purification. Monolithic matrices prepared from a silica monomer, tetramethoxysilane or TMOS, can be easily created in the microfabricated device format. These have been shown to yield fast, efficient, solid phase extraction of DNA from a variety of biological materials. The process relies on the adsorption of DNA to the solid surface via hydrogen bonding. The work reported here investigated extraction and purification of DNA from semen, a complex biological mixture. Also highlighted is the extraction of DNA from a microchip purified sperm cell fraction. A method for extraction and purification is described, along with an elution profile for DNA from the solid phase in small volume aliquots. A detailed evaluation of extraction efficiency of DNA from semen using the microchip-based system is also described. The effect of DTT, a standard component in differential extraction of sperm cell DNA, on the extraction efficiency is presented, with conditions for optimum extraction efficiency detailed. Comparisons of the microchip extraction with conventional kit-based methods (Qiagen®, Promega®) are also presented. Finally, the suitability of the DNA extracted for subsequent PCR is demonstrated by COfiler™ and Profiler Plus™ amplification, with conventional analysis on ABI 310 instrumentation. This work represents one of the major steps required for the incorporation of a solid phase-based extraction process for DNA into either modular or fully integrated microdevices capable of total systematic DNA analysis for forensic casework.

Sperm, DNA, Microchip

B72 GeneMapper™ ID Software Test Plan Performed for Software Verification

Rhonda K. Roby, MPH, Cherisse Boland, BS, Yasser Daoudi, BS, Liwei Qi, MS, and Brenda Takara, MS; Applied Biosystems, 850 Lincoln Centre Drive, M/S 404-3, Foster City, CA 94404*

The goal of this presentation is to summarize the verification performed for GeneMapper™ ID Software v. 3.1, an integrated fragment analysis software application, on databasing- and forensic-simulated samples amplified with AmpFISTR® PCR Amplification Kits.

This presentation will describe and verify an excellent tool for genotyping of samples for forensic, databasing, and parentage applications.

GeneMapper™ *ID* Software v. 3.1 (Applied Biosystems, Foster City, CA, USA) was specifically designed to be a complete integrated software solution for forensic, paternity, and databasing laboratories performing STR analysis using ABI PRISM® genetic analysis instruments and AmpFISTR® PCR Amplification Kits for automated genotyping. This software analyzes the raw data collected from the ABI PRISM® instrument platforms and automatically identifies peaks, quantifies signal intensity, sizes each DNA fragment, and makes allele calls using defined panels and bin sets with its automated genotyping capabilities. A test plan, which Applied Biosystems has defined as verification of the software, was designed to develop a set of test criteria to evaluate the performance of this software in the human identification communities. The test plan lists approximately 50 key elements to evaluate the software's robustness, performance, and feature design.

Leibelt, *et al*. first introduced GeneMapper™ *ID* Software v. 3.1 at the American Academy of Forensic Sciences Annual Meeting, 2003. Additionally, a comprehensive concordance study of STR profiles of forensic-simulated samples (e.g., mixtures, degraded DNA, and inhibited DNA) generated with six (6) different AmpFISTR® PCR Amplification kits (Identifiler®, Profiler Plus®, COfiler®, SGM Plus®, and SEfiler™ kits), analyzed on four (4) ABI PRISM® genetic analysis instruments, and using various ABI PRISM® software packages for both data collection and data analysis was presented by Boland *et al*. (American Academy of Forensic Sciences Annual Meeting, 2003). Samples were processed on the ABI PRISM® 310 Genetic Analyzer (for both Macintosh® and Windows NT® operating systems), 377 DNA Sequencer (for both Macintosh® and Windows NT® operating systems), and 3100 Genetic Analyzer and 3100-*Avant* Genetic Analyzer. All samples were then analyzed using both GeneScan® software and Genotyper® software and compared to GeneMapper™ *ID* Software v. 3.1. Data were analyzed with GeneScan® Software v. 3.7.1 and Genotyper® Software v. 3.7, for use with Windows NT® OS; GeneScan® Software v. 3.1.2 and Genotyper® Software v. 2.5.2, for use with Macintosh® OS; and GeneMapper™ *ID* Software v. 3.1 in Classic and Advanced modes. The combination of these studies and associated data have led to a comprehensive verification test plan for GeneMapper™ *ID* Software v. 3.1.

The verification test plan requires that features such as workflow; data handling; peak detection and sizing; HID algorithm testing; and CODIS functions be evaluated with a pass/fail criteria. These criteria include: allele number error for loci containing more alleles than specified in the analysis method; out of bin alleles; peak height ratios, low peak height and spectral pull-up levels specified by the user; broad peaks when the width of the called peak is wider than a specified value; off-scale; control concordance when the designated control sample's genotype does not exactly match the definition; and overlap for peaks positioned within the overlapping size range of two markers.

GeneMapper™ *ID* software includes three peak detector algorithms allowing different levels of user control over data analysis. The "classic" mode produces very similar results as those analyzed with GeneScan® Software v. 3.1.2 designed for the Macintosh® operating system. This algorithm aids in the adoption of GeneMapper™ *ID* software for laboratories currently using GeneScan® software developed for use with the Macintosh® OS wanting to maintain current interpretation guidelines. The "advanced" mode provides the user with the same analysis parameters available in GeneScan® Software v. 3.7.1, designed for use with the Windows NT® operating system, including several improvements made to the algorithm. An additional "basic" mode allows for analysis using limited parameters consisting of a user defined minimum peak height threshold. Additional features new to the software include CODIS export functionality, automated sample concordance checking and search capability within the GeneMapper™ *ID* software database. The design for verification testing and the results from the verification testing will be presented.

Software Verification, GeneMapper ™ ID Software v. 3.1, AmpFISTR® PCR Amplification Kits

B73 It May Have Two Sides, But It Is the Same Coin

Peter R. De Forest, DCrim, Professor of Criminalistics, John Jay College of Criminal Justice, 445 West 59th Street, New York, NY 10019*

After attending this presentation, attendees will have increased awareness concerning the implications of law-induced asymmetries that arise in applying science to physical evidence analyses and interpretations.

The marriage between law and science is a difficult one. Each of these professional pursuits has a different purpose. In the physical evidence arena, lawyers may wish to control the dissemination of scientific information generated on behalf their clients. All of the legal machinations related to access cannot be allowed to affect the objectiveness of the science. Scientists must hold to a high standard and play no role in manipulating the science to fit the case needs. The science must not be compromised. The session theme of "two sides of the same coin" offers the opportunity to contrast the perspectives of science and the law with respect to the results of physical evidence analyses. By way of an oversimplified analogy lawyers may only see one side or the other of the coin, or want to, while the scientist is obligated not only to recognize the two different sides but also to see it as a single coin. Where two scientists disagree, there is a problem. Science requires objective analysis and attempts to reach a consensus. Two competent scientists examining the same evidence should reach the same conclusions. If this is not the case, there is a serious problem. One or both are wrong, or the subject is not properly the subject of a scientific inquiry. Cavalier attitudes such as "you are entitled to your opinion and I am entitled to mine" are not appropriate. Every effort should be made to resolve differences of opinion. There is also a need to recognize when one is dealing with the "opinion of a scientist" as opposed to a *scientific opinion*. There is a distinct difference. The former may have no scientific basis. If so, it is out of place in any scientific report or legal proceeding.

The way this scientific information is used in a legal proceeding is in the province of the attorneys. In criminal cases the asymmetry in the management of information is most extreme. The prosecution as the representative of the state is obligated to make all relevant scientific information available to the defense. Evidence generated by the defense, on the other hand may be regarded as "work product" and protected from discovery. Details of the rules differ with jurisdiction. Experts for the defense may have access to, and assess the results and interpretations obtained by the state's experts, but the reciprocity may not be observed unless defense experts are offered as witnesses.

Science-Law Interface, Reciprocal Discovery, Criminalistics

B74 Evaluation of Anomalous Data

Steven J. Avato, BA, Bureau of Alcohol, Tobacco, Firearms & Explosives, 800 K Street, NW, Suite 710, Washington, DC 20001*

The goal of this presentation is to remind forensic scientists and criminal investigators of the importance of critically evaluating evidence recovered from crime scenes to determine its proper significance within the context of the overall scene. Items recovered at a scene may be critical in determining the facts of an investigation, or may lead investigators to draw erroneous conclusions. A case study will illustrate the serious consequences associated with improperly interpreting anomalous evidence.

This presentation will impact the forensic community and/or humanity by serving as a reminder of the importance of critically evaluating forensic evidence in the context of the totality of a scene.

The proper evaluation of forensic evidence requires assigning a "weight" to the importance of each piece of evidence. Investigators must decide the significance of each item recovered from a crime scene. Many scenes, and particularly fire scenes, present anomalous and sometimes conflicting data that must be carefully considered to determine what role, if any, they play in establishing a scene fact pattern. The investigation of fires, like most historical reconstructions based on science, requires investigators to gather evidence, analyze the collected data and form reasonable hypotheses based on the analysis of the evidence. Many times, all of the evidence converges and a single, clearly defined origin and cause can be determined. During other investigations, insufficient data is available on which to base a valid origin and cause conclusion. Still other investigations present a more challenging dilemma for fire investigators. In these cases, data is collected that may be unexpected or unanticipated within the context of the scene. Such findings may reasonably allow for diametrically opposed cause determinations. That two opposing conclusions can be drawn from the same data may be anathema to forensic scientists, however Thomas S. Kuhn stated that "Philosophers of science have repeatedly demonstrated that more than one theoretical construction can always be placed upon a given collection of data."[1] For example, the presence of kerosene recovered from fire debris samples may corroborate the hypothesis that an ignitable liquid was deliberately poured in an effort to accelerate flame spread. However, the liquid having been spilled during the filling of a kerosene heater might reasonably explain the same finding of kerosene. Another hypothesis could explain the kerosene as the residue of chemicals endemic to the scene. Additional information will be needed in order to properly evaluate the significance of the kerosene's discovery. Was a kerosene heater present that might support the accidental spill hypothesis? Was the kerosene found only in baseboard wood samples, suggesting that it might be the residue of an insecticide carrier? Does the fire damage match that expected from the fire dynamics of an accelerated fire? The fire investigator must thoroughly evaluate all of the possible explanations before determining the merit of the finding within the context of the incident scene. The key to successfully uncovering the truth in such cases lies in determining whether the unexpected discovery is, in fact, an anomaly or a crucial piece of evidence on which to base a new hypothesis.

Section 15.1 of the National Fire Protection Association's (NFPA) Guide for Fire and Explosion Investigations (NFPA 921) states that "In some instances, a single item, such as an irrefutable article of physical evidence … can be the basis for a conclusive determination of origin. In most cases, however, no single item is sufficient in itself." When evidence is observed and analyzed, investigators must make a judgment as to the relative significance of that item. What happens to an investigation if an investigator assigns a disproportionate valuation to that single evidentiary item? In the context of a fire origin and cause investigation, the answer to this question could be the difference between the determination of an accidental fire cause and an intentional, incendiary act. In the case study to be presented involving the investigation of a fatal house fire, such an anomalous finding in debris samples taken from the room of fire origin was encountered. The discovery of gasoline in the fire debris samples was the basis for a determination that the fire was incendiary, and consequently, the arrest of a man on capital murder charges. A brief factual synopsis will be presented as the background for a discussion on the weighing and evaluation of a single piece of evidence against the totality of circumstances found at an incident scene.

[1]Kuhn, Thomas S. The structure of scientific revolutions – 3rd ed. Chicago: University of Chicago Press, 1996.

Crime Scene Investigation, Fire Investigation, Critical Thinking

B75 Surviving the Stigma of a Wrongful Conviction Case

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After attending this presentation, the participant will understand that following a crisis over a wrongful conviction it is possible to restore the confidence of the justice system and the capability of the forensic laboratory.

In 1996 the Ontario Government called a Commission of Inquiry into the wrongful murder conviction of Guy Paul Morin, in which hair and fiber evidence played a pivotal role. As a result of that Inquiry the Centre of Forensic Sciences shared a considerable amount of blame with its justice system partners; the staff of the Centre, who had seen themselves as independent and impartial participants in the criminal justice process, were particularly affected. Following the Inquiry, the Centre became a focus of the media, the defense bar and even trial judges in proceedings involving all of the service disciplines, not solely hair and fiber. At the same time, though, there was a silver lining to this dark cloud, which was the opportunity for change and improvement.

This presentation will relate how we were able to secure the support of Government to commit resources, a chronic problem for forensic laboratories, to implement change in management practices and accountability, quality assurance systems and reporting practices. By emphasizing our objectivity as scientists, our openness to external scrutiny with our client groups through the creation of an advisory body comprised of members of the whole justice community - investigators, prosecutors, defense counsel, judiciary, and scientists - and a commitment to quality, we have been able to restore the confidence that our organization has traditionally enjoyed.

Wrongful Conviction, Quality, Organization Change

B76 Independent Analysis of Physical Evidence in Criminal Cases—A Defense Perspective

Edward E. Hueske, MA, Forensic Training & Consulting, LLC, 541 Halifax Lane, Coppell, TX 75019*

After attending this presentation, attendees will understand why it is prudent for the defense to review and/or reanalyze the physical evidence in criminal cases.

This presentation will reinforce the need for independent examination of evidence on behalf of the defense. This is not intended to be an indictment of law enforcement crime laboratories, law enforcement personnel or anyone else, but just serves to show the value of getting a second opinion in any serious matter where life, death or personal freedom are at stake and human error could be involved.

This presentation will provide the high lights of two shooting incidents in which an independent reconstruction of each of the shootings

yielded information of significance to the defense effort. These cases illustrate that there can be aspects that support the defense theory that can be over-looked by the original examiner. Honest mistakes and misinterpretations can also happen such that what appear to be "slam dunks" for one particular theory may not necessarily be so.

Case 1: The first case involves a woman accused of having shot her boyfriend as he sat across from her on a sofa-bed in a camper trailer. The decedent had a near contact shot to the right forehead that exited behind his right ear. The exiting bullet then passed through a partition at the end of the sofa-bed, struck the side of the range that was behind it and fell to the floor where the bullet was recovered.

The account of the shooting given to police by the woman had the decedent on the floor of the camper and under a table with him shooting himself. From this position, the bullet would have had to be traveling upward when it struck the partition.

The crime scene investigators focused on the fact that the exit hole in the partition was lower than the entry hole, indicating a downward trajectory. This, of course, was at odds with the defendant's version of events. They further pointed out that bloodstains were on the curtain behind the sofa-bed and on top of the sofa-bed and that these too were inconsistent with the decedent being down on the floor.

An independent examination/reconstruction was carried out in which it was learned that the bullet actually was deflected after entering the partition, thus giving the appearance of a downward trajectory when the true trajectory was upward. It was also learned that the bloodstains on the sofa-bed resulted from paramedics placing the decedent's bloody shirt there while attending to him.

A bloodstain on the wall down at the floor was clearly back spatter from the gunshot. This, along with the trajectory determination, resulted in charges against the woman being dropped.

Case 2: The second case involves a man accused of intentionally firing a rifle directly into a crowd, striking and killing a young girl. The girl was struck in the forehead by the bullet, a 7.62 x 39 steel post Chinese round that did not exit her skull.

The defendant's version of events was that he fired only warning shots into the ground and that he never fired directly at the little girl. Although there were a number of apparent bullet strikes in the ground at the scene, the prosecution pointed out that a bullet hole in a window screen behind the victim's position indicated direct fire.

In reexamining the evidence, it was noted that the bullet that was recovered from the victim had a flattened side. Autopsy photographs showed a large, irregular entrance wound in the child's forehead.

A reconstruction of the shooting indicated that a ricochet was probable. The bullet condition, the entry wound appearance, and the failure of the bullet to exit the victim's head in spite of being a steel post bullet were all consistent with a ricochet. Based upon this evidence, the defendant was convicted of a lesser charge.

Shooting Reconstruction, Re-analysis, Physical Evidence

B77 Seeing Both Sides of the Coin

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The goals of this research project are to show the difference in perspective between the prosecution/plaintiff and the defense in fire litigation.

A case study will be utilized to show the difference in perspective between the prosecution/plaintiff and the defense for fire litigation. Slides of the case study will be available to spark discussion. The facts, legal issues, investigations and laboratory tests of the case study will be given in this abstract. Members of the Academy can assume the position of Judge, jury, litigator, insurer, investigator or laboratory analyst from either side of the issue. Each participant should give a statement about the role they play in the matter, what they are required by law to do and what they did and why? Other members of the Academy or the litigators can question the participants about the motives for their actions to gain insight into their perspectives.

In the evening of a late summer day, a fire occurred in a commercial property located in a summer resort area. The property was an amusement facility for young teenagers. The facility had experienced break-ins and vandalism prior to the fire. Insurance claims had been made to replace damaged or missing amusement machines in the facility. The weather had been cold and rainy all summer, which seriously affected the income of the business. The fire was investigated by a detective from the local prosecutor's office. The detective determined that the fire started in the ceiling of the building where fluorescent light fixtures were located. He believed that a ballast of the light fixtures had overheated and caused ignition of combustible materials in the ceiling. This fire was a large financial loss in excess of several million dollars. Two insurance companies insured the property and its contents. They were on the hook to pay out several millions of dollars to the owners of the property due to the insurance policies. Consequently, the insurance companies sent a licensed professional electrical engineer to the fire scene to examine the light fixtures. If the light fixtures were defective or improperly installed, the insurance companies could subrogate against their manufacturer or installer to get their money back. Over the years many fires have been reported as caused by an overheated light fixture ballast and claimants have been successful in recovering money from ballast manufacturers and electrical contractors. A ballast is an electrical device in a fluorescent light fixture, which raises the voltage and ignites the gas in the light tube. It contains insulating materials, which some fire investigators believe will flow out when it overheats and ignite combustibles beneath it. The electrical engineer examined the light fixtures at the fire scene. He found that the fixtures and the wiring in the ceiling were not defective. The insulating material that flowed out of the ballast was due to the heat of the fire. The ballasts were thermally protected units and they contained a device to de-energize them if they started to overheat. The engineer informed the detective of his findings. The detective told the engineer that another detective had found that the serial numbers on amusement devices in the building did not "match" the insurance claims. The serial numbers were for much older equipment. Subsequently, the insurance companies sent a licensed private investigator to inspect the fire scene because engineers are not permitted to testify in many jurisdictions about arson. The private investigator found that the fire started on the floor beneath the burned-out ceiling. He took samples from the floor area for laboratory analysis. The laboratory tests indicated the presence of gasoline in the floor samples. Consequentially, the insurance companies denied to pay the owners fire claim. However, the owners were well respected members of the community and had devoted in excess of 25 years of their lives to public service. The owners retained a highly respected fire investigator associated with a prestigious university to investigate the fire on their behalf. He found that the fire originated in the ceiling of the building and it was caused by wiring, which overheated. No electrical short-circuits were found but they could have been displaced by firefighting activities. Conductors/wires coming out of the building's main panelboard were heat damaged, its components showed evidence of electrical arcing and its circuit breakers had not tripped opened due to the electrical overload. Samples taken from the floor were found to be negative for gasoline by a testing laboratory. In addition, any gasoline found on the floor area could have been inadvertently dropped there since the facility contained gasoline powered miniature racing vehicles.

Perspective, Legal Issues, Fires

B78 Public Employee by Day, Private Consultant by Night

George J. Schiro, Jr., MS, Acadiana Criminalistics Laboratory, 5004 West Admiral Doyle Drive, New Iberia, LA 70520*

After attending this presentation, attendees will learn about publicly employed forensic scientists who are also private forensic science consultants during non-public hours.

This presentation will impact the forensic community and/or humanity by demonstrating encouraging more actively working forensic scientists to become private forensic science consultants during their off-hours. By having a pool of these types of consultants, it will ensure that evidence is always accurately and objectively reported and it will limit the number of illegitimate "experts" who testify at trials.

Many publicly employed forensic scientists find themselves usually called to court to testify on behalf on the prosecution. This is because any exonerating or inconclusive evidence is presented prior to the trial and the suspect's case never goes to trial. Rarely does the publicly employed forensic scientist testify on behalf of the defense. This is usually reserved for retired public employees, public employees who can work private cases, privately employed forensic scientists, university professors, legitimate expert witnesses, and illegitimate "expert" witnesses.

This paper will examine the public employee who works private cases during non-public work hours. It will show how and why public employees become private consultants and it will discuss advantages and disadvantages of this practice. It will also cover the impressions of those who might find that their opinions are directly at odds with the testifying private consultant. Several case examples will also be discussed.

Most public employees stumble upon private casework, because, in some cases, they are the only qualified individuals in the area with access to the needed resources. The private casework usually begins by contact from a private investigator who is interested in having a forensic science examination conducted on a private or civil case. In most cases, depending on the nature of the examination, the public employee must get permission from their agency prior to accepting the case, especially if it involves using public equipment or reagents. Some agencies might allow full use of the facilities, while others might not allow the public employee to use any equipment for personal financial gain. Some agencies have a double standard, allowing vehicles and equipment to be used for private security details, but not allowing the public employee to use laboratory facilities. In some cases, public ethic boards must review the request by the public employee to assure that no conflicts of interest occur. In other types of cases and as the public employee's reputation grows, the public employee might be asked to review paperwork, photographs, and other documentation for attorneys involved in a case. Typically, with these cases, no special resources are needed and the examination can occur in the non-public working hours. Even with these cases, the public employee must be sure that the private casework doesn't conflict with the public casework.

There are several advantages to this practice. One advantage is that it provides a source of supplemental income. Another advantage is that it can provide a second opinion or interpretation of the case evidence. This ensures that all interpretations of the evidence are presented to the court. It also provides the expert with exposure to proceedings in a variety of jurisdictions. This will make the forensic scientist more well-rounded and might also provide him or her with new ideas and approaches to cases. Having an expert available for the defendant at trial also means fewer appeals if the defendant is found guilty. Another advantage is that a publicly employed forensic scientist can also make a fair evaluation of the evidence and analytical results based upon the prevailing forensic science standards and criteria.

There also several disadvantages to this practice. One disadvantage is that there can be a variation in the submission of cases resulting in a "feast or famine" case flow. Possible conflicts of interest can occur when handling private cases. There is also the danger of the expert developing a "hired gun" reputation, especially among his or her forensic science peers. This is why the expert must always maintain objectivity when reporting results and testifying in court. The public employee must never compromise their public duties or it could result in the loss of public employment. By establishing criteria and working with their public agency, the public employee/private consultant can minimize the disadvantages and maximize the advantages.

Public employees make very good private consultants. This is because they are experienced and they are usually current in the latest available, practical technologies. They are also actively analyzing evidence and they are aware of the latest quality assurance standards in the field. As a result, they cannot hold someone else to an unrealistic standard of work. Provided the proper restraint and safeguards are taken, a public employee can become a successful and respected private forensic science consultant.

Public Employee, Forensic Scientist, Private Consultant

B79 Obscuring the Obverse: The Obligations of Disclosure

Peter D. Barnett, BS, Forensic Science Associates, 3053 Research Drive, Richmond, CA 94806*

After attending this presentation, attendees will understand the process by which the work of any scientist is evaluated is independent peer review. There are a number of elements that are necessary for adequate peer review, with the published report of the scientist as the starting point for the peer review process. Various recommendations for the content of a scientific report will be reviewed. Requirements for disclosure to enable an adequate independent review will be presented.

There is much debate among forensic scientists about their role in exploring "the other side of the coin." This reverse side of the coin is important - but the obverse of the coin should not be obscured by lack of disclosure of ultimate conclusions and underlying data.

The primary work product of a forensic scientist is the report. It is the report that serves as the basis of most of the major decisions made during the investigation, pre-trial litigation, and, often, trial. The decisions that are made, or should be made, based on the forensic scientist's findings in an investigation are made by individuals who are not technically competent and whose interests are often served by intentional or unintentional misrepresentation of the report. It is the obligation of the forensic scientist to issue a report that provides full disclosure of the forensic scientist's opinions and the underlying data and reasoning that supports those opinions and minimizes, if not eliminates, the possibility of misunderstanding or misrepresentation of the report.

Formats for reports are discussed in a variety of sources: Forensic science text books, guidelines issued by various forensic science technical working groups, standardization bodies such as ASTM, and publication guidelines issued by scientific journals or professional societies. Legal obligations as expressed in statutory requirements or case law guidelines also attempt to define the material that must be disclosed by litigants under different situations. The forensic scientist's report serves two purposes: First, the report informs interested parties of the results, conclusions and implications of the work done by the forensic scientist. Second, the report serves as mechanism by which another scientist can review the work done and understand the reasons, and reasoning, behind the opinions and conclusions expressed in the report. In the end, no one who reads the report should be surprised by any opinions or conclusions expressed by the scientist, either in the report or in subsequent testimony. Another knowledgeable scientist should be able to review the report and understand the basis for the conclusions and opinions expressed.

The obligations for disclosure are primarily based on the obligations of a scientist. Independent peer review is the process used by scientists to evaluate one another's work, and it is the obligation of the sci-

entist to facilitate such peer review. The obligations of each scientist to the process of peer review culminate in the publication of the scientific report. Those obligations begin, however, at the earliest stages of the scientific investigation: The collection of evidence and its preservation for subsequent analysis; the determination of the examinations, analyses, or experiments that are necessary; and the conduct of those operations in a way which provides for adequate peer review are all the responsibility of the forensic scientist.

Report, Disclosure, Peer Review

B80 Use of Principal Components Analysis in the Individualization of Smokeless Powders

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After attending this presentation, attendees will understand the applicability of principal components analysis to forensic samples

This presentation will demonstrate the increased awareness of multivariate statistical analysis of large data sets in establishing similarity/dissimilarity between evidence and exemplars.

Traditionally, some smokeless powders can be identified to manufacturer and brand based on physical measurement of particle size and shape. Chromatographic analyses by GCMS, HPLC or MEKC have been shown to further distinguish samples. While some products are quite similar from lot to lot, others vary widely, complicating both brand identification and individualization to the lot level. Recent legal challenges to forensic evidence have stressed the need for statistical metrics for similarity and/or dissimilarity for comparison of evidence and exemplars.

To meet this need, a series of over 200 smokeless powders from the ATF smokeless powder collection have been analyzed for their extractable organic constituents by HPLC-DAD and GCMS. Use of multivariate statistical techniques, such as principal component analysis (PCA), demonstrates that among double base powders, the combination of nitroglycerin, 2,4 dinitrotoluene (2,4DNT), and dibutyl phthalate concentrations can be used to distinguish the various powders tested. Among single base powders, the 2,4DNT, methyl and ethyl centralite concentrations distinguish those powders. Greater than 95% of the variance among the powders can be explained using these few analytes. Cluster diagrams are useful in showing the degree of similarity or dissimilarity among the powders. Examples distinguishing among different lots of the same brands will be given.

Smokeless Powder Analysis, Principal Components Analysis, Explosives

B81 The Interpretation of Projected Gunpowder Particle Deposition and Impact Characteristics

Kay M. Sweeney, BS, KMS Forensics, PO Box 8580, Kirkland, WA 98034*

After attending this presentation, attendees will understand how to evaluate gunpowder deposit and impact characteristics so that more complete scientifically based opinions about where the firearm was, when it discharged on the scene, can be developed and proffered.

This presentation will help those forensic science practitioners faced with interpreting gunpowder deposits understand that all information about the deposit must be thoughtfully developed. This data, keeping in mind the mechanics of deposit, must be considered before reaching a conclusion and offering an expert opinion relating to how the deposit was produced. The more information, the more specific the conclusion can be.

One of the primary points of interest in gunpowder deposition interpretation is distance, commonly referred to as proximity testing. How far was the firearm muzzle from the target at the time of firearm discharge?

When gunpowder particles are present on the fabric target medium, there are four important characteristics to be considered when pondering a conclusion specifying a distance.

1. Type of powder present, specifically, is it typical of the weapon and ammunition suspected of being used.
2. Pattern of distribution. The powder pattern shape and how it is oriented relative to the point of bullet penetration.
3. Density of powder particle deposition.
4. Penetration level. If powder particles have penetrated the surface of the target medium, to what depth are they lodged?

In a recent case where a man had been fatally shot in the groin area, his clothing was examined in the laboratory. The firearm, a Smith and Wesson .357 magnum revolver, was found at the scene and submitted as well. Ammunition remained in the weapon so appropriate ammunition could be purchased and used in testing. The entry hole was in the bottom of the zipper placket in the crotch of the victim's black denim pants. A heavy concentration of unburned gunpowder was deposited around the entry hole and lesser amounts were noted out to distances of two to three inches with individual particles further out. This pattern suggests contamination and transfer during the collection and preservation stages. Since this was a thick area of fabric and the victim fell to, and remained on his back, there was no blood on the exterior surface to help keep the powder particles from migrating, however the heavy concentration at the entry hole indicated a close range discharge. Examination of the victim's white cotton brief underwear revealed the presence of gunpowder at the edge of the bullet penetration hole in the crotch. The hole in the denim pants was through an area made up of seven layers of fabric comprising a seam and folded fabric of the bottom of the zipper placket. Laboratory testing, using seven layers of denim fabric on one layer of white cotton brief fabric on a firm backing, resulted in gunpowder being deposited on the underlying white cotton when the firearm muzzle was within 4 inches, or closer, to the target.

Under other conditions and circumstances, such on hard surface targets, only tiny traces of gunpowder may be present making distance determinations very difficult, if possible at all. On painted surfaces, such as automobiles, the paint may be damaged as a result of the gunpowder particle impact. In the case of plastic surfaces, again the surface may be damaged by gunpowder particle impact and/or exhibit heat associated with the discharge. In another recent case, an assault rifle chambered for 7.62 X 39 mm ammunition was suspected of being fired into the upper corner of the inside surface of a door of a pickup truck. A penetrating bullet defect was found in a painted metal surface in this area. A smoke pattern was noted on the plastic panel adjacent to the metal surface with the bullet hole. Additionally, gunpowder particle impact damage was noted around the bullet entry defect. Test firing into painted metal vehicle panels was conducted until a similar damage pattern was produced which showed that the muzzle of the firearm was within four to six inches of the door when it discharged.

In another unrelated case, bullet damage was noted in the interior front passenger's side door panel of a passenger car. There was speculation that the victim of a fatal through and through shooting was shot while sitting in this vehicle. Examination of the door panel in the laboratory revealed a gunpowder particle attached to the edge of the bullet entry defect in an area down inside the map pocket. This evidence detail

ruled out the possibility of the victim being shot in a position where the fatal bullet exited her body and penetrated the door panel.

Research should be conducted to provide data to help practitioners properly evaluate gunpowder deposit and damage characteristics involving, skin, bone, a variety of wood surfaces, a variety of fabrics, leather surfaces and plastic surfaces, to name a few.

Gunpowder, Proximity, Pattern

B82 Identification of Organic Components in Intact and Burned Black Powder Substitutes Using GC-MS

John V. Goodpaster, PhD and Raymond O. Keto, MFS, Bureau of Alcohol, Tobacco, Firearms and Explosives, National Laboratory Center, 6000 Ammendale Road, Ammendale, MD 20705-1250*

After attending this presentation, attendees will learn the history of black powder substitutes and the challenges in identifying the alternative fuels present, particularly ascorbic acid. A newly developed method that addresses this issue will be presented and its applicability to intact and burned powder samples will be discussed.

This presentation will demonstrate that black powder substitutes are likely to grow in popularity and therefore they will be more commonly encountered in improvised explosive devices. This presentation will share a new method for analyzing these explosive samples as they have been difficult or impossible to fully characterize in the past.

Black powder substitutes such as Pyrodex or Golden Powder were originally designed to have improved properties relative to black powder. For example, these propellants generate similar muzzle velocities at lower peak pressures, demonstrate lower sensitivity to friction and shock, and generate fewer or no corrosive combustion by-products. The latter is accomplished through reducing or eliminating sulfur content and replacing it with other organic fuels such as sodium benzoate, dicyandiamide (DCDA), ascorbic acid, or fruit sugars. The first product of this type was Pyrodex, which was patented in 1978 by Pawlak and Levenson. This propellant contains KNO_3 and $KClO_4$ as oxidizers and charcoal, sulfur, sodium benzoate, and DCDA as fuels. Since that time, a number of commercial products have been developed that contain ascorbic acid as an alternative to sulfur. The original patent for Golden Powder (containing KNO_3 and ascorbic acid) was granted in 1985. The Golden Powder formulation was later modified and produced as Black Mag Powder (containing KNO_3, $KClO_4$, and ascorbic acid) by the Arco Powder Company from early 1996 through January 1997. This product has been subsequently re-released as "Black Mag '3". Legend Products manufactured Black Canyon Powder (containing KNO_3 and ascorbic acid) in 1996 and 1997. Clean Shot Powder (containing KNO_3, $KClO_4$, and ascorbic acid) was introduced in 1999 and is manufactured by Clean Shot Technologies. Most recently, GOEX briefly produced Clear Shot Powder (containing KNO_3 and cooked sugars, rather than ascorbic acid) in 2001.

Among organic additives, ascorbic acid demonstrates the most significant chemical instability, particularly when in the presence of moisture or metal ions. In this mechanism, ascorbic acid (aa) reversibly degrades to dehydroascorbic acid, then irreversibly to diketogulonic acid. Further degradation yields a vast array of compounds, including dihydroxybutanedioic acid, 2,3,4-trihydroxybutanoic acid, glycoaldehyde and glyceraldehyde. As a result, ascorbic acid can be gradually lost from powders, making its identification difficult or even impossible by traditional methods such as X-ray diffraction analysis or infrared spectroscopy. As a result, various instrumental methods have been developed to determine these species in clinical and food samples. In particular, the use of trimethylsilyl (TMS) derivatization agents has been successful in the separation and analysis of AA and its degradation products by gas chromatography-mass spectrometry (GC-MS). In addition, ascorbic acid and benzoate have been successfully identified in intact Clean Shot Powder and Pyrodex, respectively, using electrospray ionization mass spectrometry.

In this study, the TMS derivatization method was used to identify organic fuels and their degradation products by GC-MS. Black powder substitutes were extracted with *bis*(trimethylsilyl)acetamide (BSA) in acetonitrile, which converts carboxylic acid and/or alcohol functional groups into trimethylsilyl esters and ethers, respectively. Subsequent analysis by GC-MS allowed for the identification of trace amounts of ascorbic acid, benzoate, DCDA, sulfur (if present), and degradation products such as hydroxylated carboxylic acids, furanones, and lactones. Unburned samples of black powder substitutes such as Clean Shot, Pyrodex, Triple Seven, Clear Shot, Black Canyon, Black Mag '3, and Golden Powder were successfully analyzed with sample amounts ranging from 2 – 20 mg. Ascorbic acid and/or its degradation products were detected in Clean Shot, Black Canyon, Black Mag '3, and Golden Powder. Of these samples, Black Canyon showed the greatest amount of ascorbic acid degradation. In contrast, a lack of ascorbic acid but detectable amounts of simple fruit sugars allowed Clear Shot to be differentiated from the other products. The presence of benzoate, sulfur, and DCDA in Pyrodex and Triple Seven was also evident using this method. Lastly, burned samples of pure ascorbic acid and various black powder substitutes were analyzed for residual organic fuels and their breakdown products.

Explosives, GC/MS, Ascorbic Acid

B83 A Comparison of GSR Collected With Swabs and With Swabs Analyzed by Inductively Coupled Plasma Mass Spectrometry

Elzbieta Bakowska, PhD, Lawrence A. Presley, MS, MA*, Anna Foror, BS*, and April A. Shea, BA*, National Medical Services, Inc., 3701 Welsh Road, Willow Grove, PA 19090*

After attending this presentation, attendees will understand the possibility of analyzing GSR samples by ICP-MS regardless of the collection method (swabs or stabs)

This presentation will present the opportunity of utilization of ICP-MS as a confirmation technique following the analysis of stubs by SEM/EDX or by other non-destructive technique.

Cotton swabs are currently used for the collection of GSR prior to the quantitative analysis by either atomic absorption (AA) or Inductively Coupled Plasma Mass Spectrometry (ICP-MS). Stubs are traditionally used for the collection of GSR subsequently analyzed by SEM/EDX.

Each of the analytical techniques mentioned above offers unique advantages. Also both of those analytical techniques exhibit unique limitations. Currently the method of collection of GSR dictates which of those techniques will be utilized for the analysis of the samples. This presentation will compare the results of analyzing GSR specimens collected with either swabs or stubs by a single analytical method: ICP-MS.

This work demonstrates the opportunity of analyzing the GSR samples by ICP-MS regardless of the method of sample collection. It also presents the possibility of utilizing ICP-MS as a confirmation technique following the analysis of stubs by SEM/EDX or by other non-destructive technique.

GSR, ICP-MS, SEM/EDX

B84 Survey of Trace Elemental Contributions to the Environment: Comparison of Samples From a Diverse Group of Occupational Workers With Primer Residues From Firearms

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By attending, participants will understand how trace elemental distributions on skin surfaces of different occupational segments of the population compare with trace element concentrations expected on the skin of someone that has fired a weapon.

This presentation will impact the forensic community by advancing knowledge of the natural variation of elemental components of GSR in persons who have not handled a firearm.

The objective of this phase of the study is to obtain a reliable estimate of the amount of environmental lead, barium or antimony present on the hands of individuals who have not recently handled or discharged a firearm. The study sample consists of individual volunteers from diverse occupational groups who as a group have differing potentials of coming into contact with environmental lead, barium or antimony.

The occupational groups selected for this experiment include: 1) carpenters, 2) electricians, 3) firearms examiners, 4) gas station attendants, 5) brake mechanics, 6) plumbers, 7) painters, 8) roofers, 9) police officers, 10) machinists, and 11) x-ray technicians. A group of office workers will serve as a control cohort.

In order to be included in the sample, the participant must not have handled or discharged a firearm within the previous 24 hours, nor must the participant have washed his or her hands within the previous hour. After obtaining informed consent, each participant had either the right or left hand swabbed twice with a cotton swab containing 4 drops of a 5 percent solution of nitric acid. The non swabbed hand was sampled with a commercially available carbon backed sticky tape affixed to a stub intended for Scanning Electron Microscopic (SEM) examination.

The collected samples were placed in the sample containers provided by the manufacture of the GSR collection kit, placed in an envelope and sealed. Analysis for lead, barium and antimony is being completed by the National Medical Service for comparison with individuals who have discharged a firearm immediately before sampling testing. Results from these Inductively-Coupled Plasma Atomic Emission Spectroscopic/Mass Spectrometric (ICP-AES/MS) examinations of swabs, digested using a 10% nitric acid solution with incubation at 80° C for 2-hours will be provided for each of the cohorts.

Comparisons with the control group (office workers) will be used to verify the method of collection and understanding of conventional environmental background. Comparison of elemental analytical results for workers from "non-weapon" occupations will be used to determine the discrimination potential for these examinations. The results of these experiments will add to the body of knowledge necessary to properly interpret results from similar collections and analytical procedures in cases in which handling or firing of a firearm is at question.

This NIJ-sponsored work at the Henry C. Lee Institute of Forensic Science at the University of New Haven is being performed in collaboration with other NIJ- and NASA-collaboratively sponsored research into the application of remote sensing technologies for improved recognition of trace evidence in and on crime scene evidence.

Gun Shot Residue, Environmental GSR, Trace Elements

B85 The Effect of Water Immersion on the Analysis of the Organic Additives in Smokeless Powder

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Attendees will learn about what organic additives are present in smokeless powders, about how these additives may be analyzed by GC/MS and about how the analysis of the organic additives may be adversely affected by environmental conditions.

This presentation will impact the forensic community by encouraging forensic chemists to explore the effects of environmental conditions on post-blast explosive residues.

Forensic chemists frequently analyze post-blast debris from pipe bombs for traces of smokeless powder. If smokeless powder grains are found they may be analyzed by Fourier transform infrared (FTIR) spectrometry to demonstrate the presence of the energetic compound nitrocellulose. Organic additives in the smokeless powder grains (for example, stabilizers such as diphenylamine and ethyl and methyl centralite) may also be analyzed by gas chromatography, gas chromatography-mass spectrometry or micellar electrokinetic capillary electrophoresis (MECE). The organic additive suites in smokeless powders are useful for determining the brand and lot of smokeless powder from which the explosive filling of the bomb came. Environmental conditions may adversely affect such analyses. This research examines the effect of exposure of smokeless powder grains to water on the quantities of diphenylamine and methyl dinitrobenzene isomers extracted from the grains.

Samples of eight different smokeless powders were immersed in distilled water for up to four weeks. Four of the powders were reload powders from IMR Powder Company (Plattsburgh, NY): SR 4759 (lot # L11208), IMR 4895 (lot # L7927), IMR 7828 (lot # L8208) and PB (lot # L14547). Three were reload powders from Hodgdon Powder Company (Shawnee Mission, KS): Hodgdon HS-7, Hodgdon BL-C(2) and Hodgdon Titewad. The remaining powder was Solo 1000 reload powder from Accurate Arms Company, Inc. (McEwen, TN). Small (4-6 mgm) samples of each powder were carefully weighed and then immersed in 1 mL of distilled water for two and four weeks. At the end of the immersion periods, the water was carefully removed from each sample vial; the smokeless powder grains were then briefly rinsed with 100 µL of methanol; and finally 100 µL of a 0.1% (w/v) methanolic solution of octadecane were added to each sample vial. After overnight extraction, 1-µL aliquots of the methanolic extracts were analyzed by gas chromatography-mass spectrometry using a Varian Saturn 2000 GC/MS system equipped with a Varian CP-SIL 8 capillary column. The helium carrier gas flow rate was 1.0 mL/min. The injector temperature was 250°C and a 1:20 split ratio was used. The following oven temperature program was used: The start temperature was 90°C; the temperature ramp was 16°C/min; and final temperature was 230°C. The mass spectrometer scanned the mass-to-charge ratio range from 20 to 330. The ratios of the peak areas of diphenylamine and the energetic plasticizers 2-methyl-1,3-dinitrobenzene, 1-methyl-2,4-dinitrobenzene, 4-methyl-1,2-dinitrobenzene and 2-methyl-1,3,5-trinitrobenzene to the peak area of the octadecane internal standard were determined.

The quantities of the energetic plasticizers and diphenylamine extracted from the smokeless powder grains generally declined as the period of immersion in water increased. However, for some of the smokeless powders the quantities of organic additives extracted first declined and then increased. This may be a real effect: the smokeless powder grains may break down, exposing more surface area to the methanol extractant. Because the method for quantitating the organic additives in the smokeless powder samples may have been subject to sig-

nificant error, the ratios of the peaks representing the methyl dinitrobenzene isomers to the diphenylamine peak were also examined. For two of the powders (IMR 4895 and IMR 7828) the ratio of the aggregate areas of the peaks representing the energetic plasticizers to the diphenylamine peak fell significantly over the course of the experiment (in the case of the IMR 4895 powder by more than a factor of two). Most of the decline occurred in the first week of the experiment. The decline in the quantity of the methyl dinitrobenzene isomers extracted from the powder particles after water immersion may be due to the fact that the solubilities of the methyl dinitrobenzene isomers in water are higher than the solubility of diphenylamine. Changes in the relative amounts of organic additives detected in smokeless powder grains would have a negative impact on the determination of the brand and lot of smokeless powder used in a pipe bomb.

Explosives, GC/MS, Smokeless Powder

B86 Matrix Effects on Explosives Recovery and Detection

Michael E. Sigman, PhD and Alexi Gapeev, PhD, National Center for Forensic Science, University of Central Florida, PO Box 162367, Orlando, FL 32816; Ralph H. Ilgner, MS, Chemical and Analytical Sciences Division, Oak Ridge National Laboratory, PO Box 2008, Oak Ridge, TN 37831*

This paper is to present to the forensic science community results from recent studies on the effects of sample matrix and sample holding conditions on the recovery and detection of organic explosives trace evidence.

The results of this study provide important information concerning the proper handling and analysis of post blast debris in order to optimize chances of recovering trace levels of organic explosives.

Whereas many organic explosives have extremely low vapor pressures, nanogram quantities of the explosives can be lost by vaporization from some surfaces in a matter of minutes. Laboratory experiments have provided dramatic demonstration of the vaporization of a series of explosives deposited on Teflon surfaces at room temperature. The series of explosives studied included nitroesters, nitramines and nitroaromatics (i.e., nitroglycerine, 2,4,5-trinitrotoluene, RDX, tetryl, PETN…). These results will be discussed along with studies of the effect of the sample matrix on the recovery of explosives. The matrices from which post blast explosives samples are collected will typically be comprised of common building materials and commercial surfaces such as brick, wood, plastic, glass, metal, painted surfaces, and soils. The initial approach taken in this study is to examine relatively "simple" matrices that offer a comparison of explosives recovery from surfaces with known properties. For example, while glass and silica or sand are similar in many respects, glass is nonporous and silica is porous. Similar property comparisons and their effect on explosives recovery will also be discussed.

Sample holding conditions are an important aspect of the current study. Preliminary results indicate that trace quantities of explosives may be lost to the walls of the sample container at room temperature, whereas lower temperatures can reduce the loss. Results from temperature effects and holding time on the recovery of explosives from various matrices will be discussed.

Explosives Analysis, Post Blast Residue, Trace Evidence

B87 LC/MS of Explosives: RDX Characterization Through Impurity Profiles

Alexi Gapeev, PhD, Jehuda Yinon, PhD, and Michael E. Sigman, PhD, National Center for Forensic Science, University of Central Florida, PO Box 162367, Orlando, FL 32816*

The objective of this paper is to present the forensic community a methodology for characterization of a common explosive, RDX.

This study provides the tools for a methodology to detect trace components, such as byproducts, precursors, degradation products and additives in RDX, thus providing an individualizing profile or a fingerprint for a particular explosive sample. Accordingly, such a profile, when finally developed, may be of a great value in differentiating and sourcing samples.

Type and origin of an explosive is one the most important questions to be addressed in a bombing investigation. RDX (1,3,5-trinitro-1,3,5-triazacyclohexane) is a high power explosive that is extensively used for military and commercial applications throughout the world. Unlike TNT, RDX does not have isomers that may serve as markers for profiling. Furthermore, many precursors and intermediates do not seem to survive harsh manufacturing conditions.

Liquid chromatography - mass spectrometry (LC/MS) is an attractive technique for the analysis of trace levels of explosives because the analyses are conducted at room temperature thus preserving thermally labile compounds. This paper reports a study for the characterization of RDX through its impurities and degradation products profile using LC/MS. This study will give forensic scientists the tools for the development of a method to determine the manufacturing route and to estimate time of manufacture. In addition to HMX that is the major impurity in RDX, seven other compounds were found in RDX samples. They can be divided in three groups:

1. Acetylated nitramines; common byproducts in RDX manufac turing by the Bachman method
2. 1,3-dinitro-5-nitroso-1,3,5-triazacyclohexane; an RDX degradation product
3. Impurities not associated with a particular manufacturing method

All these compounds contribute to a profile of an individual sample that might lead to a fingerprint or a signature of that sample. It also can be seen as a future tool that will facilitate relation of the sample to its probable source due to some impurities being specific to a particular manufacturing route. Degradation products and other impurities may accumulate as the sample is exposed to the environment and therefore their concentration could be used as a measure of the sample age.

Explosives Analysis, RDX, LC-MS

B88 Construction and Development of a SPME/IMS Interface for Detection of Explosive Compounds and Taggants Evaluated by SPME/GC/MS

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This presentation describes the construction and optimization of an interface for introduction of a solid phase microextraction fiber (SPME) into an ion mobility spectrometer (IMS). The detection limits of the IMS are calculated based on calibration and SPME equilibrium curves created using SPME/GC/MS. The following explosives: 2,4,6-trinitro-

toluene (TNT) and 2,6-dinitrotoluene (DNT) and the following taggants: dimethyldinitrobutane (DMNB), 2-nitrotoluene (2-NT), and 4-nitrotoluene (4-NT), were used as model compounds to evaluate the interface. The absolute detection limits for the SPME/GC/MS method were also calculated and based on three times the signal to noise (3S/N) from five point calibration curves. The utility of the SPME/IMS interface was also evaluated by sampling from different sized containers in order to decrease the concentration of the explosive compound and simulate real world application.

This research offers a method of screening large volumes of enclosed space for explosive compounds and taggants using a newly developed interface between solid phase microextraction (SPME) and an ion mobility spectrometer. This instrumental technique offers speed, rapid presumptive screening, field use, and easy data interpretation.

A system to sample large volumes of enclosed space such as may be found in a large room, a cargo container, or the fuselage of an airplane for the volatile components of explosive formulations is described. Massive screening of luggage, personnel, and cargo is difficult due to the small amount of material that is available for detection and the time constraints placed upon screeners. Analysis strategies for these two types of trace samples are evaluated in order to create an effective method for extraction, separation, analysis, and interpretation that will be suitable to the investigators needs, i.e., a simple and rapid identification of ultra-low levels of material using a field portable sampling system.

Solid phase microextraction (SPME) provides improvements over the use over other extraction methods due to its selectivity, field portable capability, cost, ease of use, shorter extraction times, and solvent free extractions. Ion mobility spectroscopy (IMS) affords a low cost, rapid, and portable method for presumptive analysis of organic materials, such as explosives. These instruments have become widely used in our nations airports and their installation base is very large. Ion mobility spetrometry separates ions based on their gas phase mobility in weak electric fields. Ionization through a radioactive B emitter at atmospheric pressure can be controlled so only certain groups of compounds are ionized, i.e., explosives. The IMS is known to be an extremely sensitive technique with capabilities of detecting explosives in the low picogram range and it is very easy to use and interpret the results. The sensitivity of the IMS can be attributed to the negligible loss of ions or neutrals to vacuum pumps, the walls of the cells, or recombination processes. This presentation will briefly describe the applications of the SPME/IMS interface to simple, rapid identification utilizing a field portable sampling system.

A Varian 3400 Gas Chromatography is coupled to a Saturn 2000 Ion Trap Mass Spectrometer detector with MSn capabilities and used as a benchmark method of the identification of the analytes of interest. A GE Ion Track Itemiser® 2 ion mobility spectrometer was used in conjunction with an in-house designed SPME/IMS interface. The operation and detection limits of the interface/IMS system when used with SPME as a pre-concentration and sampling device of large enclosed volumes are presented and discussed.

Explosive Compounds, Taggants, SPME/IMS

B89 The NITE-CRIME Network: Development of International Protocols for the Use of Natural Isotopes and Trace Elements in Criminalistics and Environmental Forensics

JoAnn Buscaglia, PhD and Robert D. Koons, PhD, FBI Laboratory, CTFSRU, Building 12, FBI Academy, Quantico, VA 22135*

Attendees of this presentation will learn about the NITE-CRIME Thematic Network and results of its efforts to develop protocols for the use of natural isotopes and trace elements in the fight against international terrorism, fraud and environmental crime.

This presentation will impact the forensic community by demonstrating international protocols for elemental analysis of forensic evidence; lessons learned from and results of interlaboratory validation studies; validation studies that will help support legal ladmissibility of elemental analysis methods

Characterization of evidentiary materials by their trace element and isotopic compositions can provide valuable sourcing information, which can be used in the fight against international terrorism, fraud, and environmental crime. To support this effort, in 2000, eight organizations representing European countries joined with three international partners to form a Network for the development of analytical protocols for the use of natural isotopes and trace elements in criminalistics and environmental forensics (NITE-CRIME). The principal goal of the NITE-CRIME Network is to be a global forum for the development of analytical protocols involving trace element and isotopic analysis of materials of forensic significance. Most of the analytical protocols being developed involve the use of laser ablation inductively coupled plasma-mass spectrometry (LA-ICP-MS), but additional studies utilizing methods such as x-ray fluorescence spectrometry (XRF) and inductively coupled optical emission spectroscopy (ICP-OES) are also being conducted. In addition to protocol development, the NITE-CRIME Network also has the objectives of guiding the development and production of standard reference materials, providing guidelines for establishment of international databases of compositions of various materials, and fostering exchange of information and training of forensic scientists through publications, technical presentations, a NITE-CRIME website, and training workshops. Specific materials of interest include glass, bullet lead, human hair and nails, steel, tape, marble, sugar, bovine serum, and selected drugs of abuse. Some of the lessons learned in organizing the Network, protocol development, and the conduct of interlaboratory validation studies will be discussed. Examples from the instrument cross-validation study and glass and bullet lead protocols will be used to illustrate considerations concerning sample preparation procedures, the use of mass spectrometers of differing designs, and the selection of appropriate elements and isotopes for source discrimination purposes.

Trace Elemental Analysis, Criminalistics, Interlaboratory Validation

B90 The Scientific Working Group for the Analysis of Seized Drugs (SWGDRUG): Update

Joseph P. Bono, MA and Thomas J. Janovsky, BS*, Drug Enforcement Administration, Office of Forensic Sciences, 2401 Jefferson Davis Highway, Alexandria, VA 22301*

After attending this presentation, the attendee will learn about the updates to the SWGDRUG process and become familiar with the most recent recommendations for forensic drug analysis.

This presentation will describe familiarization with the recommended standards for forensic drug analysis.

The Scientific Working Group for the Analysis of Seized Drugs (SWGDRUG) has been in existence since 1997. The mission of SWGDRUG is to recommend minimum standards for the forensic examination of seized drugs and to seek their international acceptance.

The objectives of SWGDRUG are the following:

- To recommend minimum standards for forensic drug analysts' knowledge skills and abilities
- To promote professional development of forensic drug analysts
- To provide a means of information exchange within the forensic drug analyst community
- To promote the highest ethical standards of practitioners in all areas of forensic drug analysis

- To recommend minimum standards for drug examinations and reporting
- To establish quality assurance recommendations
- To seek the international acceptance of SWGDRUG minimum standards

The SWGDRUG core committee is comprised of representatives from federal, state and local law enforcement agencies in the United States, Canada, Great Britain, Germany, Japan, Australia, the European Network of Forensic Science Institutes (ENFSI), the United Nations Drug Control Program (UNDCP), Africa, and South America, a forensic science educator, the American Society of Crime Laboratory Directors (ASCLD), ASTM, and the National Institute of Standards and Technology (NIST). All members of the core committee have worked together over the past six years to build a consensus on the development of recommendations which have impacted forensic drug analysis standards internationally.

Published recommendations have been available since 2000 to forensic scientists around the world. These recommendations have addressed Methods of Analysis, Education and Training, and Quality Assurance issues. All recommendations were developed with input from the international forensic drug analyst community.

SWGDRUG has undertaken the development of a second set of recommendations which will address the following:

- Developing ethics, competence and certification standards for forensic drug analysts
- Validating analytical methods for seized drugs
- Sampling seized drugs for qualitative analysis

These three sets of recommendations are currently in the discussion phase. After the forensic science community has had an opportunity to review all recommendations and provide comments, the revised recommendations will be adopted by the SWGDRUG core committee and published.

This presentation will focus on the status of the recommendations currently being developed, and enhancements to the recommendations originally published in 2000. Representatives from the SWGDRUG Core Committee will be in attendance to answer questions and address concerns of those in attendance at the presentation.

Criminalistics, SWGDRUG, Drug Analysis

B91 Comparison of Incinerated Fabrics by Differential Scanning Calorimetry

Pookalangaranarayana Ramakrishnan, MSc, Central Forensic Science Laboratory, Directorate of Forensic Science, Ministry of Home Affairs; Ramanthapur, Amberpet PO, Hyderabad, Andhra Pradesh 500013, India*

After attending this presentation, attendees will be able to compare the fabrics that come partly burnt in the forensic examination.

This presentation will describe solving certain cases of fire and arson on clothing, or fibers or fabrics.

Fibers and fabrics are commonly encountered in the crime examination. In an interesting case received, a piece of burnt and molten fabric piece of clothing and a control clothing were sent to the laboratory for comparison and analysis. It was a case of dowry burning case of a girl in India. The amount of sample was very small wherein other conventional tests could not be carried out. In this context, the differential scanning calorimetry was utilized in identifying the type of fabric. This paper describes the detailed experimental study of the different type of synthetic fabrics by differential scanning calorimetry.

Incinerated, Fabrics, Differential Scanning Calorimetry

B92 The Effect of Silencers on Gunshot Residues

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After attending this presentation, attendees will understand the effects of silencers on gunshot residues (GSR).

In firearm wounding, the investigation of the clothing is very important to determine firing distance. Firing distance determination is possible by analyzing of the gunshot residues (GSR) obtained from the victim's clothing.

The discharging of a firearm creates residues which evolve from the primer, lubricants, propellant charge and elements that are present in the bullets (volatized lead from the base of the bullet), cartridge casing, bullet jackets and gun barrel. These products of firearm discharge collectively referred as GSR.

Several factors affect the amount of GSR that are produced as well as the amount of residues that reach the target. These are distance, barrel length, propellant type, caliber etc. Also, attachments (like silencers) to the muzzle of a weapon can alter the amount of residues that are reach the target.

In this study we investigated the effect of silencers on the GSR. The guns used in this study were Micro UZI submachine gun (SMG), silenced Micro UZI SMG, Mini UZI SMG, and silenced Mini UZI SMG. The ammunition used in the experiments was 9mm Parabellum type cartridges produced by Turkish Machinery and Chemistry Foundation (TMCF). Shots were fired at white cotton from a range of contact, 2, 5, 10, 15, 20, 30, 40, 60, 80cm. Sodium Rhodizonate Test was applied on the white cotton targets to detect heavy metals containing GSR.

Except from the shot contact range, GSR was not found on the targets for silenced Mini UZI SMG. GSR was found on the target up to the distance 15cm, when experimental shots were fired with silenced Micro UZI SMG.

Silencer, Gun Shot Residues, Sodium Rhodizonate Test

B93 New Strategies for the Detection of Condom Residues

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The detection of residues from condom surfaces is a powerful method to provide evidence for the use of condom during sexual intercourse. Microscopic and chemical investigations are used together. Data on new condom markers are presented.

The detection of residues from condom surfaces in vaginal or penile swabs is important during the investigation of sexual assault cases. If a condom was used by the rapist, no sperm cells can be found. The methods presented in this paper can help to provide evidence that a questioned sexual intercourse took place.

The detection of residues from condom surfaces in vaginal or penile swabs depends largely on the manufacturing process of the condom that was used. Many different coatings are used by the industry. By chemical analysis, for example, various silicone substances can be detected. By microscopy, particles like starch granules can be observed.

If the detection of residues from condom surfaces should be used for routine casework, it is necessary to establish the surface properties of unused condoms. From these data it can be predicted what substances

could be expected in vaginal or penile swabs. These data should be used to create a laboratory database, since such a database might be helpful to identify condom residues in unknown samples. Furthermore, the time dependence of the residue detection has to be established. For this reason, vaginal and penile swabs from voluntary couples have to be analyzed. Since the manufacturers of condoms might change their coating protocols, the database should be made topical from time to time to cover the needs of forensic analysis.

We analyzed 50 different condom brands that are commercially available in Germany. Some of these condoms were produced in the US or in Sweden. The surface of the unused condoms was swabbed and then microscopically investigated (HE staining). As shown earlier, on most condom surfaces, corn starch granules can be observed. Furthermore, synthetic particles made from polyethylene could be identified. These particles replace more and more Lycopodium spores, which are suspected to cause allergies. In contrast to corn starch granules, polyethylene particles do not show polarization during microscopy. From a forensic point of view, these particles have the advantage that they do not occur naturally and that they are rarely found.

For the chemical investigation, the condom surfaces were rinsed. After alkaline extraction, various silicone oils could be identified by GS/MS. Substances that were added for the flavor of the condom could not be identified with this technique. These substances seem to be less important for the specificity of the observed chromatograms. However, we will present data on the detection of dithiocarbamat. Dithiocarbamat is more or less solely used for the vulcanization of rubber. This substance could become a highly specific marker for the use of condoms.

Eight voluntary couples had sexual intercourse with different condom brands. Subsequently, vaginal swabs were taken after defined time periods. These swabs were analyzed microscopically and chemically. The "new" condom marker polyethylene particles could be detected up to three days after the intercourse. Using GC/MS, we could detect silicone oils up to three days as well. The presence of nonoxinol-9 in vaginal swabs was only seen in rare cases. The detection of dithiocarbamat was not successful so far.

The microscopic detection of polyethylene particles in vaginal swabs is a new strong evidence for the use of condoms. Besides that, the presence of starch granules is important as well. The microscopic results together with the chemical analysis using alkaline extraction and GC/MS can provide evidence for the use of a condom up to three days after the intercourse.

Condom Residues, Microscopy, GC/MS

B94 The Mother of All DNA Contracts - 16,000 Sexual Assault Kits and Counting (Part II)

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After attending this presentation, attendees will learn about the statistical information associated with a very large casework DNA contract.

This presentation will impact the forensic community by showing some of the types of statistics collected during the project, others in a similar situation may be able to use some of the information to develop their own outsourcing projects.

This presentation will describe the data generated during a large outsourcing contract. This data includes information about the analysis of sexual assault kits, such as the percentage of sexual assaults kits that were "positive" for semen and/or male DNA, what sample types were positive (vaginal swabs, anal swabs, etc.), and how often mixtures were encountered. Data will also be presented about the percentage of DNA profiles generated from the cases, the percentage of DNA profiles that were SDIS and NDIS eligible (the number of loci callable), and reasons why some cases failed to yield CODIS eligible DNA profiles.

Information will also be presented about the "investigations aided" (hits) generated as a result of the DNA profiles generated at the local, state, and national levels: case-to-case matches, convicted offender matches, and conviction matches.

Part I of this presentation is an oral presentation which will present experiences gained during the course of the contract, as well as some interesting outcomes of the project such as the identification of sexual assault patterns and the exculpation of an erroneously convicted man.

DNA, Sexual Assault Kits, Outsourcing

B95 Statistical Tools for Forensic Analysis of Toolmarks

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The goal of this presentation is to provide statistical methods that will provide a means to objectively calculate a "degree of association" between matches of similarly produced toolmarks in order to validate the proposition that particular manufacturing methods produce marks on the workproduct (or tool) that are substantially different from tool to tool.

The statistical methods developed here may be applied to test the assumption that no two tools are manufactured with the same surface machining marks.

This presentation will show the results of a comprehensive statistical study of toolmark variation produced by several manufacturing methods (filing, grinding, whetstoning, broaching, stamping, and milling) and present a data reduction/statistical method software tool for comparison of the toolmarks.

There have been several studies that have shown the impact of various tool manufacturing methods on the individuality of toolmarks and striations produced on tools. These studies are reviewed in an article by Nichols[1] and have routinely shown that similar and/or sequentially produced tools have toolmarks that are distinctly distinguishable. The major shortcomings of these studies is that they concentrated on only a single manufacturing method (e.g., broaching) and they typically used a small number (less than 10) of samples. This work extends these previous studies by conducting a more comprehensive statistical study of toolmark variation produced by the different manufacturing methods by expanding the number of samples compared and generating a digital database to facilitate toolmark comparison and analysis.

Algorithms have been developed to facilitate the image matching and are intended to mimic the process employed by an examiner (i.e., rotate the samples on a comparison microscope so that principal features in each are oriented and adjust the "hairline" separating the split image in an attempt to find a strip along which the images exhibit similar patterns). The algorithms focus on several key steps: i) analysis of each image to determine directions of maximum and minimum variation at a given point; ii) comparison of one-dimensional image "strips" along the directions of greatest spatial variation; iii) iterative strategy for selecting local areas in each image for comparison, and; iv) match validation, i.e. determining whether an apparent match is real or an artifact due to similarities only in sub-areas of the images.

Results of the algorithms applied to image data sets (of no less than 100 images per manufacturing process) will be presented and discussed. Toolmark variations in manufacturing methods will be examined on commercial tools and on in-house sequentially produced samples.

1). Nichols, R.G., "Firearm and Toolmark Identification Criteria: A Review of the Literature," *Journal of Forensic Sciences* 42, 466-474 (1997).

Toolmarks, Statistics, Digital Imaging

B96 Eliminating Sources of Pipetting Error in the Forensics Laboratory

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After attending this presentation, attendees will understand the role of training in the accurate dispensing of liquids using an air displacement pipette.

This presentation will provide a broader understanding of the topic that will improve the quality of analysis.

Hypothesis: Pipettes are complex precision instruments that are subject to error due to mechanical failure and improper operator technique. Improved performance may be obtained by following essential quality control guidelines and by providing basic pipetting technique training.

Content: This poster discusses the nature of pipette performance including how pipettes work and why pipettes fail. Suggestions are offered for mitigating sources of error via straightforward quality control and operator training guidelines. Data is presented showing the beneficial impact of pipetting technique training. Specific pipetting technique training tips are provided.

Conclusion: Today's air displacement pipettes are precision instruments that should not be taken for granted. Pipettes tend to fail silently and randomly, impacting sample and reagent delivery. Periodic calibration and preventive maintenance are essential to ensure the integrity of laboratory results. Operator technique training, especially if it offers the opportunity to obtain immediate feedback, is easy to do and has a significant beneficial effect on performance.

Pipette, Accuracy, Training

B97 Mitochondrial Coding and D-Loop Analysis Using Pyrosequencing

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This presentation will describe a fast analysis tool for mtDNA analysis including extended information retrieved by analysis of coding regions in the mitochondrial genome.

In forensic analysis, mitochondrial DNA is often used when the evidence material contains limited amounts of nuclear DNA. We have developed a novel, rapid and easy to use typing system for analysis of mitochondrial DNA based on the Pyrosequencing technology. This is a rapid, non-electrophoretic, single-tube sequencing-by-synthesis method in which a cascade of enzymatic reactions yields detectable light. The pyrosequencing system was first developed for analysis of the highly polymorphic mitochondrial D-loop and a database of D-loop sequences from 200 randomly selected blood donors has been compiled. However, a more discriminatory mitochondrial DNA analysis would be preferable, especially in cases where none or few differences in comparison to the Cambridge reference sequence are found between different individuals. Therefore, the system has been extended to also include analysis of short fragments in the coding region.

The coding region fragments were chosen, based on the diversity determined in 26 Swedish as well as 52 European whole mitochondrial sequenced individuals, and cover the most informative polymorphic sites throughout the entire mitochondrial genome. A database over coding region variation in 150 individuals has been compiled for the 19 different coding region fragments that were designed and optimised for pyrosequencing analysis. After the initial database analysis samples with none or one difference from the Cambridge reference sequence in the D-loop were studied in more detail. In order to achieve a better discrimination than D-loop analysis alone between these individuals, 8 of the 19 coding sequence fragments were chosen as a part of the complete typing system. The fully developed typing system, for an optimal discrimination, consists of 18 PCR fragments and 24 pyrosequencing reactions: 8 D-loop reactions, 8 haplogroup determining reactions and 8 reactions analysing additional SNPs for a possibility to distinguish between individuals identical in the D-loop sequence.

The pyrosequencing D-loop typing system has been evaluated in analysis of 50 previously sequenced forensic casework evidence materials. All pyrosequencing results were identical to the Sanger sequences with an average read length of 45-100 nucleotides. The coding fragment analysis has shown a capability to reduce the number of not distinguishable D-loop analysed samples (due to only one or no differences) by as much as 80%. Moreover, coding region analysis has been used successfully in a forensic case from 1952 to exclude a suspect exhibiting only one D-loop difference in comparison with the evidence material. In the future, this system, for analysis of the most informative parts of the whole mitochondrial genome, will be more informative and faster, than the D-loop sequence analysis used routinely today.

mtDNA, Pyrosequencing, Coding mtDNA

B98 A Micellar Electrokinetic Screening Method for Common Sexual Assault Drugs

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The objective of this analysis was to develop a simultaneous method of detection for benzodiazepines and gamma-hydroxybutyric acid (GHB) analogs using micellar electrokinetic chromatography.

Much attention has been given to benzodiazepines and gamma-hydroxybutyric acid (GHB) related compounds owing to their widespread use as date-rape drugs. The rapid metabolism and lethargic effects of these compounds make them perfect weapons for an assailant. Many of the current screening methods for benzodiazepines involve immunoassays that have insufficient cross reactivity with low-dose metabolites, while current methods for the detection of GHB can involve complex derivatization. Since either of these drugs is possible in a case of drug facilitated sexual assault, toxicologists would greatly benefit from a screening method that allows the simultaneous detection of both groups of substances.

Capillary zone electrophoresis (CZE) is often compared to gas chromatography (GC). Advantages of using CZE over traditional GC are that it does not require extensive extraction or derivatization steps. While CZE is limited in its ability to detect neutral compounds, micellar electrokinetic chromatography (MECC) permits the analysis of uncharged molecules by providing a secondary separation through the addition of a surfactant that forms into micelles. These aggregates will interact with the analytes of interest and carry them countercurrent to the electroosmotic flow, enabling greater separating power.

Optimization of the borate buffer was carried out using a set of standards containing 8 benzodiazepines, GHB, GBL, and the internal standard, sulfanilic acid. The optimal buffer was found to contain 20 mM SDS and 7% acetonitrile at a pH of 9.2. In the case of an interfering peak, the buffer containing 30 mM SDS and 10% acetonitrile may provide a better separation.

The benzodiazepines were calibrated with concentrations ranging from 2.5mg/µL to 100µg/mL. GHB was run at 0.1 to 2.5 µg/mL, while the GBL concentrations were from 0.5 to 10 µg/mL. The method was shown to have a detection limit of less than 2 µg/mL for five out of eight benzodiazepines. The detection limits for GHB and GBL were 32 µg/mL and 150 µg/mL, respectively.

In many cases of drug-facilitated sexual assault, the drug has been placed into a victim's beverage. For this reason, a series of GHB spiked beverages were monitored to determine the effects of time on the drug

analysis. After 48 hours, there was no observed degradation of GHB in any of the analyzed beverages. Possible interfering peaks from drugs of abuse and artifacts from a variety of different drink combinations were also studied in detail. The analysis of GHB involved a simple 1:10 dilution of the beverage sample and so any interferences were present at very low levels. In the beer sample, there was a peak that eluted with the GHB. Using the 30 mM SDS/10% acetonitrile buffer, the two were separated. For the benzodiazepines, a liquid-liquid ethyl acetate extraction was used. Using the two optimized buffers, it was shown that a variety of interfering drugs have distinguishable mobilities in comparison to GHB and the benzodiazepines.

The method shows good separation of all benzodiazepines as well as GHB and provides a rapid screening for many of the common sexual assault drugs and other club drugs. When encountering an unknown sample, the recommended procedure is to dilute an aliquot 1:10 as described for GHB analysis. A second aliquot should be prepared for extraction to detect the drugs that may be present at lower concentrations. We believe this method would provide an excellent overall screening tool for the detection of date-rape drugs.

Benzodiazepines, GHB, MECC

B99 Shampoo Investigations in Relation to a Rape Investigation

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After attending this presentation, attendees will the participant will appreciate the possibilities of surfactant compositions for forensic investigations of toilet products such as shampoo.

This presentation will impact the forensic community and/or humanity by demonstrating surfactants which are used in many industrial products can be encountered as forensic evidence and needs to be characterized and compared to other evidence material. Presently surfactant component information is hardly used at all for forensic investigations. The results of this presentation demonstrate the possibilities in using this information. It is expected more forensic applications will follow. By making forensic practitioners aware of these possibilities it is expected they will access this source of information.

Introduction. Results are presented of shampoo investigations in relation to a suspected anal rape of a young boy by an older teenage boy. The victim stated that the suspect used shampoo as a lubricant during the rape. Victim's anal swabs, the victim's clothes and underwear, the suspect's underpants as well as all surfactant containing products from the suspect's bathroom were submitted by the police. In this investigation we used visual methods, LC-MS, GC-MS and MALDI MS techniques to detect and identify surfactants as well as other relevant chemical components.

The victim and suspect's samples were first investigated for the presence of potential shampoo components. Afterwards component compositions on the various items were compared. We focused at first on involatile surfactant components. Investigations were performed using a Crimescope system for visual characterization at a number of wavelength regions, GC-MS for component analysis, LC-MS and MALDI MS for surfactant analysis. Sodium lauryl ether sulphate is a surfactant that is widely used in shampoos. All shampoos in the submitted products contain this ingredient according to the product label. The chemical formula C_nH_{2n+1}-$(OC_2H_4)_xOSO_3Na$ where x denotes the number of ethylene oxy-segments and n=12 for the pure chemical form. This is a synthetic chemical component not produced naturally by plant or animal and not secreted by humans. Even one industrial single surfactant consists already of a large number of similar components differing, e.g., in the exact alkyl group (in the above example n) and the number of ethylene oxy segments (x in the example) in a poly ethylene oxy segment. This variation offers possibilities in a forensic investigation to determine the presence of these component mixtures and make comparisons. Apart from the product label information further confidential product information was obtained from a number of shampoo producers.

Visual investigation. The victim and suspect's clothes were investigated visually for potential shampoo residues. Samples of the products from the bathroom of the suspect were dried and investigated similarly. Both the tops of the anal swabs and the white cotton front inside of the suspect's underpants displayed fluorescent stains.

Using a Crimescope (irr. 515 nm, det. > 550 nm) a light yellow pattern was observed at the same position on the front inside of the suspect's underpants. On the victim's clothes no clear stains could be observed in daylight. For the victim's clothing stains were especially expected on the (rear inside of the) underpants. Further investigations of the victim's clothing were therefore directed on the underpants.

Only two shampoos from the relevant toilet products (including all shampoos) from the suspect's bathroom displayed similar fluorescence behavior as described above. Only one shampoo (named A below) displayed a light yellow color upon drying. Application of the two fluorescent shampoos on the green material of the victim's underpants after drying resulted in stains that were not visible in day light and did not fluoresce using the Crimescope.

LC-MS. Instrumental conditions were selected to detect and identify anionic surfactants such as lauryl ether sulphate. Using these conditions mostly groups of compounds with different alkyl terminal groups will be separated. Compounds with identical alkyl terminal group but with different numbers of ethylene oxy segments in the poly ethylene oxy segments can be discriminated by mass spectrometry. In a preliminary separate Flow Injection Analysis (FIA) MS experiment, bypassing the LC separation part, it was determined that the bathroom products not investigated in the above fluorescence experiments did not contain sodium lauryl ether sulphate.

Methanol extracts of different fluorescent parts of the white cotton inside on the front of the suspect's underpants as well as the cotton swabs with material from the victim's anus (anus swabs) and some selected parts of the victim's underpants were investigated using the LC-MS method. In all these different samples lauryl ether sulphate was identified with the alkyl part varying in the range decyl to hexadecyl (n=10, 12, 14, 16) and the number of ethylene oxy units, dependant on the alkyl group, varying in the range x=0 to x=12. The results for the clothing samples and the victim's anus swabs corresponded well in lauryl ether sulphate composition. Methanol diluted samples of the two fluorescent shampoos were investigated using this LC-MS method. Results for shampoo A corresponded well with the results for both underpants and the anal swabs. The alkyl distribution for the other shampoo (named B below) was somewhat narrower.

MALDI MS. This technique was applied to water extracts of the suspect's underpants and an anal swab from the victim. Also samples of the two shampoos A and B were investigated using this technique. Experiments were performed for us using facilities at Unilever Research. Best results were obtained detecting positive ions and using a Tetrakis matrix. Four different ion series were detected. Two ion series are interpreted as $C_{12}H_{25}$-$(OC_2H_4)_xOSO_3Na_2^+$ and $C_{12}H_{25}$-$(OC_2H_4)_xOSO_3NaK^+$ ion-series. These were identified in the water extracts of the suspect's underpants, the anal swab and both shampoos. A third, as yet unidentified ion series (m/z= 413, 475, 519, 563, 607, 651, 695, 739 and 783) was detected in all the above samples except shampoo B. The fourth non-specific ion series has not been interpreted.

GC-MS was applied to methanol extracts of suspect and victim's underpants and an anal swab of the victim. Samples of the two shampoos A and B were diluted in dichloromethane and investigated with a standard GC-MS method. Mainly non-specific background components

are detected in the clothes and anal swab samples. These are identified as compounds introduced during sample preparation and compounds already present in blank clothing and swab samples. Among this background extra compounds were detected in the methanol extracts of the suspect's and victim's underpants and the anal swab. These extra compounds are not observed in blank samples or the sample of shampoo B but are again observed in the sample of shampoo A. For now these compounds have not been identified.

Conclusions:

1. Lauryl ether sulphate components were detected on the suspect's and victim's underpants as well as the anal swabs. Lauryl ether sulphate is an anionic surfactant that is widely used for shampoos and shower/bath products. The human body does not secrete it.
2. The lauryl ether sulphate components were detected locally on the inside front of the suspect's underpants. The distribution of the lauryl ether sulphate components on the victim's underpants was less clear, partly as a consequence of different fluorescence product behavior on this underpant.
3. Shampoos A and B are the only products of the 13 products from the suspect's bathroom that correspond in some characteristics with the residues on both suspect's and victim's underpants and the anal swabs.
4. Results from visual, LC-MS, MALDI MS and GC-MS investigations on the samples of victim and suspect correspond better with shampoo A than with shampoo B.

In our opinion the residues on the suspect's underpants and the victim's anal swabs are from the same category of products, probably a shampoo, shower or bath product. Out of all the products in the suspect's bathroom shampoo A is the most likely candidate for this.

Shampoo, Surfactants, LC-MS

B100 Performance Testing of Commercial Containers for Collection and Storage of Fire Debris Evidence

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The objective of this paper is to present to the forensic science community results from recent studies on the performance of commercial containers in the retention of ignitable liquids.

This presentation will provide important information concerning the proper handling and analysis of fire debris evidence and the viability of commercial sample containers.

Long-term storage of samples in suspected arson cases requires that the evidence containers be free from leaks that can result in total loss of the volatiles or evaporative aging of the sample, leading to an altered hydrocarbon profile. Previous investigations have reported significant leak rates for various commercial containers, primarily paint cans and polymer bags. This research project undertakes a study of the vapor retention properties of commercial containers through repeated removal of small (c.a. 20 micro-L) vapor samples from large (c.a. 1 gal.) containers, and an investigation into the dynamic behavior of hydrocarbon vapors in the closed container.

The dynamic behavior of a mix of volatile hydrocarbons inside a closed container complicates analyte sampling and analysis, while at the same time revealing important properties of the vapor which can significantly impact the interpretation of analytical data. Depth profiling of recovered hydrocarbons within closed containers by collection on standard carbon strips will be presented for a set of hydrocarbons, and the practical implications of the data for sampling methodology and source determination will be discussed.

Results from a long-term study of hydrocarbon retention by one gallon commercial paint cans will be presented. Data revealing the leak rate of the containers and the dynamic behavior of the hydrocarbon vapors will be discussed along with the significance of these results for methods of fire debris sample analysis

Fire Debris, Ignitable Liquids, Trace Evidence

B101 Solid-Phase Microextraction Based Approach for Enantiomeric Analysis of Amphetamines

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The goal of this presentation is to advance the development in solid-phase microextraction (SPME), specifically, to explore an one-step absorption/derivatization approach for enantiomeric analysis of amphetamines.

This presentation will benefit the forensic scientist's analytical knowledge of these SPME techniques.

As a solventless approach and with advances in fiber manufacturing technology, SPME has great potential in various sample pretreatment processes. Reported applications of this technology to the analysis of amphetamines included: (a) the inclusion of the derivatizing reagent in the sample matrix [1] or the chromatographic injection port [2]; (b) a two-step approach in sequentially placing the fiber in the headspace of the sample- and derivatizing reagent-containing vials [3]; and (c) an one-step procedure in placing the fiber in the headspace of the derivatizing reagent-containing vial, which was in turn placed in the headspace of the sample vial [4]. This current study represents a further progress in the application of the SPME technology. Specially, an one-step process is used to complete the absorption/derivatization process for the analysis of the enantiomeric compositions of amphetamines.

(S)-(-)-N-(Trifluoroacetyl)-prolyl chloride (l-TPC) was adapted as the chiral derivatizing reagent and added directly into the sample matrix. Temperature, absorption/desorption duration, and the amount of derivatizing reagent were studied to determine their effects on the yields of analytes on the fiber. The derivatization products resulting from this study show excellent desorption characteristics of the polydimethylsiloxane-coated fiber (100 μm) used in this study. For example, an one-time 5-min desorption leaves no detectable carry over. Optimal operational parameters (absorption: 70 ^{o}C for 10 minutes; injection: 250 ^{o}C for 5 minutes) cause minimal negative impact on the fiber, allowing repeated use (> 30 times) of the fiber.

This method was evaluated for its effectiveness (a) in quantitative determination of the enantiomeric pairs of amphetamine and methamphetamine — in terms of repeatability, linearity, and limits of detection and quantitation; and (b) by comparing its analytical findings with those derived from a conventional liquid-liquid extraction approache (Table 1).

Table 1. Comparison of methamphetamine/amphetamine enantiomeric compositions resulting from two sample preparation protocols (SPME and liquid-liquid extraction)

SPME (concentration in ng/mL)

Sample	d-Methamp	l-Methamp	d-Amp	l-Amp.
1	12,169	1,280	2,477	72
2	1,821	219	1,010	42
3	7,436	593	1,329	36
4	13,845	1,960	2,581	94
5	3,766	340	2,675	93
6	10,745	1,254	3,324	92
7	3,090	704	1,466	78
8	2,482	5,863	580	403
9	5,398	486	1,971	50
10	6,667	608	2,376	84
11	6,761	947	2,220	78
12	8,600	972	1,308	90

Liquid-liquid (concentration in ng/mL)

Sample	d-Methamp	l-Methamp	d-Amp	l-Amp.
1	10,638	1,564	2,702	63
2	1,427	146	976	32
3	7,768	429	1,318	37
4	11,753	1,233	2,545	67
5	3,310	252	2,763	72
6	9,931	1,315	2,973	79
7	2,564	591	1,381	79
8	2,010	6,317	482	538
9	4,680	435	1,928	43
10	5,649	543	2,230	66
11	5,632	449	2,100	73
12	6,276	950	1,276	58

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SPME, Enantiomeric Analysis , Amphetamines

B102 Scientific Validation of the Reliability of Detector Dog Teams: Progress Towards the Development of a National Standard for Best Practices

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This presentation highlights recent progress towards developing scientifically sound best practice procedures validating the reliability of detector dog teams. Current scientific research and draft best practices developed at biannual national detector dog conferences are presented

This presentation will update interested parties on recent progress towards developing scientifically sound, best practice procedures validating the reliability of detector dog teams.

Even with technological advances in instruments, detector dogs still represent one of the most reliable and widely used real time detectors of contraband and forensic evidence. Unfortunately, to date, there have been limited peer-reviewed published scientific studies demonstrating exactly how these biological detectors work so efficiently and limited scientific assistance to improve performance and confirm the stated reliability of these detection teams. Recent criminal investigations focusing on bomb dogs have highlighted the need to have a standardized method for confirming the performance of detector dog teams.

This poster discusses the critical and independent evaluation of the selectivity and sensitivity of law enforcement detector dog teams and the refinement of optimal methods to validate the performance of these teams. The data indicate that canine detection teams that undergo sufficient initial training and maintenance provide scientifically reliable detection of suspect samples with high precision and accuracy. A model scientifically sound certification protocol for detector dogs including drug and explosive canines has been evaluated. Important training and maintenance factors include the use of double blind tests, positive controls minimizing contamination issues and negative controls including representative distractors.

Also discussed are the results of the refinement of draft best practices for detector dog teams at the 3rd National Detector Dog Conference held recently in North Miami Beach, Florida. Highlights of the group discussions included the need for standardization of nomenclature, specific recommendations based on the work function of the detection team (narcotics, explosives, etc.), general requirements for detector dog trainers, protocols for certification of detector dog teams and best practices for maintenance and deployment record keeping. As one example, certification should only be valid for the specific handler/dog team, should last for one year, and requires that the handler conduct regular maintenance training, among other requirements.

Towards the pursuit of a National Standard for detector dog team best practices, the authors are in the process of initiating a planning panel to explore establishing a Technical Working Group in conjunction with the Department of Homeland Security's Transportation Safety Administration and other national authorities in the field. The best practices draft document should serve as a resource towards the development of a National Standard. The beneficiaries of such a reference standard may include practitioners and policy makers at federal agencies, law enforcement and the legal and judicial community, and those in the private sector who work with detection canines. In addition, if there is to be a National Standard, challenges will be in bridging gaps with other agencies and detection canine associations with respect to their existing Standards and protocols, the harmonization of nomenclature being but one of potentially several issues.

Scientific determination of the reliability of detection teams and the use of scientifically validated teams also facilitates scientific research aimed at identifying the active odor signature chemicals used by canines and the development of improved instrumental methods capable of both particle and vapor detection. Examples from the authors' labs applied to drug, accelerants and explosives detection will be highlighted.

Best Practices, Detector Dogs, Narcotics and Explosives

B103 Continued Scientific Investigation of Explosives Detection by *Canis Lupis var. familiaris*

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After attending this presentation, attendees will have a better understanding of canine detection best practices.

This presentation will provide a better understanding of canine detection best practices. Acceptance of the differences between canine training with real explosives or simulated training aids and the impact that this can have on the quality of the canine performance.

This presentation will communicate the continuation of previous work by the authors, focused upon identification of the active odour signatures of explosives, detailing the new results and broadening the scope of samples studied to included explosives not previously presented. With a view to better understand and give scientific validation to biological detection of explosives by detector dogs, this work continues with more odours identified and currently under investigation.

Another area of work appropriate to this study is the diffusion of explosive odors though a variety of polymers. It is proposed that through appropriate choices of plastic material, the target odor may be released at a controlled rate to produce a highly effective training aid. Gravitometric studies into the loss of explosive material from polymer packaging are also presented in this paper.

The analysis and characterization of the headspace 'fingerprint' of a variety of explosives, followed by canine trials of the individual components to isolate and understand the target compounds that the dogs alert to. Studies to compare commonly used training aids with the actual target explosive have also been undertaken to determine suitability and effectiveness. The reliability of commercially available canine training aids is investigated

The vapor headspaces of a range of explosives have been collected using Solid Phase Micro Extraction (SPME) and analyzed by chromatography-mass spectrometry. Using SPME-GC-MS, samples of a variety of explosives obtained from local law enforcement agencies for odor determination have been characterized, and the prevalent signature odor chemicals identified. Studies have also been performed using SPME-HPLC-MS to observe the non-volatiles, and thermally unstable compounds within the samples.

Following the characterization of the potential odor signatures of the explosives, canine detection is then applied to a combination of double-blind trials of the individual components from the odor signature. The chemicals identified by canine trial are then packaged in a variety of polymer bags, as prototype designs for safe, inactive training aids

SPME has been demonstrated to have a unique capability for the extraction of volatiles from the headspace of explosives. Results to date have shown comparable, chemical differences between readily available training aids and the actual explosive matrices that they seek to replicate. Odor signatures of TNT, RDX based plastic explosives, and assorted propellants are presented.

Current work, including recent dog trials, has confirmed the hypotheses that 2,4-DNT and 2-Ethyl-1-hexanol are the active odor signatures of TNT and C-4/Plastic Explosives respectively. Dog trials have also discounted the taggant DNDMB, and diphenylamine as previously proposed active odor signatures for C-4/Plastic Explosives and Smokeless Powder respectively. Investigation into the effectiveness of commercially available training aids has highlighted several major concerns regarding the suitability of the aids, and their simulated odors, regarding canine training.

Canine Detection, Explosives, SPME-GC-MS

B104 Comparison of Field Portable Instruments and Accelerant Detection Canines for the Detection and Collection of Ignitable Liquid Residues at Fire Scenes

Shirley S. Chin, BS and Kenneth G. Furton, PhD, International Forensic Research Institute, Florida International University, University Park, Miami, FL 33199*

This presentation will demonstrate a complementary method used in the search for ignitable liquid residues (ILR) at fire scenes when Accelerant Detection Canines (ADCs) are not available, or when the hazards of the scene prevent the use of such dogs, while maintaining the sensitivity and selectivity of ADCs. In addition, an investigation into the use of an on-site portable ILR sampler for the separation and extraction of volatile accelerants will be discussed. It is proposed that this method would hopefully simplify the collection and transportation of samples from fire debris for subsequent chromatographic analysis in the laboratory.

This presentation will demonstrate the practicality of using these portable detectors for fire/arson investigators to detect the use of accelerants at a fire scene, and to collect adequate samples for submission to a forensic laboratory for analysis.

Arson, the intentional burning of property, is a serious crime in many countries including the United States. The use of flammable liquids is a frequent choice for arsonists to help accelerate the spread of a fire. One of the responsibilities of the fire investigator is to look for signs of accelerant use that could have started these incendiary fires. Chemical analysis of accelerant residues in the fire debris would assist the investigator in determining if the fire was due to intentional or natural causes.

It is well known that dogs have superior olfactory capabilities, thus Accelerant Detection Canines (ADCs) have been employed at some fire scenes to pinpoint locations where flammable liquids had been used. It has been reported that ADCs can distinguish between some accelerants and interfering pyrolysis products of common materials found at the fire scene. Not only are they able to discriminate between the accelerants and pyrolysis products, but it has also been reported that ADCs can detect down to levels below the sensitivity limits of analytical instruments used in forensic laboratories. Although accelerant detection canines have been involved in court cases in the United States, there have also been controversies over admissibility of canine testimony. Unless confirmed by laboratory analysis, canine alerts would raise a reliability issue in court.

A complement to using these biological detectors is to use electronic sniffers. The purpose of this study is to determine the capability of one such on-site electronic detector compared to ADCs. The TLV Sniffer® (Scott Instruments) is used to detect the presence of combustible gases. This instrument was put through similar proficiency tests that accelerant detection canines perform, as outlined by the Canine Accelerant Detection Association (CADA).

Since the TLV Sniffer® is designed to detect and measure concentrations of combustible gases, it will also indicate the presence of hydrocarbons from pyrolysis products. For confirmatory purposes, another field instrument was considered. The Portable Arson Sampler (PAS) separates and collects volatile accelerants from the fire debris. Ideally, one would use the TLV Sniffer® to first locate the source(s) of accelerants among the fire debris. Once located, the PAS would be used to sample the headspace of that fire debris and extract the volatile gases onto adsorbent tubes. The contents of the tubes would then be chemically or thermally desorbed for subsequent gas chromatography-mass spectrometry (GC/MS) analysis at the laboratory.

To study the selectivity of the TLV Sniffer®, various substances that could be found at a fire scene, including pinewood, Styrofoam, newspaper, and nylon carpet, were set on fire. Comparisons between fires that were extinguished by oxygen deprivation and by dousing with water were carried out. Headspace analyses of these burned matrices were conducted, both with and without being spiked with 5uL 50% weathered gasoline.

Results show that the weathered gasoline can still be detected under both extinguishment conditions, even after air venting for 30 minutes. Burnt wood, nylon carpet, and Styrofoam produce pyrolysis products, but these would not be confused with gasoline once analyzed by GC/MS. However, burned black and white newsprint paper generates common compounds also present in gasoline. But to a skilled analyst, their chromatograms would not be mistaken due to the ratios and patterns of the peaks generated by gasoline. A problem may arise, however, when the sample has been air vented for 30 minutes or more, as most of the alkylbenzenes of gasoline will have evaporated. Thus there is a need for adequate comparison samples to act as a negative control. Overall, these results indicate that electronic sniffers and adsorption samplers can be useful complements to ADCs, as they offer an objective qualitative analysis which can be used in a court of law. In addition, there are advantages of the on-site sampling capabilities offered by the PAS including reduction to loss of sample, less bulky packaging sent to the laboratory, and the ability to sample from areas that cannot be conveniently transported to the laboratory.

Arson Investigation, Electronic Detectors, Accelerant Detection Canines

B105 National Forensic Laboratory Information System: 2003 Data Analysis

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After attending this presentation, attendees will have an understanding of the National Forensic Laboratory Information System (NFLIS) that systematically collects results from drug analyses conducted by state and local forensic laboratories. The data and results presented will provide a detailed approximation drug evidence seized by law enforcement agencies and sent to forensic laboratories for analysis from January 1, 2003 to June 30, 2003.

This presentation will provide timely data on the variation in the distribution of controlled substances across geographic areas, identify emerging drugs of abuse identified in forensic laboratories, provide information on the diversion of licit drugs into illicit channels, and improve the ability to estimate drug availability based on laboratory analysis and identification.

This poster will describe the NFLIS program which first began implementation by the DEA and Research Triangle Institute (RTI) in September 1997. To date, approximately 36 state forensic laboratory systems and 56 local forensic laboratories that perform drug analyses, comprising a total of 192 individual forensic crime laboratories throughout the United States, have joined NFLIS. With the goal of including all of the forensic laboratories in the United States, the sustained recruitment of non-participating state and local forensic laboratories remains a priority.

NFLIS provides results of drugs analyzed and reported by participating labs through semi-annual reports, annual reports, and the Interactive Data Site (IDS). The IDS combines timely and detailed data analyses with a flexible, user-friendly system. It allows participating laboratories to run parameterized queries against the NFLIS database in a near real-time capacity. Labs can initiate queries for their own data at the individual case-level or they can calculate aggregate regional and national results. IDS users can specify the time period, region, type of laboratory, and drug type in order to customize these queries. Aggregate results of drugs identified and reported by participating NFLIS laboratories representing the period January 2003 through June 2003 will be presented. Highlighted findings will include the estimated prevalence of selected "drugs of interest" and analyzed drug items by category. The distribution of drug items by percent and number of total analyzed items in the state and local forensic laboratories will be depicted. The number and percentage of analyzed drug items for the twenty-five most frequently reported drugs, as well as the major drug categories such as narcotic analgesics, benzodiazepines, "club drugs," stimulants, and anabolic steroids will be presented in tables and graphs. Special study data on (1) drug combinations, (2) drug purity, and (3) drugs identified in strategic geographic locations as well as major metropolitan areas will be summarized.

The NFLIS data base is serving the drug enforcement community: supporting drug control/drug scheduling, highlighting variations in distribution of controlled substances across geographic areas and over time, improving estimates of drug availability, providing timely information about the diversion of licit drugs into illicit channels, identifying emerging drugs of abuse, increasing our understanding of the nation's drug problem, and linking the drug enforcement and forensic laboratory community across the nation.

Drug Analysis, National Forensic Laboratory Information System, Drug Database

B106 Elemental Analysis of Materials by Laser Ablation Inductively Coupled Plasma (LA- ICP-MS) for Forensic Applications; Instrumental Considerations

José R. Almirall, PhD and Tatiana Trejos, BSc, Florida International University, Department of Chemistry, University Park, Miami, FL 33199*

This presentation will cover the instrumental considerations associated with the analysis of trace amounts of metals in materials such as differences between sample introduction systems, mass spectrometers and available options.

This presentation will facilitate a better understanding of the use of the different sample introductions systems into an ICP-MS. The presentation will also cover the selection of spectrometer types for the purpose of trace elemental analysis, including the use of TOF, quadrupole and magnetic sector instruments. An analysis of the dynamic reaction cell technology as applied to forensic analysis, is also presented.

The elemental analysis of materials has become an important yet underutilized type of evidence at many crime scenes. Although the utility of trace elemental analyses and comparisons for glass or paint fragments has been shown to offer a high degree of discrimination between different sources of these materials, the lack of method devel-

opment, validation of methods and publication of results in the open literature have limited the adoption of this technology by the typical forensic laboratory. Additional barriers include the expense of the equipment and the sophistication required for its operation.

This presentation will focus on presenting the commercially available options for the elemental analysis of materials such as glass using ICP-MS, the most sensitive and practical of the elemental analysis methods available to the forensic scientist. Forensic examiners have the option to analyze glass by dissolution (digestion) or, by using a solid sample introduction system (laser ablation). The advantages and disadvantages of each of these choices are presented. Forensic examiners then have the option of selecting the type of mass spectrometer as the detector. Time of Flight (TOF), quadrupole and magnetic sector instruments are available. Speed of analysis, resolution and cost considerations will determine the instrument of choice and these factors are discussed. Within the quadrupole class of mass spectrometers, new collision cell accessories are now available in order to reduce the interferences that often plague unit resolution devices.

While solution analysis does not require the additional purchase of a laser ablation system, significant disadvantages related to the digestion of glass samples leads one to conclude that the added expense of the solid sampling introduction system is worthwhile. A direct comparison of solution data with LA-ICP-MS data for a variety of glass sample types is presented. A direct comparison of the data generated using the different mass spectrometer detectors is also presented. Finally, a study to determine the utility of a dynamic reaction cell using a Perkin Elmer DRCII mass spectrometer as compared to the use of an Agilent 4500 plus mass spectrometer is also presented. The most significant advantage to the addition of dynamic reaction cell technology is the potential for the elimination of polyatomic ion interferences for Se, As, Fe, K, Cr, Mn and Cu upon detection.

A direct comparison between two laser systems (CETAC LSX 200 plus and the CETAC LSX 500) when used for materials analysis is also presented. The LSX 500 offers better limits of detection and precision (<5% RSD) due to the increased power of the laser and the flat beam profile, both of which lead to better laser/material interaction. Scanning Electron Microscopy (SEM) imaging was also conducted in order to evaluate physical characteristics of the craters left by the laser in the glass fragments. A JSM-5900-LV JEOL SEM operated at high vacuum, using secondary electron imaging at 20 KV was used to image craters of a spot size of ~ 40µm. The glass samples were coated with gold to prevent charging.

Elemental Analysis, LA-ICP-MS, Materials Analysis

B107 The Mystery of the Mummified Baby

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This presentation will highlight a multidisciplinary investigation performed over a two year period in a case from Toronto, Ontario, that involved the Office of the Chief Coroner, the Toronto Police Service, and the Centre of Forensic Sciences, working together to manage a major case from both the scientific and investigative perspectives.

This general interest presentation, involving different scientific disciplines, including forensic pathology and biology, will demonstrate the value of working in partnership to solve a challenging case.

On July 16, 2001, the mummified remains of an infant were discovered in the storage locker of a Toronto waterfront condominium by the 150-year-old adopted daughter of its female owner. The infant was found inside a garbage bag, clothed in a diaper and shirt, and wrapped in blankets. The condominium owner, a successful business woman, had succumbed to a seven year battle with cancer two weeks prior. Several questions required an answer: Who was the child? When and how did the child die? Why were the remains in the locker? Had a crime been committed?

Due to the mummification of the remains, the sex of the child and the cause of death could not be determined at autopsy. The question of identity was answered by DNA profiling of the bone marrow from the left and right femurs of the infant. DNA typing was performed using the AmpFlSTR® Profiler Plus and COfiler Amplification Kits, and a 13 STR loci female DNA profile was obtained. The DNA profile of the condominium owner proved elusive, and attempts were made to obtain it from personal effects, as well as two bladder biopsy samples. The full profile was eventually determined by analysis of a bloodstain in a pair of underwear that had been worn at the hospital during the last few days of her life. It was determined that she could not be excluded (LR = 520,000) as the biological mother of the infant. The adopted daughter, on the other hand, was excluded.

The question of when the child died remained unanswered. A U.S.-based expert estimated that mummification had taken approximately 69 days, based on an analysis of the infant's clothing and an assessment of various factors in the decomposition of human remains; however, this information was of no assistance in establishing the time of death. The condominium owner's ongoing medical treatment for the past seven years meant that it was not likely that the infant could have been born during this period of time. Another clue to the year of the birth was provided by an assessment of the age of the diaper. Photographs of the diaper were sent to a manufacturer (Kimberly-Clarke) and it was determined that the particular style had been discontinued in 1984.

With the time frame narrowed down to the mid 1980s, investigators questioned the relatives, friends and work colleagues of the owner as to who the father could have been. None of these individuals had any idea that she had been pregnant at any time; however, the identity of a potential father was determined. The ex-boyfriend, who had moved to England since their involvement, had no knowledge of the pregnancy and did not think that the infant could be his. DNA profiling was carried out and it was determined that the ex-boyfriend could not be excluded (LR = 61,000) as the biological father of the mummified child, and the year of the birth was thus established as the year in which the relationship ended, 1985.

No cause of death could be established, due to the condition of the body, and therefore no charges were laid.

Mummification, Familial DNA, Major Case Management

B108 Cat or Dog Hair?—The Root of the Problem

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After attending this presentation, attendees will learn that the differentiation between cat and dog hairs based solely on the appearance of a spade-shaped root, cited in standard texts as being a characteristic of dog hairs, may lead to an erroneous identification.

The presentation will demonstrate that the identification of putative cat or dog hairs based solely on the appearance of a spade shaped root may result in an erroneous identification.

This poster will present results of a study conducted at the Forensic Science Centre, which shows that cat hairs may possess spade shaped roots comparable to the ones typically found on dog hairs. The differentiation between the spade shaped roots of these two animal species may be made on the basis of their lengths.

The present study was initiated as a result of findings during the examination of a large number of animal hairs related to a double homicide case in Adelaide, South Australia. During the microscopic

examination of these hairs the author identified the majority of the hairs as being dog in origin. However, during the course of the examination a few animal hairs although bearing spade shaped roots exhibited other features characteristic of cat hairs. The spade shaped roots on the putative cat hairs were significantly shorter than the spade shaped roots on the hairs identified as originating from a dog. This finding prompted the author to conduct a preliminary study to determine whether cat hairs possessed spade shaped roots and if so, to measure the lengths.

Guard hairs from 21 dogs and 20 cats were collected by grooming an animal, either by hand or with a brush, along the entire length of its back. Some smaller breeds of dogs were deliberately chosen in addition to larger ones in order to determine if the spade root characteristic lengths varied with the size of breed.

Guard hairs were chosen because these hairs exhibit characteristics that are the most useful in identifying the animal of possible origin. No attempt was made to differentiate between hairs from different parts of the body, as the forensic scientist is not usually concerned from which part of an animal's body a particular hair originated.

Ten hairs were selected at random from each sample, resulting in a total of 411 hairs (199 hairs from cats and 212 from dogs). The unequal number of hairs for each animal was due to some of the hairs not bearing roots. Each of the ten hairs was individually mounted in XAM mounting medium, on labeled microscope slides. The roots were examined on a compound, transmitted light microscope capable of up to 400x magnification. The shapes of each root and their lengths were noted. The lengths were determined in microns using an eyepiece graticule calibrated according to the manufacturer's instructions.

The examination of the cat hairs revealed that approximately 30% of the hairs examined exhibited a spade root comparable to the ones seen on the dog hairs. The spade-shaped cat hair roots were not limited to any particular breed of cat. The most significant difference between the spade roots of the two genera was length. The average length of the cat spade roots was approximately 200 microns, whilst those of the dog spade roots were approximately 500 microns. An overlap region of 260-320 microns occurred between the respective roots of the animals.

The results of this study highlight that whilst the standard works serve as excellent guidelines to the identification of animal hairs it is crucial that the hair examiner be aware that they are not definitive or exhaustive works. The results of the study indicate that if the determination on whether a putative hair is of cat or dog origin is based solely on the appearance of a spade root an erroneous identification may be made.

Spade-Shaped Root, Forensic Animal Hair Analysis, Animal Hair

B109 Optimization of Collection and Storage Methods for Scent Evidence and the Identification of the Volatile Components Comprising an Individual Human Odor Signature

Allison M. Curran, BS and Kenneth G. Furton, PhD, Florida International University, Chemistry Department, CP-345 University Park, Miami, FL 33199*

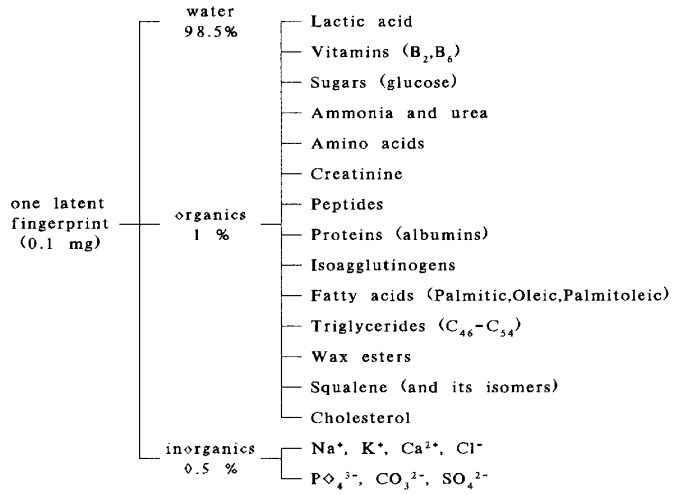
After attending this presentation, attendees will understand the best procedure for the collection, as well as the preservation, of human scent evidence samples and different passive headspace sampling techniques used to evaluate the uniqueness of human odor.

This presentation will impact the forensic community and/or humanity by demonstrating the optimization of scent evidence collection and preservation procedures as well as an evaluation of the uniqueness of human odor may lead to scent evidence being utilized in the U.S. as an investigative tool in criminal cases.

The use of canines, *Canis lupus* var. *familiaris*, within the fields of law enforcement and forensic science is widely accepted, however, to date, there are few peer reviewed studies confirming their accuracy and reliability. The use of detector dogs for "human scent lineups" has been utilized in European countries (such as the Netherlands) but has not gained widespread acceptance in the United States due, in large part, to the lack of definitive studies demonstrating the reliability of this approach. This lack of information has resulted in successful legal challenges to the use of these biological detectors in a court of law.

Fingerprints recovered from evidence and at crime scenes can be used to identify suspects. However, if a print recovered from a crime is smudged or incomplete it may be hard to distinguish between individuals in question. The identification of the chemical and volatile components of the print may aid in the discrimination between individuals in question. The identification of the chemical components within fingerprint residue may lead to a 'chemical fingerprint' of the individual as may also hold true for the volatile components of fingerprint residue. These volatile components are what comprise the signature odors that law enforcement certified canines alert to when searching for humans and distinguishing between individuals.

Chemical residues of human fingerprints have been studied in some detail but, at present, there have been few reports of the volatile constituents of human odor from various parts of the body. The following diagram shows some of the chemical components found in fingerprint residue:



This paper describes the use of headspace extraction combined with gas chromatography and mass spectrometry to identify the signature odors that law enforcement certified detector dogs alert to when searching for humans and distinguishing between individuals. Comparisons of two different passive headspace extraction techniques: solid phase micro-extraction (SPME) and activated charcoal strips (ACS) will be presented. Studies include the analysis and identification of the headspace 'fingerprint' of a variety of samples, followed by completion of double-blind dog trials of the individual components in an attempt to isolate and identify the target compounds to which dogs alert. SPME–GC/MS and SPME-LC/MS have been demonstrated to have unique capabilities for the extraction of volatile compounds from the headspace of forensic specimens and show great potential to aid in the investigation and understanding of the complicated process of canine odor differentiation. Major variables evaluated for the headspace SPME include fiber chemistry, a variety of sampling times, and the resultant effect on ratios of isolated volatile components.

Various methods for sampling human scent will be presented, including the use of the Scent Transfer Unit – STU-100 (Lynn Peavey Company, Lenexa Kansas). Different mediums are being evaluated for use in the collection of human scent, such as: sorbents (silica, octadecyl, Florisil, etc.), cotton pads (soft, stiff), cotton balls, polyester, and wool.

Sampling methods and mediums are being investigated in an attempt to optimize the recovery and storage of human scent from forensic specimens. Persistence/dissipation studies will also be presented evaluating variables such as static conditions, dynamic airflow, and temperature effects. Various containers are being evaluated for use in storage of human scent samples, including: glass jars, paint cans (lined, unlined), bottles, Ziplock bags, heat sealed bags (i.e., Kapak), as well as different plastics. Headspace and bulk human scent residues collected in different ways will be compared. Determining the effect of odor traces collected from different areas of the body (feet, hands, underarms, etc.) will also be presented.

Canine, Human Scent, Odor Signature

B110 LC/MS Analysis of Flunitrazepam (Rohypnol®) Solid Dosage Tablets

Andrew Benson, MS, Florida International University, Department of Chemistry, University Park CP-178, Miami, FL 33174-3509; Stefan Rose, MD, Florida International University, University Park CP-178, Miami, FL 33199; Yali Hsu, MS, Florida International University, Tamiami Park CP-178, Miami, FL 33199; Kenneth G. Furton, PhD, Florida International University, University Park, Department of Chemistry, DM-445, Miami, FL 33199; Alberto Sabucedo, PhD, Florida International University, Department of Chemistry, Miami, FL 33199*

After attending this presentation, attendees will understand the qualitative and quantitative analysis of flunitrazepam by Liquid Chromatography Mass Spectrometry (LC/MS). This poster will convey the process of extracting and quantitating this drug by LC/MS. It includes quantitation and confirmation by LC/MS.

This presentation will demonstrate to the forensic community that LC/MS will provide an improved methodology over GC/MS methods related to the analysis of this drug. This chromatograpy and sensitivity is a significant improvement over current GC/MS techniques.

The quantitative analysis of seized flunitrazepam tablets can be performed using liquid chromatography-mass spectrometry (LC/MS). LC/MS is ideal because of the physical properties of flunitrazepam and the faster analysis times relative to gas chromatograph-mass spectrometry (GC/MS). Gas chromatography-mass spectrometry (GC/MS) techniques are not ideal for molecules that are polar and have low volatility such as flunitrazepam. Liquid-liquid extraction (LLE) was used to isolate flunitrazepam from the inert water-soluble constituents of the tablet. The technique is rapid, sensitive and confirmatory for flunitrazepam in solid dosage tablets.

Flunitrazepam is a class of potent hypnotic agents available on prescription in most European and Latin American countries. In the United States flunitrazepam is a scheduled drug of abuse. Many date-rape cases have been linked to the incapacitating effects of flunitrazepam. These effects are exacerbated by the presence of alcohol typically found in environments where flunitrazepam is illegally utilized. The availability of these pills originates from the illegal smuggling from countries that manufacture this drug for therapeutic purposes.

The tablets are dissolved in water to break up the tablet matrix. The tablets form an aqueous suspension that is mixed with an equal volume of chloroform. The sample is vortexed and sonicated for a few minutes. The chloroform layer is allowed to separate by centrifugation for a few minutes. The denser chloroform layer is aspirated with a pipette to avoid contamination of the organic phase with the aqueous phase. The procedure should be repeated five times to be able to achieve quantitative recovery of flunitrazepam. It should be noted that basic extractions should be avoided because of the instability of flunitrazepam in alkaline medium. The higher the pH the faster the degradation kinetics of flunitrazepam. We used distilled water instead of an alkaline aqueous solution to perform the liquid-liquid extraction.

The assay used a deuterated internal standard, flunitrazepam-d7, to correct for changes in running conditions. A C-18 reverse phase column was used to 4.6 x 150mm, 1 mL/min, methanol:water (70:30) mobile phase with isocratic elution. A plot of the ratio of the areas of [Flunitrazepam]/[Flunitrazepam-d7] versus the respective concentration gave us an excellent linear regression fit for the standard curve. The linearity range of the assay was 0 to 500 ng/mL. The standard linear regression line had a coefficient of correlation, r = 0.999. The limit of detection (LOD: S/N =3) was 12 ng/mL (injection volume 20uL) and the limit of quantitation (LOQ: S/N = 10) was 50 ng/mL. The assay was run in selected ion monitoring mode (SIM) choosing several ions that can be used for qualifying and quantitation. The need to produce fragmentation can be achieve by increasing the cone voltage of the Finnigan aQa Navigator™ LC/MS system. This is important for forensic work where a minimum of three ions, ion ratios within +/-20%, and retention times are part of the confirmatory requirements for selected ion monitoring.

The ions monitored for flunitrazepam were m/z 314, 300, 272, 239 and for the deuterated internal standard, flunitrazepam-d7, m/z 321, 307, 279, 246. The highest sensitivity for this assay can be obtained with a lower cone voltage, but the fragmentation pattern would not be achieved. The analysis of solid dosage tablets is not usually dependent on sensitivity of the assay because of the high concentrations of drug found in the tablets.

The analysis performed on a confiscated pill presumably manufactured by Roche had a label concentration that read 1 mg. The tablet appears to be legitimate based on its identifying marks. The quantitative analysis by SIM mode LC/MS gave a recovery of approximately 1.08 mg flunitrazepam. The label number seems to indicate that this was a 1 mg flunitrazepam tablet. The assay showed quantitative recovery of flunitrazepam, recovery of tri-level controls were within 10% of target value and our negative controls were negative. This indicates that our deuterated standards did not contain detectable quantities of non-deuterated standard. In addition, no carryover effects were present at the highest concentration of the linear range. The assay developed is a rapid, sensitive and confirmatory for the presence of flunitrazepam in solid dosage tablets. The extraction technique is simple, efficient and quantitative. It allows for a robust confirmatory technique for flunitrazepam by LC/MS.

Flunitrazepam, Rohypnol®, Roofies

B111 Analysis of Explosives for Homeland Security by Chemical Ionization GC/MS

Eric Phillips, BS, Thermo Electron, 2215 Grand Avenue Parkway, Austin, TX 78728*

After attending this presentation, attendees will understand the technique for analyzing low levels of explosives and residues.

Explosive compounds are by their very nature unstable. Analysis of these compounds, precursors, and residues by GC/MS requires the samples be forced into the gas phase without decomposition. This can be accomplished by using a PTV injector. The sample is injected at a temperature that is high enough to volatilize the solvent but not the compounds of interest. The injector temperature is then quickly ramped to volatilize the compounds of interest. This injection technique also allows larger sample volumes. This larger sample volume combined with negative chemical ionization will allow extremely low detection limits. The Trace DSQ eliminates neutral noise and there is virtually no chemical noise when using negative chemical ionization. There are very few types of compounds that will form a stable negative ion. Due to the fast scanning rates of this instrument, fast GC techniques will be used.

EPA method 8095 includes compounds that are explosives, explosive residues, and compounds that are used in the creation of explosives. Following EPA method 8095 protocols, which is normally performed on an ECD, the Trace DSQ with large volume injections and

negative chemical ionization is able to show a linear calibration curve from 1 to 1000 pg/ul. This will show correlation coefficients of 0.99. Scanning at 3000 amu/s will allow the GC run time to be less than 12 minutes and enough points across the peak for it to be fully characterized.

Homeland Security, GC/MS, Explosives

B112 Expansion of an AFLP DNA Marijuana (*Cannabis sativa*) State, National, and International Database

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The goal of this presentation is to demonstrate how AFLP can be used to create databases of non-human origin and how they can be applied to the forensic and law enforcement community.

This presentation will impact the forensic community by demonstrating how AFLP can be used to create databases of non-human origin and how they can be applied to the forensic and law enforcement community.

Amplified Fragment Length Polymorphism (AFLP) analysis is a polymerase chain reaction (VCR) based DNA typing method in which amplification of restriction fragments are used to individualize single source biological samples. The authors are currently in the latter stages of completing state, national, and international AFLP marijuana *(Cannabis sativa)* databases composed of law enforcement seizure samples. The database has forensic significance in that it has the potential to identify and link clonally propagated marijuana plants with cultivators, distributors, and users as well as tracking certain "strains" that illegally enter into and are circulated throughout the United States. In order to determine the genetic variability of marijuana and its statistical correlation, a large marijuana population database is being created from seizure samples provided by state and local authorities in Connecticut, Vermont, Florida, Iowa, Kentucky, Wyoming, Tennessee, West Virginia, Canada, and Taiwan. These seizure samples were used to create state (100 samples), national (150 samples), and international (200 sample) databases.

The database was created by using four selective primer sets (EcoRT-ACT FAM/MseI-CAA, EcoRI-ACT FAM/MseI-CAT, EcoRl-AAG JOE/MseI-CAT, and EcoRI-AAG JOE/Msel-CTA: Al, A4, F4, and F5 respectively) from the Applied Biosystem's AFLP™ Plant Mapping Kit and separating PCR products by gel electrophoresis on an ABI 377 DNA Sequencer. 100 predetermined fragments are then scored in Genotyper® (ABI) and converted to a binary code sequence that represents the samples genetic "profile." This combination of "1s" and "0s" are then imported into the database, which is used as a valuable search tool for identifying samples that are consistent with clonality. However, due to the fact that there is the possibility of two or more unrelated or half-sibling samples being represented by the same binary code, samples whose profiles match are then superimposed upon each other in Genescan® (ABI) to determine whether any minor peaks outside the defined categories are detected.

As with many forensic applications, statistics play an important role when a database of this type is used in court. Two types of statistical analyses are being conducted a) the counting method and b) the confidence interval. To determine the random match probability (RMP), the conservative counting method of 1/N (N=the total number of unique profiles in the database) is used. Since this statistical method may be used, the greater the size of the database the more meaningful the statistical values will be. With this in mind, the authors are hoping to eventually create a 500 unique profile database. For an even rare conservative statistical approach two methods may be used. $1\text{-}\alpha^{1\text{-}N}$ (? =0.05 for the 95%confidence interval) can be applied to profiles not previously observed within the database, while for those profiles that have been observed, P+/-1.96(vP(1-P/N) may be employed. Again, since a 95% confidence interval is being used, the latter two statistical methods are much more conservative than the more commonly used counting method.

In demonstrating the usefulness of this technique and database, two case study examples will be presented in detail.

AFLP, Marijuana, Population Database

B113 Case Report: Tangential Gunshot Wound With MagSafe Ammunition

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The goal of this presentation is to present to the forensic community a case report demonstrating the characteristic autopsy findings that can be utilized to identify wounding patterns of unconventional prefragmented ammunition such as MagSafe ammunition.

This poster will present the wound characteristics that can be used to identify MagSafe ammunition. MagSafe ammunition is a type of unconventional prefragmented handgun ammunition that has great wounding potential and therefore should be differentiated from other types of prefragmented ammunition.

This case reports describes the fatal gunshot wound sustained by a 35-year-old woman. The unique features reported herein are the nature of the wound and the ammunition used to produce it. The MagSafe bullet produced a tangential type wound with an underlying keyhole defect of the skull. The wound has an entrance defect that is contiguous with the exit defect. The projectile disrupted the skin, subcutaneous tissue, bone and brain matter leaving an elongated central defect in its path. The skin defect is edged by lacerations, which are formed by skin tags. A skin tag is defined as an elongated fragment of tissue connected to the margin of a graze wound and projecting into its central portion. This injury is a classic example of skin tag formation as a result of damage by a tangential projectile. The trajectory can be determined because the skin has not been altered by decomposition, fire or surgical intervention. The lacerated skin has a semicircular abraded edge at the anterior aspect typical of an entrance defect. The posterior aspect of the wound or exit end is split. It should be noted that the lacerated border of the skin tag is the edge toward the weapon and the abraded border adjacent to the skin tag is away from the weapon. The lacerated edge will typically have irregular margins and tissue bridging.

MagSafe Ammo is a type of prefragmented handgun ammunition. Its construction consists of a copper jacket filled with birdshot that is potted in a hard epoxy resin. MagSafe utilizes a poured epoxy cap to seal the birdshot in the copper jacket. There are two distinctive features of MagSafe ammunition: differential thickness of the epoxy cap and the ability to choose the shot size. The poured epoxy cap can be made thin for early fragmentation or thick for greater penetration. They are light high-speed projectiles that deliver a huge release of kinetic energy and fragment upon impact with a target. While this rapid transfer of energy decreases penetration, it imparts remarkably devastating wounding capabilities with less over-penetration and ricochet. The pieces of plastic

or epoxy can be used to identify this specific type of ammunition. Gunshot wounds produced by this ammunition require careful examination in order to differentiate them from a shotgun or shot shell ammunition. There are many clues that can be used to accomplish this task.

In summary, this presentation is of a MagSafe gunshot wound to the head with unique identifying features. Prefragmented bullets such as this one are designed to release tremendous kinetic energy with decreased penetration and ricochet. Differentiating types of prefragmented ammunition used to inflict gunshot wounds may be achieved by analysis of the fragmented bullet components.

MagSafe Ammunition, Prefragmented Ammunition, Tangential Wounds

B114 Mineralogical Changes in Soil — A Great Tool to Forensic Explosive Investigator

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The study has been done keeping in view the difficulties faced by forensic experts in explosion cases. The presentation will impact the forensic experts as the resume of conclusion of mineralological and geochemical changes occurring at the time of explosion due to tremendous heat may be used in fingerprinting the explosive identification and time lapse even after several years.

When a high explosive is detonated to cause explosion, it produces a large quantity of gas and heat in a very short time resulting in development of a very high pressure. There is sustained shock wave and sufficiently effective blast pressure. During the explosion, the temperature developed may be as high as 5000 ºC. There is absorption and adsorption of volatile and nonvolatile constituents of explosive substances and their combustion products in different layers of soil. Thus, the soil at the site of explosion is likely to under go significant physical, chemical and mineralogical changes. Depending upon the type and quantity of explosives there would be variation in the resultant changes. The larger the explosive charge; the deeper will be the crater. The explosion will accordingly affect even the deeper layers (B Horizon) of the soil resulting in scattering of the affected soil to a larger area keeping the crater as center. Therefore, the debris collected from the site of explosion is usually available in large quantities. The first priority of examination of soil samples so collected from the site of explosion is to detect and identify the explosive used. A wide range of methods has been used by workers in the field for analysis of post explosion residues. It may not be possible to identify explosive materials if proper soil sample from the debris is not available due to scanty amount of explosive substances admixed with the soil. The explosive may not be identified from the available small quantity of soil carried by the suspect from the site of explosion in apparel, shoes and other belongings. It is still more difficult after considerable time lapse. A foolproof methodology is therefore warranted for the examination of soil samples to arrive at some significant forensic conclusions.

In view of the aforesaid discussion, a detailed study of post explosion soil samples [exploded with RDX] has been undertaken and mineralogical changes were studied by XRD and IR. A perusal of the XRD and IR data and summary of mineral phases identified points to some very relevant features about assemblages present in the pre-explosion control sample (CS) and post-explosion samples and will be discussed at time of presentation.

Mineralogical, Explosives, Criminalistics

B115 Leuco Dye Detection of Latent Blood: New Fluorescein Chemistry and Other Promising Chromophores

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After attending this presentation, attendees will understand how to use this new latent blood stain detection kit, and how this kit is superior to other techniques.

This presentation will describe new chemistry that significantly improves latent blood detection, greatly increases the time window for evidence collection and is easy to use. Additional leuco dye chemistries can be tailored to avoid interferences. This new fluorescein chemistry works even through paint.

Leuco dyes typically exhibit zero or very little fluorescence when applied to surfaces. If latent blood residues are present leuco dyes are oxidized and become fluorescent dyes. Fluorescin has been used frequently for this purpose. The chemistry used in the past has several disadvantages. The most significant of these is the rapidly diminishing contrast after application. Typically the investigator has a very limited time to secure pictures of the site. After a few minutes fluorescin background becomes fluorescent even where there is no blood residue thus effectively preventing photography of the crime scene. In addition to the background difficulties, past chemistries need to be prepared at the site. This new fluorescein chemistry works even through paint.

This paper discusses a new chemistry for fluorescin latent blood detection. This new chemistry results in excellent contrast for several hours and in a significant number of cases the contrast remains for days or weeks. The FBI's Evidence Response Team and DNA I unit worked together with Georgia State University to validate this new fluorescin chemistry for use in the field. This new chemistry requires no preparation at the crime scene. The kit is supplied in a ready-to-go format, i.e., the formulation is packaged as used. This ready-to-use format does not adversely affect shelf life and it can be stored up to a year.

Several examples will be presented to illustrate how time and conditions affect contrast and false positive results. The performance of the new fluorescin chemistry on different substrates will be discussed. While this new chemistry is fully compatible with presently used light sources, new truly portable light sources can be used as well. The use of blue LED light sources will be discussed. These light sources are now commercially available from several sources or can be made easily using off the shelf components.

In addition to the visualization of latent bloodstains, this kit is also suitable to observe latent fingerprints on certain surfaces. This feature does not interfere with latent bloodstain detection due to the time delay. In addition to the practical applications of this new kit, the presentation will discuss the chemistry behind the kit, e.g., what components are present in latent blood or fingerprint that would facilitate fluorescin oxidation. In addition to fluorescein, rhodamines can be prepared in their leuco form and are oxidized by latent blood stains. This new rhodamine chemistry requires no preparation at the crime scene similar to fluorescein. The longer wavelength absorption and fluorescence properties of rhodamine can be very useful on certain substrates of high interference. Finally the paper will discuss typical interferences and how those can be minimized.

Latent Blood, Leuco Dyes, Fluorescein

B116 Dr. Edmond Locard and Trace Evidence Analysis in Criminalistics in the Early 1900s: How Forensic Sciences Revolve Around Trace Evidence

Eric Stauffer, MS, Applied Technical Services, 1190 Atlanta Industrial Drive, Marietta, GA 30066*

After attending this presentation, attendees will understand that proper cognitive process that are applied to trace evidence analysis, that forensic sciences revolve around the trace evidence itself and not the analytical instruments used to analyzed it, and finally, some of Dr. Locard's work.

This presentation will impact the forensic community by demonstrating that forensic scientists will be able to apply the proper cognitive process to the approach to trace evidence analysis, and that forensic sciences revolve around the trace evidence itself.

This presentation will introduce the original criminalistics developed by Dr. Edmond Locard in the early 1900s. The writings of Dr. Locard were revolutionary, and they constitute the strong base from which modern forensic sciences evolved through science and technological advances. In the midst of this evolution, however, it is sometimes forgotten that trace evidence is the real subject of interest in forensic sciences.

Today, it seems that a crime laboratory cannot perform any work without the use of a gas chromatograph-mass spectrometer (GC-MS), a Fourier Transform Infrared Spectrometer (FTIR), and Capillary Electrophoresis (CE). While this holds true for some particular aspects of forensic sciences, the absence of such instruments does not prevent the criminalist from, first, properly collecting trace evidence at crime scenes and, second, analyzing a great number of traces.

Dr. Locard was the pioneer of modern criminalistics, though he did not have the modern instrumentation that is available in crime laboratories in the twenty-first century. Nevertheless, his work was not necessarily less reliable than that done today because he was cognizant of the significance of his work and its limitations. However, he describes many different traces that were observed and collected from crime scenes such as prints from fingers, nails, lips, faces, feet, and teeth. He also describes the observations of stains, such as grease, candle, mucus, feces, blood, semen, rust, food, etc. The diversity of his observations is incredible and it encompasses many potential traces that are not necessarily taken into account today.

Forensic sciences should not revolve around the instrumentation used to perform trace analysis, but around the trace evidence itself. This is a very important concept that is emphasized throughout Dr. Locard's writings that seems to be sometimes disregarded in our modern times. Dr. Locard's method of reasoning is probably the most important concept in forensic sciences, and the general process of trace evidence analysis should include the following questions in this order:

- What is the trace?
- What is its composition and characteristics?
- How can this trace be linked to its origin or to another trace (or what are the pertinent characteristics that will be used for the comparison process)?
- How can that be accomplished (or what instrumentation/ technique is needed to analyze these characteristics)?

This cognitive process emphasizes the trace evidence and not the techniques used to analyze it. It ensures that the criminalist understands the importance of what is analyzed and, therefore, it establishes a proper base for the interpretation of the results. Without having a clue about the significance of the characteristics analyzed the forensic scientist cannot properly interpret the results of the analyses, and therefore cannot reach accurate conclusions. The development of many new analytical techniques seems to have led scientists away from the significance of the trace evidence itself. It is not uncommon to see scientists trying to analyze certain trace evidence with a GC-MS or an FTIR just because there is one available in the laboratory, without really thinking of the pertinence of the characteristics analyzed. This can be avoided by asking the right questions first.

Dr. Edmond Locard, Criminalistics, Trace Evidence Analysis

B117 Could Have, Would Have, Should Have: The Utility of Trace Evidence

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After attending this presentation, attendees will understand the time and money-saving aspects of trace evidence examinations and why laboratories should retain trace evidence in their services portfolio

This presentation will encourage a greater awareness of the utility, significance, and benefits of trace evidence analysis

Non-DNA forensic disciplines, particularly trace evidence, have suffered from the persistent perception of their lack of scientific rigor. Traditionally dismissed as "could have" evidence, trace evidence examiners have generally lacked the resources that have become common to their DNA-oriented colleagues. This has lead to a general weakening of the perception of the utility of trace evidence—even by trace evidence analysts themselves. A weak perception, the authors feel, leads to a weak analysis and a weaker interpretation.

Highlighting the most commonly voiced arguments against trace evidence, this paper will present counter-arguments, backed with model data, which emphasize the utility, and even the necessity, of trace evidence as a integral part of any forensic laboratory. Actual cases where no DNA was examined, the DNA was examined but was not suitable for analysis, or where a positive finding of DNA would not move the investigation forward (spousal sexual assault, for example) will be the most obvious starting point for this presentation. Additional cases that demonstrate the potential specificity and strength of trace evidence analysis will be discussed. Management issues will also be discussed showing how trace evidence can save a laboratory time and money.

For example, in three hypothetical cases involving hairs in three laboratories with differing sampling protocols, the laboratory employing microscopical hair examinations has a more efficient and cost-effective supply chain than laboratories that do not. Therefore, while hair examiners may be considered to be a "waste of time" by some laboratory managers, they, in fact, can save both time and money.

Other actual and hypothetical examples will be discussed.

($1500 per sample for mtDNA)	Lab #1 Analyzes DNA on all Q hairs, plus all K samples		Lab #2 Only analyzes 2 hairs @ from victim's underwear and SAK, plus all K samples		Lab #3 Only analyzes 1 hair after microscopical exam from each item, plus 2 K samples	
	Cost	Accuracy	Cost	Accuracy	Cost	Accuracy *
Small Case 2 positive/5 total 2 Known samples	$10,500	5 in 5	$9,000	4 in 5	$6,000	9 in 10
Medium Case 5 positive/15 total 4 Known samples	$36,000	20 in 20	$12,000	4 in 20	$9,000	9 in 10
Large Case15 positive/50 total 6 Known samples	$84,000	50 in 50	$15,000	4 in 50	$12,000	9 in 10

* Based on results published in Houck, M.M. and Budowle, B. JFS, V47, N5, 2002.

Trace Evidence, DNA, Management

B118 Future Crime Labs Without Trace Evidence—Dysfunctional Dystopias

Peter R. De Forest, DCrim, Professor of Criminalistics, John Jay College of Criminal Justice, 445 West 59th Street, New York, NY 10019*

After attending this presentation, attendees will have increased awareness of the nature and importance of trace evidence.

The term *trace evidence* doesn't refer to a single technique or technology. It is a misunderstood term.Trace evidence is an approach to problem solving as much as it is an evidence category. The approach has broad applicability to an extraordinary range of problems that arise in criminalistics. This fact is not appreciated by people whose knowledge of forensic science is derived from portrayals in the media or those of the entertainment industry. Surprisingly, to some extent this is true of people employed in forensic science. Trace evidence sections in some laboratories have been downsized as more resources are being invested in DNA typing technology. It is easy for layman and scientist alike to become enamored of high tech tools. We need to remind ourselves that tools are rarely the solution. They need to be applied knowledgeably and intelligently. Carefully framed scientific questions need to be posed before the tools can be applied with maximum effect. Hopefully, predictions of the demise of trace evidence are premature. Trace evidence is an essential contributor to case solutions in criminalistics and cannot be allowed to wither. Trace evidence is inextricably intertwined with the essence of criminalistics. It is not much of an exaggeration to assert that "trace evidence *is* criminalistics." Trace evidence approaches and assessments may define scientific problems in ways that allow the meaningful application of techniques or tools such as elemental analysis or DNA typing.

Tasks in criminalistics cannot be subdivided into a finite array of predefined problems. Every case is different. The approach cannot be selected from a reference book of methods. It cannot be known *a priori*.

Trace evidence approaches to the solution of casework problems are essential to the future of criminalistics. If we lose sight of this point, criminalistics could evolve to the extent where it is eviscerated of its essence. It would be unrecognizable. It would cease to be science. In this "*Brave New World*" crime laboratories would be composed solely of technicians, instruments, and quality control managers. Investigators would bring in evidence and select from a brightly colored McDonald's-type menu of available analyses. In this *paint-by-the-numbers approach*, the investigator would be making physical evidence assessments of sorts and the laboratory workers, I am reluctant to call them criminalists, would carry out the prescribed analyses. The laboratory workers would be mere technicians while the investigators, irrespective of their academic qualifications would be cast in the role of scientists. Some benefits might accrue. The item throughput might increase, and the resulting error rates might be vanishingly small, but much of the work would be of marginal value, or even irrelevant, and case solutions would suffer. The resulting lab system might be good at *doing the job right* but it would not be *doing the right job*. Sadly, perhaps this dystopia is closer than we think. Action must be taken to reverse the drift in this direction. The science in criminalistics is not embodied in carrying out tests and operating computerized instruments. The science is in the all-important front end assessment of the physical evidence that drives the selection of the analyses to be performed and in the critical back end integration and interpretation of the results of these tests that gives them meaning.

Trace Evidence, Criminalistics, Dysfunctional Dystopias

B119 *Daubert* Factors Applied to the Examination of Footwear Evidence

Sandra Wiersema, BS, FBI Laboratory, 2501 Investigation Parkway, Quantico, VA 22135*

The purpose of this presentation is to acquaint the footwear examiner with the *Daubert/Kumho* criteria and to offer suggestions for answering these criteria as they relate to footwear evidence.

This presentation will provide answers to these criteria that the author has used in a previous *Daubert* hearing along with suggestions that can be used to demonstrate the way that comparisons are done and the reliability of the methods used.

In *Daubert*, the United States Supreme Court has created a gatekeeping role for trial judges as to the admissibility of scientific expert testimony. The Supreme Court has envisioned that trial courts would conduct a factor-based analysis when determining whether the testimony is reliable. The issues to be considered by the trial judge are:

1. whether the theory or technique can be and has been tested.
2. the existence and maintenance of standards controlling the technique's operation;
3. whether the theory or technique has been subjected to peer review and publication;
4. the known or potential rate of error; and
5. general acceptance

The opinion noted that the factors did not comprise a definitive checklist or test.

Initially, *Daubert* was applied only to "scientific" expert testimony. In *Kumho* tire, the courts acknowledged that trial judges also have to apply the *Daubert* analysis in the context of experience-based expert testimony. This means whether your discipline is considered to be "scientific" or "technical," *Daubert* still applies.

This presentation will provide answers to these criteria that the author has used in a previous *Daubert* hearing along with suggestions that can be used to demonstrate the way that comparisons are done and the reliability of the methods used.

The prosecutor or judge may suggest that the jury be allowed to make the comparison between the footwear impression and the shoes in question. The author will recommend examples that you can use which should convince the court that this is not a good idea.

Avenues for further research and previous *Daubert* decisions will also be discussed.

***Daubert*, Footwear, Evidence**

B120 Analyzing Bar Soaps by Utilizing a Variety of Optical and Chemical Techniques

Gerald M. LaPorte, BSc, MSFS, Jeffrey Wilson, BS, MSF, Douglas Shaffer, MS, and Robert Ramotowski, MS, United States Secret Service, Forensic Services Division, 950 H Street NW, Washington, DC 20223*

After attending this presentation, attendees will understand methods to forensically examine and differentiate bar soap.

This presentation will present the forensic community with techniques to forensically identify and characterize bar soaps. This topic has not been discussed (or infrequently mentioned) in the forensic literature. As well, the authors will have a database of information which can be made available to other analysts.

As a result of the anthrax poisonings that took place in October, 2001, and highly publicized news releases pertaining to chemical and biological threats, law enforcement agencies have received numerous hoaxes involving unknown material. Materials of unknown origin are often submitted for forensic examination and can be analyzed using a

variety of analytical techniques. Recent evidentiary submissions and forensic requests at the United States Secret Service have included unidentified substances suspected to be soap. The perpetrators of these crimes were obviously attempting to instill fear into the recipient by making the victim believe they had been exposed to a chemical or biological agent. Investigators have requested identifications of the unknown substances and comparisons with known material seized from the suspect(s). After reviewing the forensic literature, there was very little information specifically addressing the forensic examination of soap bars. Therefore, the authors examined a variety of commercially available soap bars to determine if the soaps could be characterized using some of the common analytical equipment found in forensic laboratories. Fifty bars of soap were obtained and analyzed using optical techniques, gas chromatography/mass spectrometry, thin layer chromatography, fourier transform infrared spectrophotometery, ultraviolet and fluorescence spectrophotometry, and scannining electron microscopy - energy dispersive spectroscopy. Numerous differences between the soap specimens were identified and classified into a flow chart/database so that other analysts can use the information in cases involving the forensic analysis of suspected soap.

Soap Analysis, Chemical and Biological Threats, Bar Soap

B121 Analysis of Nonoxynol-9 in Condom Lubricants via Pyrolysis Gas Chromatography-Mass Spectrometry (PGC-MS)

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After attending this presentation, attendees will understand the use of pyrolysis gas chromaography mass spectrometry for presence of condom lubricants in sexual assault cases.

This presentation will demonstrate new techniques for detection of condom lubricants.

Many sexual offenders are now utilizing condoms in sexual assaults. Because of this fact, forensic examiners increasingly need to examine swabs for condom lubricants in criminal sexual conduct cases in which no sperm is detected.

Examination of condom lubricants is problematic due to both contamination issues and the nature of the chemical constituents of the lubricants. Due to the presence of bodily fluids and other lubricants commonly present on vaginal swabs it is preferable to utilize a chemical separation technique such as gas (GC) or liquid chromatography (LC) in examination of the swabs. The high molecular weight and chemical nature of the surfactants, however, make introduction and examination of samples by these instruments problematic.

One of the most common lubricant components, the spermicide nonoxynol-9 is a harsh detergent composed of a nonylphenol with a polyoxyethylene chain of varying lengths. It has a range of molecular weights differing by 44 amu, the weight of one ethylene oxide ($-OCH_2CH_2-$) group. The analysis of this detergent by traditional electron impact (EI) ionization GC-Mass Spectrometry is not useful. It is an extremely viscous liquid that is not volatile enough get through the injector and into the column. Its large molecular mass (average 616 amu) and both hydrophilic and hydrophobic ends also contribute to difficulties in analysis by GC-MS.

Several other methods for detection of nonoxynol-9 have been explored, including thin layer chromatography (TLC), desorption chemical ionization mass spectrometry (DCI-MS), matrix-assisted laser desorption/ionization (MALDI), Fourier transform infrared spectroscopy (FT-IR), electrospray ionization mass spectrometry (ESI-MS), nanoelectrospray ionization mass spectrometry (nanoESI-MS) and liquid chromatography/electrospray ionization mass spectrometry (LC-MS). All of these methods have shortcomings; several are non-specific, some are not suitable for nonoxynol-9 in mixtures and most involve techniques that are not readily available in most forensic laboratories.

In this presentation, we will demonstrate a reproducible method for detecting nonoxynol-9 using pyrolysis gas chromatography (PGC), an instrument found in most forensic laboratories. Coupled with a mass spectrometer (PGC-MS), examination and identification of nonoxynol-9 pyrolysis products in spermicidal lubricants is possible.

Pyrolysis and GC-MS conditions were varied using standard nonoxynol-9 to optimize the method. Extraction methods and sample requirements will also be discussed.

Pyrolysis, Condom, Nonoxynol-9

B122 Forensic Analysis of Architectural Paints Utilizing Raman Spectroscopy

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After attending this presentation, attendees will have been introduced to Raman Spectroscopy as an analytical technique that can aid in the forensic analysis and comparison of architectural paints.

The use and advantages of Raman spectroscopy in the forensic analysis of architectural paints and pigments will be presented. In this study, samples of architectural paint pigments and pigmented architectural paints were analyzed by Raman spectroscopy. The data presented will show that Raman spectroscopy can aid the forensic scientist in the discrimination of architectural paints. This research documents a new approach to the analysis and characterization of architectural paints. Although paint evidence is common trace evidence, the forensic analysis of architectural paints has not received significant attention in recent years.

The forensic scientist must not be concerned only with positive associations of physical evidence. As an unbiased finder of truth, the forensic scientist must be cognizant of analytical methods that provide the best discrimination among similar samples. Forensic scientists must consider all tests and analytical procedures that may result in the discrimination between paint samples. The greater the number of analytical techniques and methods the forensic scientist has available and utilizes to analyze physical evidence, the greater the probability of discriminating between items of evidence. The ability to provide greater discrimination among similar paints will result in a reduction of false inclusions. An analysis employing a battery of discriminating techniques that shows consistency between samples will result in a stronger association.

Forensic paint evidence is received at the forensic laboratory in the course of many types of criminal investigations. Such investigations include but are not limited to: forced entries, burglaries, robberies, assaults, vehicular hit and runs, abductions, rapes, and homicides. The transfer of paint occurs from miscellaneous contacts of painted objects with each other or contacts of painted surfaces with non-painted surfaces. Mutual transfers may not always be equal in quantity or quality. In some cases, very light or minimal transfers can occur, these types of transfers often present a challenge to the forensic scientist. Minimal transfers can make the characterization, identification, and association of

items of evidentiary value very difficult. Raman spectroscopy can be applied to the analysis of very small samples; and therefore is ideal for the analysis of this type forensic sample.

Over the last five years, the technology for collection of Raman spectra has advanced, transforming Raman spectroscopy from a research curiosity into a practical analytical methodology. Raman spectroscopy holds great potential for analyzing all types of forensic evidence. Advances in Raman instrumentation and technologies, have resulted in instruments that are far different from their predecessors. The cost of these new commercial instruments has decreased sufficiently that forensic laboratories can now afford them.

Prior to application, architectural paint is a liquid medium containing a mixture of a solvent(s), dispersant(s), binder(s), pigment(s), and additive(s). When paint is applied to a surface it dries to form a thin film or coating that contains all but the solvent portion of the mixture. Architectural coatings are applied to both the interior and exterior surfaces of building structures. Over 600 million gallons of architectural paint are applied to the interior and exterior surfaces of building structures each year.

Paint can contain both organic and inorganic materials. The fact that paint binders are poor Raman scatterers is advantageous. A large number of pigments used in architectural paints are strong Raman scatterers. This phenomenon allows for the identification of pigments in architectural paints. In addition, with the requirement of little or no sample preparation coupled with the speed at which Raman spectral data can be acquired, the discrimination of architectural paints can be accomplished in a matter of minutes.

Multiple applications of paint result in the production of a series of layers. Samples consisting of single layer coatings of paint as well as intact, multiple-layered paint chips were analyzed using Raman spectroscopy. A semi-quantitative analysis of the Raman spectral data obtained resulted in the discrimination of similar white paint samples. The analytical data presented will support the utility and value of Raman spectroscopy in the analysis architectural paints.

Raman, Paint, Pigments

B123 Near Infrared Microspectral Analysis of Trace Evidence

Jumi Lee, PhD, CRAIC Technologies, 2400 North Lincoln Avenue, Altadena, CA 91001*

After attending this presentation, attendees will understand techniques for analyzing representative trace evidence samples in the near infrared. Results from the analysis of basic types of trace evidence useful for aiding scientists with their own identifications.

This presentation will demonstrate the analysis of representative types of trace evidence in a spectral region that has not been previously explored.

The examination of trace evidence by UV-visible microspectroscopy has been an integral part of trace evidence examination for thirty years. Many types of fibers, paints and other evidence of concern have been analyzed in detail for both their color and UV characteristics. However, almost no work has been done investigating the near infrared spectral characteristics of such samples and determining the utility of microspectroscopy in this region as a comparative technique.

By the near infrared region, we mean the spectral range from 700 nm to 2100 nm. This work shows the results of microspectral analysis of a number of representative samples in the spectral region from 700 to 2100 nm as well as an analysis of the results. The major features are described for use by other examiners in their casework.It also discusses the best techniques for preparing samples for analysis in the NIR region.

Near Infrared, Trace Evidence, Microspectroscopy

B124 Identification of Odor Signature Chemicals Used by Detector Dogs to Locate Drugs and Items Containing Drug Odors Including Currency

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This paper describes the identification and quantification of odor signatures used by detector dogs to locate controlled substances and the significance of these finding in confirming dog alerts to items associated with controlled substances including currency

This presentation will demonstrate that law enforcement detector dogs are trained to alert to significant quantities of unique odor chemicals associated with controlled substances and not found in common over the counter preparations or circulated currency thus strengthening the value of dog alerts to items as part of an investigation.

This paper describes the use of headspace solid-phase microextraction (SPME) combined with gas chromatography mass spectrometry (GC/MS) to identify the signature odors that law enforcement certified detector dogs alert to when searching for drugs. Background information is provided on the many types of detector dogs available and specific samples highlighted in this paper are the drugs cocaine and 3,4-Methylenedioxy-N-Methylamphetamine (MDMA or Ecstasy). Studies include the analysis and identification of the headspace (fingerprint) of a variety of samples, followed by completion of double-blind dog trials of the individual components in an attempt to isolate and understand the target compounds that dogs alert to. SPME/GC/MS has been demonstrated to have a unique capability for the extraction of volatiles from the headspace of forensic specimens and shows great potential to aid in the investigation and understanding of the complicated process of canine odor detection. Major variables evaluated for the headspace SPME included fiber chemistry and a variety of sampling times ranging from several hours to several seconds and the resultant effect on ratios of isolated volatile components. CW/DVB and PDMS SPME fibers proved to be the optimal fiber types. Field studies with detector dogs have demonstrated possible candidates for new pseudo scents as well as the potential use of controlled permeation devices as non-hazardous training aids providing consistent permeation of target odors.

The results demonstrate that SPME/GC/MS combined with field tests using certified detector dogs is an effective method for identifying active odor signature chemicals in forensic specimens. For the drug studies it was found that passive adsorption using DFLEX devices containing activated charcoal was not sensitive enough to recover signature odors from the headspace of MDMA tablets. Only when very large samples (i.e., greater than 250 grams) were extracted for extended periods of time (i.e., 1 week) were odors reliably detected. However, with headspace SPME it was found that with the implemented use of the CW/DVB and PDMS fibers with 3 hour extraction times it was possible to obtain consistent signature odors from the headspace of a single MDMA tablet. Many compounds of interest were found to be present in the headspace composition of the MDMA tablets tested, including piperonal, MD-P2P and methamphetamine. Through examinations of different tablets, however, it was concluded that the metamphetamine found within certain tablets were present due to its addition as an impurity or adulterant and not the direct result of synthetic manufacturing and that piperonal and MD-P2P were the common chemicals seen in all samples tested.

In studies where different over the counter tablets were analyzed, it was concluded that none of the headspace compounds found within these tablets were present in the headspace of MDMA tablets, therefore making the possibility of false positive alerts from the canines in association with these commonly encountered tablets unlikely. Field studies

directly focusing on the signature odor of MDMA have shown that canines are alerting to approximately 10 ¡V 100 mg of the piperonal compound that is found exclusively in MDMA tablets. Since MDMA manufactured through different synthetic routes can yield different signature chemicals, it is important to perform ongoing studies of headspace odors from current street samples and more than one MDMA training aid may be required for optimal performance in the future.

The dominant cocaine odor chemical has been confirmed to be methyl benzoate via spiked samples as well as controlled delivery devices with threshold levels of 1-10ng spiked methyl benzoate or 0.1-1 ng/sec odor diffusion. The evaporation rate of methyl benzoate from circulated and uncirculated U.S. currency has also been studied in detail. The amount of methyl benzoate on currency decreased exponentially. Evaporation rates varied considerably (2 to 2000 ng/sec) depending on conditions, decreasing with increasing number of bills and the covering of the currency. The levels of signature odor chemicals needed to initiate consistent alerts from law enforcement detector dogs and the lack of significant levels of these chemicals in common over the counter items or circulated currency enhances the significance of dog alerts to items as part of an investigation.

Drugs, Detector Dogs, Currency

B125 The Effects of Adsorption-Based Extraction Methods on the Recovery of Aliphatic and Aromatic Compounds in Medium Petroleum Distillates

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Following this presentation, the attendee will have a greater understanding of the following: (1) the importance of relative aliphatic:aromatic concentrations in classifying medium-range petroleum products; (2) how adsorption-based extraction methods can affect these ratios with respect to the recovery of a medium petroleum distillate from simulated fire debris; and (3) the effects of ignitable liquid concentration on the aliphatic:aromatic ratios.

This presentation will assist examiners in understanding the phenomena associated with the extraction process and how it may skew data. This knowledge may ultimately assist in minimizing the likliehood of false inclusions or exclusions when comparing data.

Classification of ignitable liquids in accordance with voluntary consensus-based standards published by the American Society of Testing and Materials has become increasingly specific, relying upon both the chemical composition and the boiling point range of submitted ignitable liquids. Specifically, the classification of petroleum distillates and dearomatized petroleum distillates has been distinguished, such that each represents a distinct class.

In the first part of this study presented in 2003, the compositions of a variety of medium-range ignitable liquids were examined with regard to their relative proportions of aromatic and aliphatic content, as represented through the use of extracted ion profiles (EIPs). A variety of commercially available products in the medium range exhibit a broad range of compositions with respect to the proportion of aromatic compounds relative to the major aliphatic compounds present. It was shown that there are not separate and distinct ranges of aromatic content for dearomatized products, distillates, and blends; rather, there is a continuum.

This portion of the study examines how the extraction process affects the relative proportion of aliphatic and aromatic compounds recovered. Samples of simple and complex substrates were spiked with varying volumes of a medium petroleum distillate. These samples were then extracted in accordance with ASTM 1412-00 Standard Practice for Separation of Ignitable Liquid Residues from Fire Debris Samples by Passive Headspace Concentration With Activated Charcoal. Data was then examined to determine if the process of extracting the liquid from debris affected the relative proportion of aromatic and aliphatic compounds. Using data from the neat liquid for comparison, data from extracted samples were compared to note the effects of substrate type and volume of liquid. Examination of the data revealed that the primary factor affecting the recovery of aromatic and aliphatic compounds relative to one another was the concentration of ignitable liquid in the sample. A greater volume of medium petroleum distillate on the sample resulted in a greater recovery of aromatic compounds relative to aliphatic compounds. Also affecting the recovery and subsequent ratios was the nature of the debris. The more complex charred debris samples showed a greater relative recovery of aliphatic compounds compared with their recovery from a simple, non-charred substrate. These results are consistent with the hypothesis that competitive adsorption can alter aliphatic:aromatic ratios due to the fact that charred debris can provide sites for adsorption. This also further demonstrates that overloading adsorption sites can lead to skewing of data not only relative to boiling point as previously reported,[1] but also with regard to relative aliphatic:aromatic ratios. These factors studied which were found to affect recovery—amount of ignitable liquid present, and nature of sample substrate—are beyond the control of the laboratory analyst in actual casework. It is therefore incumbent upon the analyst to be aware of the significant effects of the extraction process when utilizing aliphatic:aromatic ratios in the classification process or when comparing data from extracted samples with one another or to data from a liquid source.

[1] Newman, RT, Dietz, WR and Lothridge, K. "The Use of Activated Charcoal Strips for Fire Debris Extractions by Passive Diffusion. Part I: The Effects of Time, Temperature, Strips Size, and Sample Concentration," (1996) *Journal of Forensic Science*, Vol. 41, No. 3, 361-370.

Fire Debris Analysis, Extraction, Aromatic Content

B126 Detailed Chemical Composition of Ignitable Liquids Determined With Comprehensive Two-Dimensional Gas Chromatography-Mass Spectrometry

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After attending this presentation, attendees will understand that comprehensive two-dimensional gas chromatography with mass spectrometry detection produces detailed chemical composition information about ignitable liquids that can be used to identify these substances in complex fire debris samples.

The presentation will describe advances in analytical chemistry that will have a significant impact on the field of forensic fire debris analysis. Comprehensive two-dimensional gas chromatography methods provide an order of magnitude improvement in the chemical separation of complex mixtures that will lead to enhanced identification of ignitable liquids.

Comprehensive two-dimensional gas chromatography with mass spectrometry detection (GCxGC/MS) is a three-dimensional hyphenated analytical method that is ideal for exploring the complex chemical composition of ignitable liquids. The increased separation and identification capability of GCxGC/MS represents a significant analytical advantage over traditional gas chromatography (GC) and gas chromatography-mass spectrometry (GC/MS) methods for the analysis of complex mixtures. GCxGC uses two chromatography columns with different stationary phases that are coupled serially by a modulator. Ignitable liquid

compounds can be separated by a combination of volatility and polarity or shape mechanisms to produce a two-dimensional chromatogram with hundreds of compound peaks distributed across a two-dimensional retention time plane. The two-dimensional separation is a significant improvement over traditional GC separations because many more peaks are resolved and the peaks are arranged into groups according to their chemical class. In this way, alkanes, alkenes, cycloalkanes, aromatics, and oxygenated compounds are rapidly classified. When GCxGC separations are coupled with a mass spectrometer, each two-dimensional chromatogram peak has an associated mass spectrum that leads to accurate identification with mass spectral libraries.

In this work, the chemical composition of common ignitable liquids such as paint thinner, lacquer thinner, gasoline, and kerosene will be examined. Compounds separated by GCxGC will be assigned to a chemical class and identified by mass spectrometry. The comprehensive chemical information will be used to fingerprint ignitable liquids in the presence of chemical interferences from fire debris combustion and pyrolysis products.

Arson, Gas Chromatography-Mass Spectrometry, Ignitable Liquids

B127 Evaluation of the Effectiveness of Nylon Bags as Packaging for Fire Debris

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After attending this presentation, attendees will have been presented with the limitations associated with the use of nylon bags as packaging for fire debris samples with respect to the possible loss or cross-transfer of ignitable liquid vapors.

This study confirmed that nylon bags are suitable packaging for fire debris samples if properly sealed. Heat-sealing, although the most effective at retaining ignitable liquid vapors, is not always practical in the field and is not easily reproducible. Folding the opening of the nylon bag three times and then duct taping the fold is a satisfactory alternative that limits the loss of ignitable liquid vapors. The swan neck seal proved to be least effective, however, this study shows that no cross transfer occurred between nylon bags sealed in this way when stored for an extended period of time. Nonetheless, efforts to minimize the possibility of cross-contamination, such as separating samples from different sources, are recommended.

A proper container for packaging of fire debris samples must be effective at retaining ignitable liquid vapors. Glass Mason jars, metal cans, and nylon bags are the accepted packaging. At this laboratory the preferred packaging is glass Mason jars; nylon bags are recommended as an alternative when the fire debris is too large to fit the preferred packaging. A study was undertaken to explore the effectiveness of Grand River® nylon bags with a swan neck seal, as typically received at this laboratory. The effectiveness of these bags, different sealing techniques, and the possibility of cross-transfer of ignitable liquid vapors between adjacent bags were evaluated. Analysis involved dynamic headspace sampling using tubes packed with Tenax® adsorbent and gas chromatography with flame ionization detection (GC-FID) or gas chromatography-mass spectrometry (GC-MS).

An experiment was designed to evaluate the loss of several classes of ignitable liquid vapors. A solvent mixture, gasoline, kerosene, and light, medium and heavy petroleum distillates were used. Paper towels spiked with 50µL of an ignitable liquid were packaged in nylon bags with a swan neck seal and subsequently placed into a clean glass Mason jar, which was immediately capped. Room temperature analysis of the glass Mason jar headspace was conducted to determine whether any vapors had escaped from the nylon bags. The results indicated loss of ignitable liquid vapors regardless of product class. Further work was undertaken to determine whether the loss occurred through the walls of the nylon bags or through the seal.

The effectiveness of different sealing techniques was evaluated as above using paper towels spiked with 50µL of gasoline. The sealing techniques tested were a swan neck seal, a triple fold sealed with duct tape, a single heat seal and a double heat seal. Single and double heat seals were the most effective at retaining ignitable liquid vapors, as gasoline was not identified in the headspace of the glass Mason jars. Low levels of incomplete gasoline patterns, which would not meet this laboratory's criteria for identification of gasoline, were observed from nylon bags that were sealed with duct tape. Identifiable gasoline patterns were seen in the results from the nylon bags sealed with a swan neck seal.

The effect of double bagging with a swan neck seal was also investigated using gasoline. The results indicated no significant advantage, with respect to retaining ignitable liquid vapors, over a single bag with a swan neck seal.

The possibility of cross transfer of ignitable liquids between nylon bags with a swan neck seal was explored. Two nylon bags were placed together in a cardboard box: one nylon bag contained paper towels spiked with 1mL of an ignitable liquid; and, the other contained clean paper towels. As in the first part of the study, a solvent mixture, gasoline, kerosene, and light, medium and heavy petroleum distillates were used. The cardboard box was sealed with tape and stored for approximately five months. No ignitable liquid vapors were identified in the box or the adjacent nylon bag, despite the presence of visible liquid or strong positive results in the spiked nylon bag.

This study confirmed that nylon bags are suitable packaging for fire debris samples if properly sealed. Heat-sealing, although the most effective at retaining ignitable liquid vapors, is not always practical in the field and is not easily reproducible. Folding the opening of the nylon bag three times and then duct taping the fold is a satisfactory alternative that limits the loss of ignitable liquid vapors. The swan neck seal proved to be least effective, however, this study shows that no cross transfer occurred between nylon bags sealed in this way when stored for an extended period of time. Nonetheless, efforts to minimize the possibility of cross contamination, such as separating samples from different sources, are recommended.

Fire Debris Analysis, Packaging, Nylon Bags

B128 Advances in the Smoke Odor Analysis in Fire Investigations

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After attending this presentation, attendees will have been presented with data illustrating how smoke odor analysis can be used in arson and homicide investigations and to allow the delegate to develop an appreciation of a new forensic tool.

This presentation introduce a new forensic tool.

Smoke odor comprises a variable range of individual volatile organic compounds (VOCs), which can be present above or below published odor thresholds. The detailed distribution of VOCs in the vapor phase depends upon the particular combination of materials being pyrolysed in the fire in question, for example wood, polystyrene, polyolefins, polyurethanes, polyesters, PVC, nylons, methacrylates, tissue and various accelerants. The VOC products in question can accumulate efficiently on both adsorbent materials at the scene of the crime and on the clothing and hair of a suspect exposed for a period to smoke from the fire in question. They can then be detectable organoleptically by both scene of crime and arresting officers.

The adsorbed pyrolysis products are amenable to established headspace analytical procedures, involving concentration from sealed nylon pouches onto conditioned Tenax porous polymer and thermal desorption/GC-MS analysis. Approximate quantification allows comparison with an extensive database of odor thresholds. Pyrolysis-EIMS analysis of materials from the scene of the crime can be used as a validation procedure to verify the probable source(s) of volatile products in question.

The pyrolysis products are present in smoke at typically ppb concentrations. Much care needs therefore to be devoted to data interpretation and the selection and analysis of appropriate control samples. Although the TD/GC-MS methodology is similar, this presents a significantly more challenging analytical requirement than typically encountered in the detection and characterization of accelerant residues on fire debris samples.

The M-Scan smoke odor method will be described and illustrated by reference to (a) the first English criminal case in which this approach has been used to tentatively link a suspect to a particular fire, and (b) a series of controlled combustion experiments involving known combinations of materials.

Pyrolysis, Smoke, Odor

B129 An Atypical Cause of Fire: CCTV Evidence to the Rescue

Rebecca S. Pepler, BSc, MPhil, Anglia Polytechnic University, Departmentt of Forensic Science & Chemistry, East Road, Cambridge, Cambridgeshire CB1 1PT, England*

After attending this presentation, attendees will recognize the importance of CCTV evidence when investigating a large fire scene; understand how civil litigation can direct and/or curtail an investigation; implement a multidisciplinary and multi-agency investigation; learn of an unusual substrate for spontaneous combustion; and learn how to confirm the occurrence of spontaneous combustion using laboratory facilities.

This case study will highlight the differences between the UK and the USA in the way that civil litigation can influence the extent of a fire investigation. In addition, it will demonstrate the large differences in the way in which fire investigation is undertaken in the UK and the USA.

The presentation will reinforce the basic methodology of fire investigation, refresh investigator's memories concerning aspects that should not be overlooked and how best to exploit a multi-agency approach. Furthermore, the case will reveal an unusual substrate that is capable of self-heating, thus making investigators aware of the potential of this material to spontaneously combust. The presentation will also explain how best to use the available laboratory facilities to confirm or refute initial suspicions of self-heating.

On a dry October Sunday afternoon a small fire was discovered in the external storage area of a large expanded foam factory. Due to a number of factors, including a strong south easterly wind, the fire escalated into one of London's largest fires for a decade and resulted in a £26 million loss. The ensuing investigation lasted several months and is an excellent example of a multi-disciplinary and multi-agency approach. The potential civil litigation meant that the investigation incorporated many facets of fire investigation, from sprinkler systems to fire fighting procedures, and highlights the (sometimes frustrating) role that civil litigation plays in directing an investigation.

CCTV evidence proved invaluable in identifying the point of origin of the fire. Without the video evidence, the cause of the fire may well have been recorded as deliberate ignition. As it turns out the fire was initiated in a much more unusual manner. Subsequent laboratory tests confirmed the initial conclusions and demonstrated that the fire was caused by self-heating (spontaneous combustion).

Spontaneous, Combustion, CCTV

B130 Cooperation Amongst Professionals: A Complex Case Study of a Suspicious Fire in Southern China

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The goal of this presentation is to show how the successful investigation of an unusual and complex international fraud case, spanning three different countries, relied on the input of professionals with greatly differing skills and experience before the scam was confirmed.

This presentation will demonstrate how the same skills used by forensic professionals in criminal cases can be used in the investigation of civil enquiries. It also underlines the importance of co-operation between different disciplines.

During the early morning of 7 February 1999 a burning container vehicle was reported at the foot of a steep slope at the side of the main road in a remote area between Panyu City and Shunde in Guandung province, Southern China. The vehicle consisted of a tractor, trailer and a container which was reputed to contain 7,500 state-of-the-art PC mother boards which had originated in Taiwan and been transhipped to Hong Kong before arriving on the Chinese mainland.

Initially the fire was attended by local Chinese fire and police officers who took two photographs but were not qualified to investigate the cause of the fire. The driver of the vehicle had disappeared and was never located. Later the same day the tractor, trailer, container and ~25% of the cargo of mother boards were removed to a nearby police pound where they remained until the tractor, trailer and mother boards were claimed on payment of a fine for damage to surrounding crops at the location of the accident. The empty container was not claimed and remained at the police pound.

On March 31, 1999, a change in survey personnel occurred and the new investigation team included the current authors. Despite the passage of time, when the scene of the fire was visited approximately 500 mother boards remained strewn on the ground and these were collected for further examination together with other potentially useful items such as wrapping material.

The investigation team included a fire investigator/forensic scientist, a chartered surveyor and a computer expert. The different skills of each member were needed to determine that this was an elaborate fraud which, had the insurance claim been upheld, would have resulted in the payment of a large amount of money.

This presentation will show the different reasons why the authors concluded that (1) the fire was a deliberate act, and (2) the value of the motherboards was a small fraction of that claimed.

Fraud, China, Cooperation

B131 The Business Case for Using Forensic DNA to Solve and Prevent Sexual Assault Cases

Ray A. Wickenheiser, BSc, Acadiana Criminalistics Laboratory, 5004 West Admiral Doyle Drive, New Iberia, LA 70560*

The learning objective of this presentation is to acquaint the forensic scientist and forensic science administrator with the concept and practical application of cost benefit analysis to the area of forensic science. By applying this analysis to the specific topic of "no suspect sexual assault," a business case for forensic science will be amply demonstrated in a manner that all can relate to, dollars and sense.

Through application of a cost benefit analysis, and development of a sound business case, the forensic community will better demonstrate the value of its service. The application of this method to cases of "no

suspect "sexual assault demonstrates a many fold return on investment. Ultimately, demonstrating the dollar value of using forensics to solve and prevent crime will lead to appropriate levels of funding to meet the requirements of society.

The elements truth and justice are very difficult to quantify and measure. While no one doubts the value of forensic science in the establishment of truth, and hence justice, through the objective means of science, many government forensic labs are experiencing difficulty in securing adequate financial resources to meet their goals. Only one quality of work is possible with justice at stake, the highest. The consequence of error is grave, so quality cannot be sacrificed for the sake of output. There are high requirements to provide this top quality. Education, ongoing training, proficiency testing, documentation, and accreditation itself, add to the cost of providing the forensic service deserved by all members of society. More than ever, forensic laboratories have become the victims of their own success. The demand for quality service has outstripped the financial resources available and required to deliver the services needed.

With expenditures of all levels of government scrutinized more than ever, levels of funding are very tight. Retaining funding levels is difficult, let alone increasing funding to expand services to meet increasing levels of demand, and the high cost of technology. Making a business case for forensic science involves placing a dollar value on the costs and the benefits of forensics. While it is inherently very difficult, establishing dollar cost and benefits demonstrates the real value of forensics as an investment. Furthermore, the value of the investment in forensics can be compared to expenditures and benefits of other programs.

Use of the very specific forensic case type of "no suspect" sexual assault provides the framework for this business case. Cases of sexual assault where the perpetrator is unknown to the victim are seldom solvable without the assistance of forensic science. With the help of recently established DNA databases, a suspect can be developed, and cases solved, which were previously unsolvable. There is a high level of recidivism in the case of sexual assault, where the same offender commits a number of assaults. Early detection and apprehension of offenders not only solves outstanding cases, but prevents future assaults as well. The cost of providing forensic DNA service can be quantified. The benefits of applying forensics to solve cases of sexual assault can also be calculated, as well as the value of preventing future sexual assaults. In this manner, a cost benefit analysis can establish the high value of forensic DNA in quantifiable terms. With this very high return on investment, the case can be made much more easily for adequate resources to meet the level of demand needed by society.

Business Case, DNA, Sexual Assault

B132 NYPD Backlog Project Exonerates Man After 12 Years

Linda Frese, MS, Mary Quigg, BS, Howard Baum, PhD, and Robert Shaler, PhD, Office of the Chief Medical Examiner, Department of Forensic Biology, 520 First Avenue, New York, NY 10016*

After attending this presentation, attendees will have been presented with a case in which the NYPD backlog project, and CODIS, resulted in the exoneration of a man falsely incarcerated for twelve years.

This presentation displays how CODIS is such a powerful tool. Not only can it be used to aid in prosecuting offenders but also help to exonerate those wrongfully convicted of a crime. We would not have been able to exonerate the man in this case without the help of the CODIS database.

This talk will discuss the history of the NYPD backlog project and how the re-analysis of one case exonerated a man convicted of sexual assault, and resulted in a DNA match with a convicted offender.

Prior to 1999, the examination of sexual assault kits was the responsibility of the NYPD lab.The lab was only performing serological testing on those cases going to court, and as a result, the number of sexual assault kits not being examined accumulated rapidly. In the year 2000, CODIS was implemented. The issue arose as to how the NYPD was going to handle the large backlog of cases that had accumulated. The NYPD backlog project was developed to examine approximately 17,800 cases regardless of whether these cases had been previously examined. Three independent forensic laboratories, were contracted to examine or re-examine these cases and the Office of the Chief Medical Examiner reviewed all of the data and entered it into CODIS.

On March 19, 1991, a seventeen-year-old female was sexually assaulted and robbed on the rooftop of her building. As a result, a sexual assault kit was taken but no DNA testing was conducted. The victim was able to provide the police with a detailed physical description of her assailant. The man was subsequently apprehended, placed on trial, and convicted of rape, sodomy, and robbery. The defendant claimed his innocence throughout the trial.

In 2003, Orchid Cellmark received the sexual assault kit from the aforementioned case. Their analysis found the presence of sperm on the vaginal slide. A cutting of the vaginal swab was submitted for STR DNA testing resulting in a male DNA profile. A report was generated by Orchid Cellmark and all results were forwarded to the OCME. The results were analyzed by the Department of Forensic Biology, where the male DNA profile was entered into the database to be uploaded into CODIS. The laboratory was subsequently notified that the profile uploaded for this case resulted in a match with a convicted offender. This investigative lead was analyzed and determined that the profile from the convicted offender was the same as the DNA profile obtained from the vaginal swab. However, this convicted offender was not the same man that was previously convicted of the assault.

The Manhattan District Attorney's office requested that the sexual assault kit be re-examined by the Department of Forensic Biology. The presence of semen on the vaginal swab was confirmed and a cutting was submitted for DNA analysis. An oral swab was obtained from the victim to ensure that the kit being examined was indeed from her. DNA typing of the vaginal swab corroborated the results that were obtained by Orchid Cellmark. The man that was serving time in prison for twelve years had been wrongfully convicted. On May 19, 2003, the man serving time for sexual assault was informed that all charges against him had been dismissed and that he was now a free man. Unfortunately, due to the statute of limitations regarding sexual assault, the convicted offender found to match this case cannot be prosecuted.

NYPD, NYPD Backlog Project, CODIS

B133 The Mother of All DNA Contracts - 16,000 Sexual Assault Kits and Counting (Part I)

Marie Samples, MS, Robert C. Shaler, PhD, and Howard J. Baum, PhD, New York City Office of Chief Medical Examiner, Department of Forensic Biology, 520 First Avenue, New York, NY 10016; Karen Dooling, MS, Nassau County Medical Examiner's Office, 2251 Hempstead Turnpike, Building R, East Meadow, NY 11554*

The attendee will learn the trials and tribulations associated with a very large casework DNA contract.

Since outsourcing seems to be on the upswing in order to reduce DNA analysis backlogs, presentation about the experiences of New York City may help others in a similar situation.

This presentation will describe the experiences of a large, two and one half year, outsourcing contract - the analysis of more than 16,000 sexual assault kits covering the years 1989 - 1998. These sexual assault kits had been stored by the New York Police Department; in 2000 the decision was made by New York City to contract out the analysis of these sexual assault kits to three vendor laboratories. The New York

City Office of Chief Medical Examiner's Department of Forensic Biology, which did not have the responsibility to analyze sexual assault cases prior to 1999, participated in the contracting process. As a result, the Department of Forensic Biology took on many responsibilities of the contract, including reviewing the STR data generated by the contract labs for inclusion in CODIS.

There were many trials and tribulations encountered: setting up the contracts; working out the initial bugs; preparing "dummy" sexual assault kits for quality control purposes; developing methods of efficiently reviewing the data; confirming the performance of appropriate positive and negative controls; checking the results obtained on the "dummy" sexual assault kits; identifying and remediating problems in the vendor labs; tracking the progress of shipments; identifying local, state, and national database hits; notifying the necessary agencies; and appearing in court proceedings.

The presentation will also describe some of the interesting outcomes of the project, including the identification of well over three hundred sexual assault patterns of two cases or more and the freeing of a man incorrectly convicted of a sexual assault in 1992.

Part II of this presentation is a poster presentation which will present statistical information with regard to the analysis results, quality of the data obtained, number of hits generated, etc.

DNA, Sexual Assault Kits, Outsourcing

B134 Degenerate Oligonucleotide-Primed PCR: A Whole Genome Amplification Approach to Forensic DNA

Kristin M. Meyer, BS, George Washington University, Washington, DC 20052; Kristen E. Lewis, BS, Virginia Commonwealth University, 1000 West Cary Street, Richmond, VA 23284; Moses S. Schanfield, PhD, George Washington University, Washington, DC 20052; Tracey C. Dawson, PhD, Virginia Commonwealth University, 1000 West Cary Street, Box 842012, Richmond, VA 23284*

These research findings will provide a complete set of validated protocols for the final optimized whole genome amplification experiments. All procedures will be developed for instrumentation and equipment that currently exists in most forensic DNA laboratories. These will impact the forensic DNA community by allowing for increased success rate for cases which contain compromised biological samples without a significant increase in costs or the need for specialized training.

The goal of this research project is to provide the Forensic DNA community with a tool – Whole Genome Amplification – that than can readily increase the success rate of the analysis of degraded, aged or otherwise compromised biological evidence samples using existing conventional lab technologies and standard procedures for data analysis. This presentation is aimed to familiarize the audience with one particular method, DOP-PCR, for nuclear STR amplification and analysis.

Whole genome amplification techniques such as primer extension preamplification (PEP), multiple displacement amplification (MDA), and degenerate oligonucleotide-primed PCR (DOP-PCR) have been utilized in a variety of scientific areas, including embryonics, cancer genetics, histopathology, and genetic disease diagnosis and linkage studies. Recently, DOP-PCR has been successfully used as a method to generate larger amounts of DNA that are necessary to perform SNP and microsatellite genotyping. DOP-PCR involves the use of a 16-mer degenerate primer which theoretically allows the statistical and representative amplification of the entire genome and has been shown to accomplish this from as little starting material as that contained within a single cell. This study focuses on using DOP-PCR to analyze forensic samples where the yields of high quality DNA are too low for genotyping using conventional nuclear DNA methods. A sensitivity experiment was performed using genomic DNA to evaluate the technique's lower limits of amplification. Initially, input DNA amounts ranging from 1 nanogram to 15 picograms were tested using the recommended 100ul amplification volume. In addition, mixed stain sperm fraction DNA samples from known male and female contributors (representing "compromised case" samples) that had previously failed to generate a profile were tested in order to approximate DOP-PCR's ability to generate an accurate genotype profile. Preliminary results indicate that DOP-PCR is capable of increasing the amount of total DNA, particularly for lower input DNA amounts. The total yield on average increased by several hundred-fold at the lower dilutions using the DOP-PCR method. However, the fragment sizes obtained after DOP-PCR indicate that larger fragments are not amplified as successfully as smaller fragments. The majority of DNA products resulting from DOP-PCR fell within a 500 bp to 1 kb range, which is slightly shorter than anticipated from published data reporting fragment sizes up to 3 kb. Additionally, the results for the "compromised case" samples suggest that the DOP-PCR products can successfully produce a correct profile with distinct and balanced peaks at STR loci. On average, Profiler Plus amplification of these samples produced balanced peaks for 7 out of the 10 loci, with unbalanced or failed amplification resulting mostly in the loci with larger expected fragment sizes. Further research will concentrate on the sensitivity aspect of this technique and the capability of obtaining larger amplicons from limiting or highly degraded forensic samples for both nuclear and mitochondrial genome applications.

DNA, STR, Whole Genome Amplification

B135 A Review of Fluorescent Artifacts in Genetic Analysis Systems

Rhonda K. Roby, MPH, Chu-An Chang, PhD, Natasha Coyle, PhD, Dana Elliott, BA, Paul A. Foxall, PhD, Grace Lee, PhD, and Kathy Wang, MS, Applied Biosystems, 850 Lincoln Centre Drive, M/S 404-3, Foster City, CA 94404*

After attending this presentation, attendees will have reviewed the artifacts visualized with the use of the AmpFLSTR® PCR Amplification Kits and ABI PRISM® genetic analysis instruments.

This presentation will support the caseworking forensic scientist in further developing interpretation and troubleshooting skills.

Molecular biology techniques using DNA have revolutionized the field of forensic sciences in testing of biological specimens. The forensic community realized the advantages of DNA over traditional serological techniques and first adopted restriction fragment length polymorphism (RFLP) and sequence-specific oligonucleotide (reverse dot blot) assays. Many laboratories adopted silver-stained slab gels with long tandem repeats following those techniques. Then, fluorescent dye technology was introduced. Fluorescent multicolor dye technology allows multiple loci (including loci that have alleles with overlapping size ranges) to be analyzed in a single capillary injection or gel lane. Alleles with overlapping loci are distinguished by labelling locus-specific PCR primers with different colored dyes. Laboratories can now analyze hundreds of loci in a single day using five-dye fluorescent labelling from Applied Biosystems (Foster City, CA). Additionally, the forensic community has adopted the use of multicolor sequencing for mitochondrial DNA analysis.

PCR-based technology, and especially current fluorescent short tandem repeat (STR) analysis, has proven its advantages in the past decade. PCR-based testing oftentimes produces results when the DNA is highly degraded, unlike RFLP testing. PCR-based STR testing produces discrete results. PCR-based testing has much greater sensitivity and the small size of the STR loci improves the chance of obtaining a result, particularly for degraded DNA samples. Additionally, the small size range of STR loci makes them ideal candidates for co-amplification where multiple STR loci or other markers can be profiled in a single amplification. Furthermore, advances in technology have resulted in an

increase in sensitivity, allowing the forensic community to obtain results using far less input DNA than in previous years.

Forensic DNA testing for the identification of evidentiary material involved in the resolution of legal disputes is a powerful technique. With any scientific procedure, a quality assurance (QA) program that addresses the techniques is critical. The forensic community has excellent QA programs to assure accurate results and to meet the rigors of the courts. Each method has its own advantages, limitations, and quality assurance and quality control procedures. A good QA program encompasses as many aspects of DNA testing as reasonably possible. Once a sample is amplified for STR analysis using multiplex AmpFLSTR® PCR Amplification Kits (Applied Biosystems) and run on the ABI PRISM® genetic analysis instruments (Applied Biosystems), many steps are performed and an array of reagents and consumable items are used in the final analysis of that sample. Because of this, troubleshooting can be complex.

Inherent with all of these techniques and procedures are artifacts, or anomalies. The presence of artifacts can be attributed to a number of factors including phenomenon innate with the technique, cleaning procedures, and raw material. For example, with RFLP analysis, autoradiographs often show anomalies from static electricity, defective intensifying screens [Benzinger et al. "An illustrated guide to RFLP troubleshooting," *Journal of Forensic Sciences* 1998; 43(3)665-679], shadow bands, and fingerprints. The results obtained from samples amplified for STR analysis using any one of the numerous fragment analysis systems can exhibit their own anomalies. These anomalies can be reproducible anomalies and non-reproducible anomalies. Examples of these two (2) categories of anomalies will be explored.

Peaks other than the target alleles may be detected on the electropherogram displays. Examples of reproducible anomalies include stutter, incomplete 3' A nucleotide addition (-A), mixtures, and dye-labelled artifacts. Artifacts can be intermittent and are not always reproducible. In our experience, non-reproducible artifacts can be correlated to sources other than the amplification chemistry or the moiety of the sample. For example, spikes caused by salt accumulation or dried polymer released from a dirty block and traveling through a capillary are examples of non-reproducible artifacts. Another example is an artifact resembling a "stair-step" that may be associated with a need to change the water in the autosampler tray on the ABI PRISM® 310 Genetic Analyzer.

Several artifacts associated with practices using the AmpFLSTR® PCR Amplification Kits and run on the ABI PRISM® genetic analysis instruments will be presented.

Artifacts, Fluorescent, STR

B136 Strategies for Low Copy Number (LCN) DNA Analysis

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After attending this presentation, attendees will understand various strategies that would enable samples containing low copy numbers of starting DNA template to be DNA profiled

The forensic community may be able to use the LCN typing strategies presented to obtain DNA profiles from samples containing low copy numbers of starting DNA template.

Low copy number (LCN) analysis is an approach that involves the examination of minute quantities (i.e., <100 pg) of DNA template. Even though genetic profiles can readily be obtained from body fluid stains when enough DNA is present for analysis, there are times when a genetic profile cannot be obtained because of the presence of too little DNA for analysis. When minute quantities of DNA are encountered in casework, LCN typing can provide a means by which a genetic profile can be obtained. In an attempt to provide casework laboratories with strategies to increase their DNA typing success rate by being able to routinely employ LCN methods, various LCN typing strategies were examined.

Initial experiments concentrated on the ability of increasing the PCR cycle number, using the D1S80 PCR-VNTR system as a model, in an attempt to type single or few cells. Cycle numbers ranged from the standard 30 cycles up to 50 cycles. Results indicate that increasing the cycle number to 35 cycles often resulted in the ability to type single or few (<5) cells. Increasing the cycle number beyond 35 resulted in the formation of non-specific amplification products that may obscure the presence of the true alleles. Concomitant with the ability to type single or few cells, a loss of heterozygosity (allelic drop-out) was observed.

Several whole genome amplification (WGA) methods were evaluated for LCN analysis in order to permit increased sensitivity of analysis down to a singe cell equivalent. The WGA methods tested were primer extension PCR (PEP), degenerate oligonucleotide primed PCR (DOP), and multiple displacement amplification (MDA). PEP uses a mixture of random 15 base oligonucleotide primers to prime and subsequently amplify the whole genome (or a large percentage of it) prior to subsequent genetic analysis while DOP uses a single degenerate primer. MDA is an isothermal process that employs random hexamer primers to amplify the whole genome.

Cell suspensions were first subjected to WGA analysis using PEP, DOP, and MDA. Aliquots of the products were then re-amplified using primers specific for the D1S80 PCR-VNTR locus. Cycle numbers ranged from the standard 30 cycles to 50 cycles. The results obtained are promising. It appears that WGA products from PEP and DOP can be used to increase the sensitivity of D1S80 analysis from a few cells to one cell-equivalent. Results indicate that WGA products from MDA can be used to type a few (<5) cells, but the sensitivity of D1S80 analysis is not greatly increased using this WGA method. Allelic drop-out was observed with each WGA method tested—PEP, DOP, and MDA—as expected. Allelic drop-in and non-specific amplification products were also observed. However, the extraneous alleles that were detected did not interfere with genetic typing of the samples. The preceding WGA analyses used the D1S80 PCR-VNTR system as a model; the WGA assays are being applied to autosomal and Y-STR typing systems. Detailed results will be presented including an evaluation of the efficacy of these methods for casework specimens.

Low Copy Number (LCN), Increased Cycle Number (ICN), Whole Genome Amplification (WGA)

B137 SWGDAM Validation of a 19 Locus Y-STR System for Forensic Casework

Darlene Daniels, MS and Jack Ballantyne, PhD, University of Central Florida, 12354 Research Parkway, Room 225, Orlando, FL 32826; Ashley Hall, MS, National Center for Forensic Science, PO Box 162367, Orlando, FL 32816-236*

After attending this presentation, attendees will be presented with a full SWGDAM developmental validation of two Y-STR multiplexes, and will understand the unique requirements of such systems.

This presentation will impact the forensic community by demonstrating that few Y-STR multiplexes have undergone a full SWGDAM validation. We intend to present the community with a complete set of experiments and discuss the differences between the newly developed systems and the current autosomal systems in use.

A SWGDAM developmental validation study was carried out on two Y-STR multiplex systems (MPI and MPII) that collectively permit the co-amplification of nineteen Y-STR markers including DYS393, DYS392, DYS391, DYS389I, DYS389II, Y-GATA-A7.2, DYS438, DYS385a and DYS385b (MPI); DYS425, DYS388, DYS390, DYS439, DYS434, DYS437, Y-GATA-C.4, Y-GATA-A7.1, Y-GATA-H.4, and DYS19 (MPII). Performance checks subsequent to PCR parameter optimization indicated that MPI and MPII were suitably reproducible, precise and accurate for forensic use. The sensitivity of the systems was such that a full 19-locus Y-STR profile was obtainable with 150-200 ng of male DNA, and some loci were detectable even with as little as 20-30 pg of input DNA. Primate specificity was demonstrated by the lack of cross reactivity with a variety of commonly encountered bacterial and animal species, with the single exception of a monomorphic canine product that was outside of the size range of human alleles from any of the nineteen loci. Unsurprisingly cross reactivity was observed with a number of male and female non-human primates. Environmentally compromised samples produced full or partial Y-STR profiles. For example, a semen stain exposed to the outdoor elements for six months still gave a 13-locus Y-STR profile. Although a limited number of female DNA artifacts were observed in mixed stains in which the male DNA comprises 1/300 of the total, the full 19-locus male profile was easily discernible. Even at a 1500-2000 fold dilution of male DNA with female DNA partial Y-STR profiles were obtained. Furthermore the potential utility of MPI and MPII for forensic casework is exemplified by their ability to dissect out the male haplotype in a variety of case type samples including, *inter alia*, post-coital vaginal swabs, admixed male and female bloodstains, the non-sperm fraction from a differentially extracted semen stain and to determine the number of male donors in mixed semen stains.

SWGDAM Validation, Y-STR Multiplex, MPI/MPII

B138 Development and Characteristics of a Novel Y-STR Multiplex PCR Amplification System

Paul A. Foxall, PhD, Sulekha Rao, PhD, Heidi Philips, and Robert Stern, Applied Biosystems, 850 Lincoln Centre Drive, Foster City, CA 94404*

After attending this presentation, attendees will understand the characteristics of a Y-STR multiplex amplification system suitable for use in forensic analysis of samples containing mixtures of male: female DNA.

This talk will acquaint the forensic community with a novel Y -STR multiplexed kit that will provide reliable and robust Y haplotypes from forensic samples. This will be able to be used in conjunction with their existing instrumentation currently used for autosomal STR analysis.

Analysis of the Y chromosome is useful for tracing human evolution through male lineages and in a variety of paternity and forensic applications. In a forensic setting, Y chromosome tests provide the ability to separate and analyze the male DNA component from samples containing mixtures of female and male DNA. If autosomal short tandem repeat (STR) markers are used, preferential amplification of the major component of the mixture can mask the genetic profile of the minor contributor. A multiplex PCR amplification system containing Y – STR loci can enhance the detection of low levels of male DNA in these types of samples. Y - STR loci show moderate levels of polymorphism when compared to autosomal STR's currently used in forensic analysis due to the haploid nature of the Y chromosome. The addition of recently described Y - STR loci to the European minimal haplotype and Scientific Working Group on DNA Analysis Methods (SWGDAM) recommended loci increases the possibility of obtaining sufficiently discriminative haplotypes for use in forensic investigations.

A multiplex PCR amplification system in development at Applied Biosystems has been designed to include the complete European minimal haplotype and SWGDAM loci of DYS19, DYS385, DYS389I, DYS389II, DYS390, DYS391, DYS392, DYS393, DYS438, and DYS439, along with a number of additional loci chosen for their power of discrimination and allele size range. To ensure no overlap between allele ranges, loci are labeled with 6 - FAM™, VIC®, NED™ and PET® dyes. Thermal cycling conditions are optimized for the GeneAmp® PCR Systems, with subsequent amplified products being run on ABI PRISM® genetic analysis instruments in conjunction with G5 and G5v2 dye sets or modules (Applied Biosystems).

Male DNA samples and female DNA samples were quantified by using a real - time PCR quantification system, the Quantifilerä Y Human Male DNA Quantification Kit, or the Quantifiler™ Human DNA Quantification Kit respectively (both Applied Biosystems, currently under development at the time of writing this abstract). These reactions were amplified and analyzed on an ABI PRISM® 7000 Sequence Detection System (Applied Biosystems). From these data, the quantity of amplifyable DNA in each sample was calculated and this value used to prepare test samples. These test samples included serial dilutions ranging from 2ng to 0.0625ng, along with male:male mixtures in ratios of up to 10:1, and female:male mixtures in ratios of up to 200:1. Using these samples, the amplification conditions were optimized for signal strength, color balance and to minimize stutter and –A artifacts. Cross reactivity studies showed no consistent peaks for male animals and prokaryotes, although some reproducible peaks were seen with DNA samples from higher primates. Haplotypes produced from the male DNA samples were consistent across thermal cyclers and instruments used throughout the development of the kit.

This Y - STR PCR amplification system and the Quantifiler™ Y Human Male DNA Quantification Kit, used in conjunction with instrumentation from Applied Biosystems, are designed to produce reliable and accurate Y - haplotypes and provide the forensic scientist with a robust set of tools for Y - chromosome analysis.

For Research, Forensic or Paternity Use Only. Not for use in diagnostic procedures. The PCR process and 5' nuclease process are covered by patents owned by Roche Molecular Systems, Inc. and F. Hoffmann-La Roche, Ltd. ABI PRISM, Applied Biosystems, PET, VIC and GeneAmp are registered trademarks and 6-FAM, NED and Quantifiler are trademarks of Applera Corporation or its subsidiaries in the US and/or certain other countries.

DNA Testing, Y-STR, PCR Amplification

B139 Examination of Non-Suspect Samples Lacking Sperm Using a Y-STR 10-Plex

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The results of the study indicate that it is possible to obtain a male STR profile even in the absence of spermatozoa by examining Y-chromosome STRs.

This study indicates that even in the absence of spermatozoa by visual examination, it is possible to obtain a male STR profile by using Y-STRs. Y-STR loci should become an important part of the CODIS database in the future if they can be used in solving non-suspect sexual assaults.

Y-chromosome short tandem repeats (Y-STRs) have gained interest in the forensic community due to their ability to identify the male component of a sample. Y-STRs are particularly valuable in sexual assault cases in which the amount of female DNA overwhelms the amount of male DNA present, thereby making genotype interpretation more challenging. To detect male DNA from compromised sexual assault evi-

dence, ~45 non-suspect samples were analyzed with 10 Y-STRs. The non-suspect samples were positive for the presence of human seminal fluid, but were negative for the presence of spermatozoa by microscopic examination. Complete or partial Y-STR 10-plex profiles were observed in 27.6% and 52.9% of the samples, respectively. On samples yielding partial profiles, results were obtained on an average of 5 loci per sample. Approximately 19.5% of the samples did not yield any results. The inability to obtain results may be due to either an insufficient amount of amplifiable male DNA, PCR inhibition, or unfounded accusations of sexual assault. The results of this study indicate that it is possible to obtain a male STR profile even when there is no visible evidence of spermatozoa. Furthermore, Y-STR loci should become an important component of the CODIS database in the future if they are to be used in solving non-suspect sexual assaults.

Y Chromosome, STRs, Forensics

B140 Detection of STR and SNP Markers on the Y Chromosome Using the Pyrosequencing Technology

Martina Nilsson, MSc, Charlotte Johansson, MSc, Hanna Andreasson, MSc, and Marie Allen, PhD, Uppsala University, Section of Medical Genetics, Department of Genetics and Pathology, Rudbeck Laboratory, Uppsala, SE 751 85, Sweden*

After attending this presentation, the attendees will learn about the principles of the Pyrosequencing technology and the possibility to detect variations found on the Y-chromosome by using this flexible and rapid method.This typing system is based on wellknown Y-SNPs and Y-STRs that can be used in analysis of DNA found in degraded forensic or ancient samples.

This typing system is based on a new technology which will improve the analysis of short DNA fragments that are found in ancient samples and in forensic casework materials. This technology detects variations found in the genome and is very reliable and roubust.

Analysis of DNA sequence variation on the Y-chromosome is a useful tool in forensic casework analysis, especially in cases of sexual assault where mixtures of female and male DNA are found. Moreover, analysis of Y-chromosome markers is valuable in studies of paternal relationships. The routinely used Y-STR assay, which is based on determination of size after fragment separation, is reliable and robust but will require analysis of large fragments if the assay is multiplexed in order to analyze multiple markers simultaneously. To be able to analyze ancient DNA and forensic casework samples that have been exposed to severe environments resulting in degradation, amplification of short fragments is often necessary. We have developed a system based on the pyrosequencing technology (SQA analysis), which allow sequence analysis of short stretches of DNA to detect SNP and STR variants found on the Y-chromosome.

Pyrosequencing is a non-electrophoretic, single-tube sequencing-by-synthesis method, which is rapid in comparison to many other technologies used for SNP and STR analysis. The pyrosequencing assay is flexible, easy to perform and will reveal the sequence of the repeats in the STR rather than the length. Since the actual sequence is determined in this assay additional information such as the nature of a mutational event can be achieved. Moreover, the PCR fragments can be designed to be very short, covering only a few bases outside the actual repeat unit, to ensure a highly sensitive assay.

In this study, we have designed a typing system based on well-known Y-STR and Y-SNP markers to be analyzed by pyrosequencing. A major advantage with commonly used markers is that allele frequency information from many different populations is available. A first set of STR markers, DYS 392, DYS389-II, DYS438 and DYS 390 has been evaluated. The PCR products for these markers yield fragments between 80 and 227 nucleotides. The repeat lengths for a number of male samples were easily interpreted in the pyrosequencing analysis and all products were male specific. A second set of markers, DYS19, DYS391, DYS389-I and DYS393 is undergoing further development for pyrosequence analysis. The system also consists of 19 previously reported SNP markers on the Y-chromosome, which are selected to be highly informative in Scandinavians. The primers for each fragment were designed to be as short as possible, resulting in PCR products between 48 and 96 nucleotides. Specificity of the primers was first confirmed by evaluation in singleplex PCR reactions, followed by analysis of the primers in multiplex PCR reactions to save valuable material.

In addition to the multiplexed PCR, time and reagents can be saved by multiplex pyrosequencing analysis. A first combination of the STR markers DYS392 and DYS438 have been analyzed simultaneously and the repeat length of both markers can easily be inferred in the pyrogram. The SNP markers have also been developed for performance of multiplex pyrosequencing. The SNP positions studied so far in these multiplexes were successfully interpreted and scored for the different polymorphisms.

In this study we have analyzed variations found on the Y-chromosome using the pyrosequencing technique. The use of short fragments containing Y-SNP and Y-STR markers in this system will improve the possibility to amplify and analyze degraded DNA in casework analysis or ancient DNA studies. When fully developed analysis of teeth from remains in a family grave, which were found 1915 in the church of Varnhem, will be performed. These are the disputed remains of the founder of Stockholm, Birger Jarl (1205-1266) and his son. Analysis of Y-chromosome SNP and STR variation might support a paternal relationship between the two individuals in this case.

Y-STR, Y-SNP, Pyrosequencing Technology

B141 Real-Time Mitochondrial and Nuclear DNA Quantification of Forensic Evidence Materials

Martina Nilsson, MSc, Hanna Andreasson, MSc, and Marie Allen, MD, Uppsala University, Section of Medical Genetics, Department of Genetics and Pathology, Rudbeck Laboratory, Uppsala, SE 751 85, Swedzen*

The attendee will learn about a new quantification technology based on real-time 5´exonuclease detection, TaqMan. The system has been used to determine the amount of DNA found in various evidence materials. This technology can be used to choose the optimal target (mtDNA or nDNA) and to avoid waste of valuable DNA material.

This TaqMan technology is a highly sensitive method that can estimate the copy numbers of both mtDNA and nDNA simultaneously. It is a quick and simple method that enables valuable DNA found in evidence materials not to be wasted.

Biological evidence material, found at a scene of a crime, often contains limited amounts of DNA. Samples with scarce DNA amounts are often analyzed by sequencing of mitochondrial DNA, due to its high copy number per cell. Higher discrimination power is however obtained by analyzing nuclear STR-markers, which is preferable when possible. Since the choice of analysis method will be influenced by the amounts of available DNA in a sample, a sensitive and accurate DNA quantification assay is essential in forensic DNA analysis. Moreover, DNA quantification results can be used to estimate the optimal DNA amount to be used in different experiments to ensure successful amplification and avoid allelic dropout or preferential amplification.

We have developed a highly sensitive, rapid and reliable system for quantification of nuclear and mitochondrial DNA copy numbers that consumes a minimum of the valuable DNA sample. The system is based on the real-time 5'exonuclease detection assay, using the ABI PRISM® 7700 instrument (TaqMan). Two specific probes, labeled with different dyes, enables simultaneous quantification of the nuclear Retinoblastoma 1 gene and the mitochondrial tRNA Lys gene.

The quantification system has furthermore been used to determine the DNA copy numbers available in a number of different evidence materials frequently found at the scene of a crime. Analysis of cell debris from different accessories, such as rings, watches and necklaces showed large differences in DNA quantity. Shed hairs, roots from plucked hairs and body hairs have also been quantified successfully using the quantification assay. Since shed hairs are common as evidence materials, differences in DNA quantity in the root part between hairs as well as within single hairs at different lengths were studied. In addition, the high sensitivity and short amplicon length in the assay will allow DNA quantification of degraded and ancient DNA. To evaluate the assay performance on ancient DNA it has been used for quantification of mitochondrial DNA extracted from ancient bone remains found in a grave from the 1000-century in Sigtuna in mid Sweden.

This DNA quantification assay and the evaluation of DNA content in different types of forensic materials have proven very useful in forensic analysis. Moreover, it has been used to determine the minimal amount of DNA required in several different DNA typing systems.

DNA Quantification, TaqMan Technology, Real-Time PCR

B142 Mitochondrial DNA Analysis by Pyrosequencing

Susan Hastings, MS, University of Central Florida, National Center for Forensic Science, 12354 Research Parkway, Room 225, Orlando, FL 32826; Jack Ballantyne, PhD, University of Central Florida, PO Box 162367, Orlando, FL 32816-2367*

The attendee will be introduced to mitochondrial DNA analysis by pyrosequencing.

This presentation will introduce the community to mitochondrial DNA analysis using a novel sequencing technology.

Mitochondrial DNA (mtDNA) analysis is often used in forensic cases in which traditional nuclear DNA testing is, or is likely to be, unsuccessful. Such cases typically involve compromised, or difficult-to-analyze specimens such as hair or bone. Currently, mtDNA analysis proceeds by standard sequencing of DNA isolated from such specimens. Although current methodology is robust, its principal shortcoming is that is is labor intensive and time consuming. This diminishes the efficacy of mtDNA analysis in the investigative process and discourages its more widespread use within the criminal justice system. We have evaluated a new sequencing technology, pyrosequencing, for its potential applicability to forensic casework

Pyrosequencing uses the basic biochemistry of polymerase mediated DNA chain elongation to determine the order of the bases. When a deoxynucleotide triphosphate (dNTP) is added to the growing DNA strand, a pyrophosphate (PP_i) is released. A sulfurylase utilizes this molecule to generate ATP, which in turn fuels a luciferase reaction. Luciferin is converted to oxyluciferin, generating visible light proportional to the quantity of ATP. This light is detected by a CCD camera and translated into a peak on the resulting program.

We have evaluated the performance of pyrosequencing with regard to sensitivity, specificity, and compromised template DNA (including mixtures). The advantages of this technology include vastly improved timeliness of analysis (hours rather than days), a requirement of only femtogram quantities of template DNA, and the potential for higher mtDNA throughput by automation. This work has resulted in a set of assays and associated standard operating procedures that should aid in the transfer of the technology to operational casework and provide an impetus for more widespread use of mtDNA testing for those cases requiring it. These will be discussed in detail.

Mitochondrial DNA, DNA Sequencing, Pyrosequencing

B143 Real-Time mtDNA Specific Quantitation

Kerri A. Dugan, PhD, Helen Lawrence, MS, Mark Kavlick, BS, and Elizabeth M. Olivastro, PhD, Counterterrorism and Forensic Science Research Unit, Laboratory Division, Federal Bureau of Investigation, Quantico, VA 22135; Constance Fisher, PhD, DNA Analysis Unit II, Laboratory Division, Federal Bureau of Investigation, Quantico, VA 22135*

After attending this presentation, attendees will learn by incorporation of a mtDNA control region TaqMan assay into mtDNA sequence analysis could be extremely beneficial to the forensic community.

A mtDNA control region TaqMan assay could reduce pre-amplification assay time and enhance casework results which is desirable because forensic mtDNA testing is a lengthy, tedious and labor-intensive procedure.

Many laboratories that perform forensic mitochondrial DNA (mtDNA) analysis use quantitation of nuclear DNA to estimate the amount of mtDNA present in a DNA extract. Since mtDNA can be analyzed successfully from samples with little to no detectable nuclear DNA, extracts are routinely processed even if the nuclear DNA quantitation is inconclusive. In addition, the slot blot hybridization technique that is currently employed by many laboratories to quantitate extracted DNA is time-consuming and relies on subjective interpretation of the quantity of DNA. Alternatively, quantitative real-time PCR provides a rapid, objective estimate of DNA quantity and is amenable to automation. Importantly, quantitative real-time PCR provides the opportunity for custom quantitation. The TaqMan assay uses oligonucleotide probes that hybridize to specific DNA sequences. The probes are designed with a reporter fluorophore on the 5' end and a quencher fluorophore on the 3' end. During PCR, the probe hybridizes to the template DNA downstream of the primer and the 5' to 3' exonuclease activity of the DNA polymerase separates the reporter molecule from the quencher molecule during template extension. Cleavage of the reporter molecule results in a measurable increase in fluorescence. As each DNA strand is extended an increase in fluorescence is observed. This presentation will describe the development of a TaqMan based assay for quantitation of mtDNA.

While others have described real-time PCR assays for quantitation of mtDNA, these assays have targeted areas of the coding region of the mtDNA genome. Previous work by our group has produced a real-time PCR based assay for quantitation of mtDNA based on amplification of region HVIA within the control region. As an extension of our previous project, this work focuses on another, less polymorphic, mtDNA target that lies in the control region of the mitochondrial genome. Since forensic DNA analysis requires human specific DNA quantitation, it is necessary to choose a target region that is conserved among humans but does not amplify DNA from other species. Primers and probes were designed to interrogate a region between HVI and HVII and are specific to human or higher primate mtDNA.

Amplification reactions were optimized for amplification temperature, MgCl2 concentration, primer concentration and probe concentration. Once the conditions for optimal amplification were determined, sensitivity and reproducibility studies were carried out under these conditions. The HL60 mtDNA control region was cloned into pCR2.1 (Invitrogen, Carlsbad, CA) to create a reagent for use as a mtDNA standard to prepare standard curves. This allows the user to compare the fluorescence generated by the sample to a standard curve and determine the amount of mtDNA present in the extract. In some DNA extracts, quantitation by methods such as slot blot hybridization reveals that DNA is present but the DNA does not amplify under standard amplification procedures. Two possible causes for this observation could be DNA degradation or the presence of PCR inhibitors in the extract. The ability to distinguish between degraded DNA and PCR inhibition has been explored. In addition, the effect of various PCR inhibitors on the ability to quantify mtDNA using real-time PCR has been studied. Finally, a validation study on evidentiary-type samples is underway.

Improvements that reduce assay time and enhance casework results are desirable because forensic mtDNA testing is a lengthy, tedious and labor-intensive procedure. Incorporation of a mtDNA control region TaqMan assay into mtDNA sequence analysis could be extremely beneficial to the forensic community. This work has generated a reagent that allows easy creation of standard curves for quantitation of mtDNA by PCR as well as a TaqMan based quantitative PCR assay to quantify mtDNA. This protocol has been optimized and the sensitivity and reproducibility of the method as well as the effect of PCR inhibitors on the assay have been assessed. Finally, a study to validate this assay for use in pre-amplification mtDNA quantitation has been undertaken.

Mitochondrial DNA, Pre-Amplification Quantitation, Real-Time PCR

B144 Development of Microchip-Based Sample Processing Systems for Forensic DNA Analysis

James P. Landers, PhD and Jerome P. Ferrance, PhD, University of Virginia, Departments of Chemistry and Pathology, PO.Box 400319, McCormick Road, Charlottesville, VA 22904*

This talk will discuss the development of modular and integrated microchip-based technologies that can be utilized in expediting sample processing and analysis steps for forensic DNA analysis

The impact of this talk will be to explore the developments in microfluidic processing and analyses which are applicable to forensic DNA analysis.

Forensic DNA analysis is a multistep process that involves a diverse array of molecular and analytical techniques executed in a sequential manner with STR analysis as the final step. Individually, these steps are time-consuming and labor-intensive, which has resulted in a slow throughput rate for forensic analysis and contributed to the backlog of samples awaiting forensic DNA testing. One approach for reducing analysis time for the individual processes involved in forensic DNA analysis is to exploit miniaturized technologies. In particular, microfluidic devices have been utilized in biochemical processes and analyses that are applicable to forensic work, with the added benefit that they can be designed with monotasking functionality, or in an integrated format for multiple process execution on a single device.

The last decade has seen an explosion of efforts to miniaturize sample preparation steps, such as DNA extraction and PCR amplification, with the expressed goal being to expedite the molecular diagnostic evaluation of human samples. These efforts have demonstrated, unequivocally, that the microminiaturization of analytical processes on microchip platforms can lead to enhanced efficiency and a reduction in time (versus conventional methods). In addition, optimized microchip sample processing can accommodate small sample sizes and does so with minimum reagent consumption. This has been demonstrated with the microchip-based extraction of nucleic acids from complex samples including whole blood, PCR amplification of specific genomic targets in volumes (as low as a few hundred nanoliters) on microchips, microchip electrophoretic separations for DNA analysis, and, to a lesser extent, with chip-based sorting of blood cells in labyrinth-like silicon structures.

The power of analytical microchip technology for carrying out analytical processes rapidly and efficiently can be exploited in numerous ways by the forensic community. Traditional forensic DNA analysis methods, such as differential extraction, DNA purification and quantitation, STR amplifications, and capillary electrophoretic separations, can be replaced with equivalent microchip methods that provide a equivalent, if not higher, level of confidence. One embodiment of a forensic microdevice design involves a 'modular' approach, which aims to develop stand-alone, dedicated instrumentation that accepts single-task, single use microchips designed for automated analysis. These are being developed for cell sorting, DNA extraction, and PCR amplification processes. These microdevices are designed in a 'task-conscious' manner so that easy introduction into the conventional sample processing work-flow is possible. An alternative embodiment, the 'integrated' approach, is being pursued to create multi-task microchips capable of carrying multiple processes in a sequential manner. This requires the seamless interfacing of at least two different chip microstructures, both fluidically and electrically, so that a single sample can be processed through multiple steps automatically. Challenges here are multidisciplinary in nature, requiring efforts in electrical and mechanical engineering, surface science, polymer chemistry, molecular biology and analytical chemistry to be brought to bear on the problem.

Ultimately, one can envision a forensic micro-total analysis system (□-TAS) that could accept a sample, extract and sort cells if required, purify and quantify the DNA, amplify the target sequences of interest and then electrophoretically separate the fragments with the single base pair resolution required to generate an STR profile of forensic utility. For rape kit evidence in particular, this type of microdevice processing will provide male and female DNA analysis from a single swab in a reasonable amount of time, allowing faster evidence processing for current cases, and contributing to reducing the significant backlog of cases which currently exist.

Microchip Technology, Integrated Microdevices, Sample Processing

B145 Automated PCR Setup for Casework Samples as Part of a Total Automated System

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After attending this presentation, the participant will have an understanding about a new automated PCR setup system designed for casework samples that is flexible, customer friendly and integrated with automated DNA purification and quantitation modules.

This presentation will impact the forensic community by demonstrating streamlined casework processing to alleviate the backlog cases inundating the community.

Automated workstations have proven their utility for processing sample backlogs for offender databases. These systems can be optimized for a single sample type and do not have to be efficient. The varied sample quality and amount encountered in casework presents additional challenges in automated sample processing. Additionally, contamination concerns restrict the flexibility of robotic systems and require extensive validation. This presentation will discuss advances in developing an automated PCR setup system that works over a 50 fold range of initial DNA concentration. In addition, improvements for automated DNA extraction and human-specific quantitation using the same robotic instrument as PCR setup, the Beckman Coulter Biomek® 2000 Workstation, will be described. Developed initially as independent modules, these three steps can be integrated with minimal hands-on time. This modular approach provides quicker access to automation and minimizes cost.

Automated PCR setup has been in use for many years. However, due to the wide range of DNA concentrations associated with casework samples, few laboratories have successfully automated this tedious and time-consuming process. We modified the Beckman Coulter Normalization Wizard developed for the Biomek® 2000 Workstation so the program can dilute the DNA to a customer defined concentration starting with DNA concentrations between 0 and 5ng/µl. The initial DNA concentration values are imported from a modified AluQuant®

Calculator. The user then selects the final concentration and volume parameters. The system will flag samples that are too dilute or concentrated and allow the user to exclude individual wells. This process conserves on expensive amplification reagents. After the DNA has been diluted to the desired concentration a set amount of this DNA and PCR master mix are added to a PCR plate and mixed. The user then caps the plate and places it in a thermal cycler. Master mix can also be added manually if desired.

We have integrated this PCR setup module with DNA purification and quantitation on the same robotic platform to maximize its usefulness and are continuing to gain experience on new sample types. To provide the maximum recovery and flexibility, samples are currently preprocessed manually to remove biological material from solid supports. In most cases, this involves incubation of the support in DNA IQ™ Lysis Buffer, followed by centrifugation through a spin basket. Samples containing very small amounts of DNA are incubated in a Proteinase K solution while samples containing sperm and epithelial cells are treated using the standard differential extraction procedure. Once the samples have been extracted from the solid support they are transferred to a Biomek® 2000 Workstation for hands off purification using the DNA IQ™ System. Recent modifications to this automation program reduce processing time and adjust for environmental factors, such as low humidity.

Human-specific quantitation is required for casework samples to ensure the amplification of an appropriate amount of DNA. The AluQuant® Human DNA-Specific Quantitation System was developed to allow an automated approach to this step. Using solution-based hybridization of a highly repeated human specific sequence, the method is sensitive, provides numerical results, and does not rely on amplification of the sample DNA. Recent improvements to the automated process allow the use of 4µl of sample DNA and improve sensitivity. In addition, the DNA concentrations calculated in the AluQuant® Calculator are automatically formatted for easy importation into the Normalization Wizard program.

While not yet a "black box" sample analysis system, the current setup provides a flexible system that automates several time consuming processing steps on one robotic platform. Hands-on time between the different programs is minimized and primarily involves replenishing the deck with labware and reagents.

Automation, PCR, Quantification

B146 Miniplex Primer Sets: Sensitivity, Peak Balance, Inhibitor and Concordance Studies

Denise Chung, Jiri Drabek, PhD, Kerry L. Opel, MA, and Bruce R. McCord, PhD, Ohio University Department of Chemistry, Clippinger Laboratories, Athens, OH*

After attending this presentation, attendees will have been presented research on the current development of the Miniplex primer sets for the analysis of degraded DNA.

This presentation will discuss the utility of the Miniplex primer sets in the analysis of degraded DNA. In degraded DNA, only low concentrations of DNA template are generally available and PCR inhibitors may be present. The effect of DNA template concentration on signal intensity and peak balance ratio will be presented. This presentation will also discuss the effect of PCR inhibitors on the amplification efficiency of the Miniplex primer sets. Lastly, a full concordance study of 541 DNA samples as part of the method validation process will be presented.

In DNA recovered from the crime scene or site of disaster, the possibility of finding an intact target DNA sequence is greatly reduced due to extensive fragmentation of the DNA template. Most commercial kits have amplicon products ranging from 100-500 base pairs. Thus, in multiplex typing kits with a wide range of amplicon sizes, the larger PCR amplicons often have lower signal intensity and fall below the detection threshold. Re-designed Miniplex primers are positioned as close as possible to the ends of the stretch of repeats to reduce the amplified product size. However, in situations where DNA is degraded, the DNA template is not only highly fragmented but the concentration of the DNA template recovered is also low. To test the hypothesis that shorter PCR amplicons can improve amplification efficiency, we examined the effect of DNA template concentration on signal intensity and peak balance ratio.

DNA concentrations ranging from 31 pg to 500 pg were amplified with Miniplex 2, Miniplex 4 and Big Mini in 25 µl reaction volume. The Miniplex primer sets were able to successfully amplify DNA targets at these concentrations although these are below the range recommended for commercial sets. For example, amplification at 100 pg/ 25 µl gave signal intensities of 2000 RFU and 800 RFU for Miniplex 2 and Miniplex 4, respectively. For the Big Miniplex, template concentrations greater than 250 pg/ 25 µl were needed to avoid allele dropout. Good peak balance ratio ($\geq$0.6) was achieved at these concentrations. Primer concentrations for the Big Miniplex were further tested to improve the sensitivity and peak balance ratio of this multiplex set.

Another challenge associated with forensic samples is the presence of PCR inhibitors. The presence of these compounds can interfere with the amplification process resulting in preferential amplification of one locus, allele drop out, or no amplification at all. The effect on amplification efficiency of the Miniplex primer sets due to PCR inhibitors such as hematin, indigo dye, humic acid, melanin, calcium, and collagen was also investigated and will be presented.

Although all known polymorphisms have been taken into account in the design of the Miniplex primers, primer binding related problems may occur. Only comparison studies can verify the presence of previously undetected polymorphisms. A concordance study of 541 DNA samples was performed to check for the existence of mutations that could lead to allele dropout or low sensitivity of one allele in standard STR typing kits. At the same time, potential point mutations in the Miniplex primer binding region or insertion/deletion between commercial primers and Miniplex primers were also investigated. These samples were obtained from the National Institute of Standards and Technology (NIST) and were previously typed with the commercial kit AmpF*l*STR™ Identifiler.

Overall, these Miniplex primer sets can provide an alternative to standard STR typing kits when allele drop out and low sensitivity of large amplicons becomes a problem due DNA degradation, PCR inhibition or primer binding site mutations.

Degraded DNA, Miniplex, STR

B147 Development of New miniSTR Loci for Improved Analysis of Degraded DNA Samples

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An approach to developing new DNA typing markers for improved analysis of degraded DNA samples will be described.

The community will learn about new DNA tests that our group is developing to improve analysis of degraded DNA samples. This will be of interest to DNA analysts doing casework or thinking about handling samples from mass disasters.

A number of studies have demonstrated that successful analysis of degraded DNA specimens from mass disasters or forensic evidence improves with smaller sized polymerase chain reaction (PCR) products

(1). Forensic DNA analysts often perform short tandem repeat (STR) typing on highly degraded biological material and then turn to mitochondrial DNA testing, which is less variable but more likely to obtain a result due to higher copy numbers in cells, if many or all of the STRs fail. The commercially available kits for multiplex amplification of the 13 CODIS (FBI's COmbined DNA Index System) STR loci usually exhibit allele or locus-dropout for larger sized loci with degraded DNA or samples containing PCR inhibitors.

By moving PCR primers closer to the STR repeat region, we have demonstrated that it is possible to obtain fully concordant results to the commercial kits while improving successful analysis of degraded DNA with smaller PCR products or miniSTRs (1). However, many of the CODIS core loci have large allele ranges (e.g., D21S11 and FGA) that make it impossible to create small PCR products. Thus, we are going beyond the CODIS core loci and examining a battery of new potential STR loci that can be made less than 100 bp in size and would therefore be helpful in testing highly degraded DNA samples. These new STR loci are being put together into novel DNA testing assays and evaluated across more than 600 samples representing the three largest populations in the U.S.: Caucasian, African American, and Hispanic.

Methods and Materials: Following selection of potential new STR loci, PCR primers were designed using a standardized approach that has been described previously (2). For the miniSTR loci, a single locus is placed into each dye color in order to keep the size ranges less than 100 bp where possible (1). Candidate loci were selected from STRs located on chromosomes that did not possess any CODIS STRs (i.e., chromosomes 1, 6, 9, 10, 14, 15, 17, 19, 20, 22, and X) so that results could be treated as unlinked and the product rule employed in any statistical analysis between the CODIS loci and new ones.

Summary of Results: New PCR primers were designed and tested for a dozen new STR loci. All loci show a moderate degree of polymorphism in the U.S. population samples tested and compared well to results from the CODIS loci in the same sample set.

Conclusions: The selection of STR loci that have a narrow allele size (e.g., less than 50 bp) and can be made smaller than 100 bp works well with degraded DNA samples. In addition, these new STR loci that are under development will be helpful in analysis of casework involving close relatives including complicated forensic paternity cases (e.g., incest) where the 13 CODIS loci are not enough.

(1) Butler, J.M., Shen, Y., McCord, B.R. (2003) The development of reduced size STR amplicons as tools for analysis of degraded DNA. *J. Forensic Sci.*, in press.

(2) Schoske, R., Vallone, P.M., Ruitberg, C.M., Butler, J.M. (2003) Multiplex PCR design strategy used for the simultaneous amplification of 10 Y chromosome short tandem repeat (STR) loci. *Anal. Bioanal. Chem.*, 375: 333-343.

Short Tandem Repeat DNA Typing, Degraded DNA, Reduced Size PCR Products

B148 mRNA Profiling: Body Fluid Identification Using Multiplex RT-PCR

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After attending this presentation, attendees will have been presented with a novel means of identifying body fluids of forensic interest.

The forensic community will be shown how the highlighted system could supplant the battery of serological and biochemical tests currently employed in the forensic serology laboratory.

Since it can be important to identify the nature of the body fluids present in a stain recovered at a crime scene, the development of a body fluid identification system that is compatible with current DNA typing procedures is desirable. Conventional methods of body fluid identification use labor-intensive, technologically diverse techniques that are performed in a series, not parallel, manner and are costly in terms of time and sample. Moreover, for some frequently encountered body fluids no confirmatory technique exists. There is no definitive test, for example, for the presence of saliva or vaginal secretions. In seeking to develop novel multiplex (i.e., parallel) analysis procedures for body fluid identification that are compatible with current DNA analysis procedures, we have considered assays based upon protein and messenger RNA (mRNA) since both are expressed in a tissue specific manner. However, multiplex analysis of complex, partially degraded protein mixtures such as those present in body fluid stains awaits further developments in proteomics. Messenger RNA is considered a better option because the technologies for massively parallel analysis continue to be developed due to the rapidly evolving field of functional genomics.

Terminally differentiated cells, whether they comprise of blood monocytes or lymphocytes, ejaculated spermatozoa, or epithelial cells lining the oral cavity become such during a developmentally regulated program in which certain genes are turned off whereas others are turned on. Thus, a pattern of gene expression is produced that is unique to each cell type, which is evinced by the presence and relative abundance of specific mRNA species. If the type and abundance of mRNAs could be determined in a stain or tissue sample recovered at the crime scene it would be possible to definitively identify the tissue or body fluid in question. Advantages of an mRNA-based approach, compared to conventional biochemical analysis, include greater specificity, simultaneous and semi-automatic analysis though a common assay format, improved timeliness, decreased sample consumption and compatibility with DNA extraction methodologies.

Previously we have reported that it is possible to isolate total RNA of sufficient quality and quantity from biological stains to enable subsequent detection of particular mRNA species using the RT-PCR technique and that we have identified candidate sets of saliva-, and semen-specific genes. Since that time, we have also identified and tested candidate sets of blood- and vaginal secretions-specific genes using a combination of literature and public database searches.

In the extraction method that we employ, total RNA is isolated from biological stains by extraction with guanidine isothiocyanate-phenol:chloroform and precipitated with isopropanol. The extracted total RNA is treated with DNase I, and then reverse-transcribed using random decamers as the first strand primer. Finally, the cDNA is amplified using gene-specific primers. The RT-PCR amplimer sizes are carefully chosen to span the range of 100bp–350bp to allow facile separation on agarose gels followed by visualization with a nucleic acid stain or by other platforms, such as capillary electrophoresis.

In the present work, we report the development of a multiplex RT-PCR assay for the definitive identification of all of the body fluids commonly encountered in forensic casework analysis, namely blood, saliva, semen, and vaginal secretions. The tetraplex is composed of four body fluid specific genes and has been optimized for the detection of blood, saliva, semen, and vaginal secretions as single or mixed stains. The methodology is based upon gene expression profiling analysis in which the tissue specific genes are identified by detecting the presence of appropriate mRNA species.

An mRNA based approach, such as the multiplex RT-PCR method described above, could allow the facile identification of the tissue components present in a body fluid stain and conceivably could supplant the battery of serological and biochemical tests currently employed in the forensic serology laboratory.

mRNA Profiling, Multiplex RT-PCR, Body Fluid Identification

B149 Stability and Recovery of mRNA in Biological Stains

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The attend will learn about the persistence of mRNA in biological stains.

This presentation will impact the forensic community by demonstrating mRNA is useful in determining the type of biological stain present and persists under various environmental factors.

In theory, RNA expression patterns, including the presence and relative abundance of particular RNA species, provide cell and tissue specific information that could be of use to forensic scientists. An mRNA based approach could allow the facile identification of the tissue components present in a body fluid stain and conceivably could supplant the battery of serological and biochemical tests currently employed in the forensic serology laboratory. Some of the potential advantages include greater test specificity, and the ability to perform simultaneous analysis using a common assay format for the presence of all body fluids of forensic interest.

Previously we have reported that it is possible to isolate total RNA of sufficient quality and quantity from biological stains to enable subsequent detection of particular mRNA species using the RT-PCR technique. In the extraction method that we employ, total RNA is isolated from biological stains by extraction with guanidine isothiocyanate-phenol:chloroform and precipitated with isopropanol. The extracted total RNA is then treated with DNase I, at which time the extract can be quantitated, when desired, using a sensitive fluorescence assay based upon the binding of the unsymmetrical cyanine dye RiboGreen. The RNA is reverse-transcribed using random decamers as the first strand primer and then the cDNA is amplified using gene-specific primers. We have already identified numerous candidate body fluid specific genes for blood, saliva, semen, and vaginal secretions using a combination of literature and public database searches.

To address concerns over stability of RNA in forensic samples, we have conducted an in-depth study on the persistence of RNA in biological stains. Stains were prepared from blood, saliva, semen, and vaginal secretions and exposed to a range of environmental conditions so that affects of different light sources (UV, fluorescent, natural), temperature (room temperature, refrigeration, freezer), and environment (outside covered, outside exposed) could be assessed. Initially, quantitation experiments were performed using biological samples of various sizes (whole 50 ul stain, ¾ stain, ½ stain, ¼ stain, and $^1/_8$ stain) in order to determine how much RNA can be recovered from the different sized stains. We also performed RT-PCR with these stains using housekeeping and tissue-specific gene candidates to determine sensitivity of the different primer sets. The results from these experiments were then applied to the analysis of the stability samples which were collected at specific time intervals (1 day, 3 days, 7 days, 1 month, 3 months, 6 months, 1 year, >1 year). The extent of RNA degradation within each type of body fluid stain was determined using quantitation of total RNA and reverse-transcription polymerase chain reaction with at least one high-abundance and one low-abundance gene. DNA was also extracted from the stability samples and quantitated to determine how the stability of RNA compares to the stability of DNA in biological stains. The results of these studies will be presented in detail.

RNA, Body Fluid Stain Identification, RNA Stability

B150 Forensic DNA Identification of Feline Hairs: Casework and a Mitochondrial Database

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After attending this presentation, attendees will have a greater awareness in the forensic community of the tools and utility of individual identification of pets as part of criminal investigation. DNA identification of animal hairs via mitochondrial haplotyping can provide a useful link between a victim and a suspect.

This presentation will demonstrate that animal hairs are a common finding in a carefully scrutinized environment such as a crime scene. The application of forensic DNA analysis techniques to hairs and other animal-derived samples opens previously unrecognized avenues of criminal investigation.

DNA typing of samples from pets, including cats, has contributed to homicide investigations and convictions in the United States and Canada. Indeed the first example of forensic DNA identification of animal hairs was a homicide investigation in Nova Scotia in which cat hair was found in the pocket of a jacket discarded near the murder scene. STR profiles of the hair matched that of Snowball, a cat belonging to the suspect's parents. While animal hairs are the most frequent animal-derived sample recovered by crime scene investigators, such hairs are usually shed telogen hairs.Despite the availability of feline STR markers, there is often insufficient nuclear DNA to perform STR typing. As in humans, mitochondrial DNA can be extracted from the hair shaft and characterized by DNA sequencing or other sequence detection methods. Assigning the significance of a DNA match between an evidence sample and reference animal requires knowledge of the frequency of the mitochondrial type in the domestic cat population. This paper presents the database derived from DNA sequencing of the mitochondrial control region from 155 purebred cats and 105 mixed breed cats.

Domestic cats have elements of complexity in the mitochondrial control not seen in dogs or humans. Between a relatively short Hv1 region and the Hv2 region is an AT-rich region with 3-5 tandem, 80 base pair repeats. While this repeat region can be avoided by the amplification and sequencing of just the 3' half of the control region, the 5' end is rich in polymorphism. Roughly 50% of cats actually show length polymorphism when the entire control region is amplified. Two to three fragments 80 base pairs apart can be electrophoretically separated demonstrating that the variability is derived from the tandem repeat region. A systematic analysis of this variability is required to ascertain its utility in reliable individual identification.

In order to generate a feline mitochondrial database, primers were designed to amplify the entire feline mitochondrial control region (approximately 1100-1300 base pairs) analogous to 16000 bp to 400 bp of the Andersen human mitochondrial genome. A total of 260 cats, including 155 purebred cats representing 14 foundation cat breeds, as well as 105 mixed breed cats were analyzed. The samples from the purebred cats had been held in storage for some years and many were too degraded to amplify the entire region. Sets of internal primers were designed to amplify smaller, overlapping regions for sequencing. These primers are also being investigated for nested PCR amplification, a procedure often required for processing of evidence hairs. Nested amplification through the tandem repeat region presents additional challenges that are being investigated. A separate study has been undertaken to ascertain whether heteroplasmy was detectable in feline hair samples and, if so, to what degree. Results from the study are important for the continued validation of feline mitochondrial haplotyping.

Feline mitochondrial typing was useful in a recent homicide investigation. In Iowa in 2000, Tracy Ann Carson disappeared; her body was found 7 months later. The body had been wrapped in a large piece of fabric, partially burned and buried; spring flooding unearthed it. Investigators found a variety of animal hairs on the fabric. Feline hairs taken from the fabric had mitochondrial haplotypes consistent with the three cats owned by the suspect. Based on a previous database based only on the 3' end of the feline control region, the haplotype frequency of the two siblings cats was 31% (the most common type) and the haplotype frequency of the third cat was 1.25%. Just before trial the suspect, Ben O'Donnell, pleaded guilty to second degree murder.

DNA typing of animal-derived samples opens new possibilities for linking suspects to crime scenes or victims. The close relationship between people and their pets is a potentially valuable source of evidence to the observant investigator. The value of such evidence will be determined by the scientific validation of both its power and its limitations.

Animal Hairs, DNA Identification, Mitochondrial DNA

B151 DNA Profiling for Forensic Soil Comparisons

Lorraine E. Heath, BSc and Venetia A. Saunders, PhD, Liverpool John Moores University, School of Biomolecular Sciences, Byrom Street, Liverpool, L3 3AF, United Kingdom*

After attending this presentation, attendees will have been presented with the preliminary finding of a novel approach to differentiating soil samples for forensic applications.

This presentation will provide the forensicmcommunity a basis for further research into the use of DNA profiling technology to identify and/or compare forensic soil samples.

This paper will present the results of a preliminary investigation that aimed to develop a reliable method of microbial DNA profiling to differentiate between surface soil samples. Samples collected from given locations with different ecological characteristics, such as uncultivated fields, forests, and sand dunes were compared, and the variation within and between ecologically different sites was determined. The implications of this research for forensic examination of soil evidence will be discussed.

Forensic soil comparisons can be used to associate a person found with soil on their clothes or possessions with a crime scene. Criminals often commit crimes, or deposit evidence, in isolated areas such as fields or forests. In most forensic cases where soil comparisons would be considered, a crime would have been committed in a known location (e.g., a field), and a suspect apprehended, who was found to have soil on their clothes, shoes, or possessions (such as a shovel or vehicle tyres). It would then be useful to compare these soil samples with control samples collected from the scene to determine if the suspect's samples could have originated from that location.

Most current forensic soil comparisons are based on geological properties. However, since the majority of forensic laboratories cannot afford an expert geologist, such analyses are rarely performed for routine casework, but are reserved for particularly high-profile, serious crimes. It has been suggested that DNA profiling of the microbial community in soil may be a potential method for soil comparisons. Currently, microbial DNA profiling techniques such as Amplified Ribosomal DNA Restriction Analysis (ARDRA), Denaturing Gradient Gel Electrophoresis (DGGE), Thermal Gradient Gel Electrophoresis (TGGE), Single Strand Conformation Polymorphism (SSCP), and Terminal Restriction Fragment Length Polymorphism (TRFLP) are being used to study the diversity of soil microorganisms. However, only ARDRA and TRFLP can be performed on the equipment normally available in the forensic laboratory. An ARDRA profile of a community with many different species tends to become too complex for easy interpretation, as one species can contribute 4-6 restriction fragments. However, TRFLP involves labelling the 5' end of the PCR primers with a fluorescent dye, so that only the terminal restriction fragments are detected following gel electrophoresis. This means that TRFLP yields less complex profiles where every visible band (fragment) represents a single 'ribotype.' Additionally, TRFLP analysis relies on the detection of fluorescently labelled primers, which is how human DNA profiling is performed. Therefore, all necessary equipment and expertise should be available in forensic laboratories, making this technique potentially more applicable. Moreover, the technical nature of TRFLP would allow high throughput of samples, as required for forensic applications.

As a pre-requisite for TRFLP analysis, various DNA extraction methods suitable for a range of soil types were evaluated. An appropriate procedure was developed for rapid and reliable extraction of DNA representative of the total microbial community. PCR was performed using fluorescently labelled universal primers targeting the 16S ribosomal RNA genes of the bacterial soil community. TRFLP analysis was then performed using the ABI Prism 373 gel electrophoresis system and GeneScan software. The resulting profiles were standardized and binary code was assigned to the peak profiles. Similarities between these binary codes were determined using the Jaccard coefficient to create similarity matrixes and dendograms were used to display the results of agglomerative hierarchical cluster analysis.

Preliminary results suggest that samples from within a specific ecological site (e.g., a field) show a higher similarity to each other than to those from other ecological sites (e.g., a forest). These results may allow the determination of characteristic profiles that will facilitate identification of ecologically different sites so that a given sample collected from a suspect could be identified as originating from, for example, a field, rather than a forest. Further research will explore small-scale spatial variation at various sites and the potential of these techniques to link a suspect's sample more precisely to its origin, and thus provide stronger circumstantial evidence.

Soil, Microbial DNA Profiling, TRFLP

B152 Scientific Crime Scene Investigation

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After attending this presentation, attendees will have learned that crime scene investigation both requires a scientific examination and can meet the criteria mandated by the scientific method.

The most critical problem in forensic science today is the examination of crime scenes. It is the initial forensic science examination and its results are the predicate for all the highly technical and sophisticated examinations that follow. Any unreliability in the crime scene examination can seldom be rehabilitated by subsequent laboratory examinations. Proper investigation requires a scientific examination. This presentation lays the foundation for a scientific approach to crime scenes.

The foray initiated by the *Daubert* decision seems not to have impacted crime scene examinations as it has the rest of forensic science. In large part, this seems to be due to the prevailing opinion that crime scene examinations are a technical activity, not a scientific one. There are some, however, who advocate that crime scene examinations not only are included in the overall discipline of forensic science but are the fundamental examination. There is little question but that it is the initial examination and that the reliability of all subsequent examinations depends on the quality of the evidence collected at the scene. But merely being the precursor for a scientific examination does not make it scientific. This presentation will advocate that the nature of a crime scene examination requires that it be performed scientifically and delineates the criteria that it must meet.

There are those who accord scientific stature only to disciplines based on technology. Science, however, is as much a thought process as a testing process. A scientific examination must have be based on a valid theory, conducted according to a reproducible, empirical protocol, and evaluated according to objective decision criteria. These criteria apply to crime scene examinations.

There are those who accord scientific stature only to endeavors that have a corresponding academic discipline. The investigation of evidential materials associated with crimes and accidents requires a wide-ranging set of background knowledge and skills incorporating aspects of most of the scientifically based forensic science disciplines. In particular, background knowledge touching on engineering (vehicular accidents and materials science), medicine (cause and manner of trauma and death), and criminology (criminal motivation and conduct of crime) is required. Obviously, one must have a sound grounding in the basic sciences of chemistry, physics and biology, as well as mathematics, logic, and statistics, to conduct competent investigations of evidential materials.

There are those who would deny scientific status to crime scene investigations because they are performed by non-scientists, (i.e., investigators). This is similar to the argument used against some of the other forensic sciences and is fallacious. The two major consideration of a crime scene investigation are reliability and relevance. The characteristics of a scientist are required for reliability – conducting valid, reproducible and objective examinations to obtain and interpret data. The characteristics of an investigator are required for relevance – applying inferences from the data obtained in order to solve crimes. Unfortunately, because our society is split into a dichotomy of scientists and non-scientists, mirrored by a dichotomy of forensic scientists and investigators, this combination investigator/scientist currently is a rarity. It does not have to remain so.

The distinguishing characteristic between a technician and a scientist is that the scientist interprets evidence while a technician only collects evidence. To begin the educational process to upgrade crime scene technicians into crime scene scientists, the field needs further analysis of the decisions that are made by crime scene investigators. The decisions required to interpret evidence vary according to the issue being investigated, i.e., the question being asked. Although the crime scene investigator will commonly be expected to reconstruct the events (explain what happened), on occasion he will be required to classify materials and to individualize them. Consequently, courses must be designed to develop facility in making all three types of decisions, not just how to properly collect and document objects and the changes in them.

Crime Scene Investigation, Scientific Examination, Crime Scene Science

B153 Assessment and In Vitro Repair of Damaged DNA Templates

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After attending this presentation, attendees will have been provided with methods for the assessment and repair of damaged DNA templates derived from forensically relevant samples.

Little is known about the damage incurred to forensically relevant DNA samples, and there are currently no methods for the repair of such templates. We intend to present the results of our assessment studies, as well as the sucessful repair of damaged DNA.

DNA extracted from biological stains is often intractable to analysis. This may due to a number of factors including a low copy number (LCN) of starting molecules, the presence of soluble inhibitors or damaged DNA templates. Remedies may be available to the forensic scientist to deal with LCN templates and soluble inhibitors but none presently exist for damaged DNA. In fact, knowledge of the biochemical nature and the extent of DNA damage in physiological stains is rudimentary at best. Also unknown is the point at which the damage inflicted upon a particular sample precludes the ability to obtain a genetic profile for purposes of identification. Therefore, the primary aims of this work were first ascertain the types of DNA damage encountered in forensically relevant stains, correlating the occurrence this damage with the partial or total loss of a genotype, and then to attempt the repair of the damage by means of *in vitro* DNA repair systems.

The initial focus of the work was the detection of damage caused by exogenous, environmental sources, primarily UV irradiation, but also factors such as heat and humidity. By incorporating various lesion specific enzymes, a set of assays, both PCR and gel-based, have been developed which describe the type and extent of damage inflicted upon DNA, both in a hydrated and dehydrated state. By dividing the UV spectrum into its component wavelengths, and combining each with various other conditions, the major causes of damage have been identified and their effects on genetic profiling assessed.

Armed with this knowledge, the next focus was the repair of the damage by means of *in vitro* DNA systems. Efforts have been concentrated on base excision repair, a direct reversal, single strand gap repair, and translesion synthesis assays. By modifying the assays and employing various combinations of the systems, a genetic profile has been obtained from previously intractable samples.

DNA Damage, *in vitro* DNA Repair, UV Damage

B154 Studies of PCR Inhibition

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After attending this presentation, attendees will be able to identify several problematic matrices for the DNA typing of bloodstains and to evaluate the usefulness of a variety of techniques for alleviating PCR inhibitory substances.

This information could be of assistance to crime labs to use as a reference for dealing with specific PCR inhibitor problems encountered with STR analysis of casework material.

Bloodstains were prepared on 15 separate matrices; titanium, blue denim jeans, lead, steel, drift wood, spruce 2x4, pressure treated spruce 2x4, maple tree bark, ocean beach sand, garden sand, compost soil, rock, dried leaf, soiled dry leaf, and fresh grass clippings. DNA was prepared from the bloodstains using a standard proteinase K digestion in buffer and organic extraction followed by a Centricon ® spin procedure.

The most widely used method to avoid PCR inhibition is to use the PCR facilitator, bovine serum albumin (BSA). Most forensic labs rely on manufacturers' kits for STR amplification. Both Applied Biosystems (AB) and Promega have included BSA in their STR kit amplification reactions. We decided to use the D1S80 AMFLP kit from AB (the last few kits available from this discontinued product line), which does not include BSA, as a model system to assess the effects of BSA on relieving inhibition. DNA extracted from bloodstains on the 15 different matrices was tested and examined for PCR inhibition. The DNA extracted from bloodstains on titanium sheet metal, denim jeans, driftwood, 2x4 spruce,

maple tree bark, ocean beach sand, compost soil, rock, soiled dry maple leaf and grass clippings exhibited D1S80 inhibition. The addition of non-acetylated BSA (at 160µg/ml, New England BioLabs) relieved inhibition of DNA extracts from blood on the titanium sheet metal, the denim, the rock, the dried maple leaf and the grass clippings. The addition of acetylated BSA (Molecular Biology Grade, Sigma) did not relieve inhibition. The results were then compared to results from the AB AmoF*/*STR Profiler Plus™ kit. All DNA extracts from bloodstained matrices that displayed inhibitory substances which could not be relieved by BSA for the D1S80 also showed inhibited STR results.

There were 5 DNA extracts that did not show relief of PCR inhibition by BSA. These were driftwood, 2x4 spruce, maple tree bark, ocean beach sand and compost rich soil. Several different techniques were used in an attempt to reduce or alleviate the inhibition observed in both the D1S80 and Profiler Plus results. These included extra Centricon® or Microcon® spins, sepharose beads, chelex®, non-human DNA on beads, QIAamp® Stool mini kit, DNeasy® Plant mini kit, diffusion in LMT agarose as well as other methods.

While some techniques were either effective or partially effective for DNA extracted from any one particular matrix, there was no universal solution for all matrices. A summary of the methods that improved results for the problem matrices will be presented.

Data on the potential of DNA IQ to remove inhibitors from DNA extracts and from bloodstains on inhibitory matrices will also be presented.

Since there was no single solution, a test was devised to determine if the inhibitory substance would be present in the final extract after extracting an unstained matrix control. The extract was mixed with control DNA and PCR inhibition was observed. The mixed inhibitory extract-control DNA sample could be used to test for the most successful method to relieve inhibition without wasting the limited critical evidence sample. This approach could be useful in very special cases.

STRs, PCR Inhibitors, Bloodstains

B155 Case Studies: Interesting Kinship Problems Solved During WTC Identification Efforts

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After attending this presentation, forensic DNA analysts will be informed of various types of pedigrees reconstructed, and other issues faced, in order to identify victims from the WTC disaster.

Identification of remains from the WTC has brought closure to hundreds of victims' families. Also, DNA and related information technology has been advanced far ahead of the normal pace of standard research, in order to make those identifications.

Relatively easy DNA identifications can be made using known victims' blood samples (e.g. from the national bone marrow donor registry) or personal effects (toothbrushes, hairbrushes, razorblades, etc.), supported by multiple familial DNA samples (parents and siblings, spouse and children, or some combination thereof). The identification process therefore also included the verification of not only all available DNA data for all associated remains, but also the physical items and information provided by victims' families and friends, used in the DNA identification process. Confirmation of who brought in what DNA-bearing items for which victim is paramount. For instance, wives occasionally turned in their own toothbrushes instead of their husbands'; well-meaning co-workers brought items in from workplace lockers of all the missing persons from that location (at least one three-way switch is known to have been made) or no collection information at all was obtained ("donor name" was either left blank, or filled in with the missing person's name). Occasionally it was found that "fathers" or "children" of victims really weren't. All of these situations require substantial meta-data analysis prior to even attempting kinship calculations.

Kinship samples, used to validate personal samples of unknown or unconfirmed origin (incomplete chains of custody were rampant), were also used to make identifications outright. In addition, confirmed (either by kinship analysis or by confirming the donor) personal effects in combination were used to make many identifications. One or more matching personal effects in addition to at least one family member allowed much higher confidence levels in those identifications.

Occasionally, analysts working on disaster identifications had to "get creative" to solve intractable cases, especially ones where multiple persons related either by blood or address (such as spouses or apartment-mates) both perished at the World Trade Center.

In one case, a brother and sister both died. She had no children, and the personal item submitted for the sister yielded no DNA. However, the brother had a wife and son; and one other sibling was available. Using the sister, the missing brother's comb, and the victim's sister-in-law and nephew enabled the identification of the missing sister in this pair.

The adult children of a couple who died in the tragedy, along with her parents (his were not available) and his sister, submitted buccal swabs for use in kinship analysis. A male fragment of remains came up as a potential "hit" for this family. Using direct lineages from this fragment to the couple's children and his sister only, did not meet the statistical threshold set for this project, although it did indicate a strong relationship probability. Addition of his in-laws' DNA samples (as grandparents of his children) to the pedigree made up for the fact his wife's DNA profile was unknown (her DNA, after all, had to have been derived from her parents'), and raised the probability into the acceptable range to declare the identification.

A pair of brothers were lost on 9/11. Both men's wives donated personal effects in the form of razors and toothbrushes, and kinship swabs were donated by their parents. In a case such as this, kinship alone is not sufficient to show which son was which, since both are related in the same way to their parents. One of the brothers was identified early on, by kinship, before it was known that his brother was missing also. The case records were reviewed and it was found that their files (and corresponding personal items) were jumbled together. The group of personal effects had two male profiles between them which showed relatedness to the parents of these two missing men. Eventually a distinguishing factor was found between the two cases, and enabled analysts to determine which profile came from which brother. Ultimately, remains were found which matched both sets of items and both men were declared identified.

In general, the more samples which can be donated for a missing person, the better. Problems ranging from poor DNA yields to wrong DNA types can be often overcome by use of kinship samples to verify that the submitted personal item was used by a member of a given family, and that the profile fits well in the pedigree in the victim's place. Once a validated personal effect matches a disaster sample, that is an identification.

World Trade Center, Kinship Analysis, Identification

B156 Case Study of 'Deleted-Amelogenin' Males Within the WTC DNA Identification Project

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After attending this presentation, attendees will be informed of the "amelogenin deletion" phenomenon (known to occur in certain Asian populations) which has been confirmed in the World Trade Center victim population.

This presentation will impact the forensic community and/or humanity by raising awareness in the forensic DNA community of "amelogenin deletion," and explain how this phenomenon was dealt with during the WTC project in order to make a positive identification of at least one victim.

Due to a known genetic mutation on the Y chromosome in which the amelogenin locus is deleted (1, 2), STR-typing kits such as Cofiler, Profiler Plus, and PowerPlex™ 16 only detect the copy of the allele which originates on the X chromosome. As a result, the genotypes appear to be female, unless shown to be otherwise by use of Y-STR typing. This rare "Y-deletion" is found most often in males from the areas between Southeast Asia and the Indian subcontinent.

The World Trade Center disaster included many persons whose ancestry can be traced to that region of the world, and the presence of Y-chromosome anomaly has been confirmed during the identification process for one victim, and is suspected in another. The latter was identified by dental records (his body was intact enough at recovery to still be wearing masculine clothing, but gave a "female" profile in autosomal STRs. Thus, for the ~ 2800 reported missing (about three quarters of which are male), the prospect of observing this twice is somewhat remarkable.

During DNA testing for the World Trade Center identification project, two human remains fragments (both are pieces of bones) found at the site matched a personal effect submitted by a male victim's family. The match was initially thought to be a "problem case" such as comingling (two persons' remains, and therefore DNA as well) or a sample mixup (for example, another family member's toothbrush submitted by mistake as an exemplar for their missing loved one), because the personal sample for this missing man came up with a female profile during initial testing (Cofiler and Profiler Plus). In addition, several members of his family submitted buccal swabs for use in kinship analysis, including his father and a full brother. It was found that all of this family's samples appeared to be female, but in all other loci tested, the correct allele inheritance patterns indicated that there likely wasn't a mixup of the swabs. These results bolstered our suspicion that the Y chromosome in that paternal line was "deleted-amelogenin."

Additional testing using Y-STRs (OCME's YM1 panel, consisting of DYS 19, DYS 389 I and II, DYS 390) confirmed an identical Y haplotype in the father's and brother's buccal swabs and the victim's toothbrush. That result confirmed our suspicion of the Y-chromosome mutation's presence in this family; and taken together, all results were enough to declare a positive DNA identification of this WTC victim.

Laboratories performing DNA typing involving victims, suspects, or missing persons (specifically, males) from southern and eastern Asia must be aware of the possibility of a situation like the above arising, not only in identifications when kinship samples are also available to confirm the phenomenon, but also during criminal casework such as homicides and sexual assaults when an unexpected additional female profile is obtained. Additional, Y-chromosome-specific, testing can be performed to help solve these cases.

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2. Roffey PE, Eckhoff CI, Kuhl JL. A rare mutation in the amelogenin gene and its potential investigative ramnifications. J. Forensic Sci. 2000; 45:1016-1019.

Y-Deletion, World Trade Center, Amelogenin

B157 Operation Iraqi Freedom: DNA Identification, Confirmation & Reassociation of Combat Casualties Based Upon Reference DNA Samples

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After attending this presentation, attendees will be provided with details of the Armed Forces DNA specimen collection program and its utility in providing ready references for issues of human identification.

This presentation will impact the forensic community and/or humanity by facilitating awareness of the benefits of a DNA reference database to successfully identify military war casualties.

This presentation will detail the casualty identification process of Operation Iraqi Freedom (OIF), report the various identification methods, and highlight the role of the U.S. Department of Defense DNA reference sample repository facilitating that process.

The opinions and assertions expressed herein are solely those of the authors and are not to be construed as official or as the views of the U.S. Department of Defense or the U.S. Department of the Army.

The war against Iraq began on March 20, 2003 and officially ended on May 1, 2003 with the U.S. military gaining control over the capitol city of Baghdad. Although hostilities continued to produce casualties this discussion is limited to the initial combat action. The 43 day war with Iraq resulted in 142 deaths of Army, Air Force, Marine, Navy, and U.S. civilian personnel. These casualties were recovered from the battlefields, prepared for shipment in country at the Theater Mortuary Evacuation Point, and transported to the Port Mortuary, Dover Air Force Base, DE, for identification. Two of the casualties were sent to medical facilities in Europe rather than Dover, DE. The 140 sets of remains arriving at Dover were examined by teams of forensic pathologists, odontologists, anthropologists, and fingerprint experts for identification. Every suitable piece of recovered human remains was sampled for DNA testing either as the primary method of identification, a confirmatory means to supplement other identification methods, or for reassociation of fragmented remains.

Operation Iraqi Freedom and Operation Enduring Freedom in Afghanistan marked the first war efforts undertaken by the U.S. Forces since the establishment of the Armed Forces Repository of Specimen Samples for the Identification of Remains (AFRSSIR) in 1991. The repository is a warehouse of dried bloodstain cards used as ready DNA references in human identification of service members. All military personnel and select civilian employees working for the military are required to have a DNA specimen on file at the AFRSSIR. The AFRSSIR is the largest DNA reference database in the world and contains more than 4,000,000 DNA reference samples. It has been used

more than 1,000 times in military identifications since 1995. The references are retrieved as required from cold storage in Gaithersburg, MD and transported to the Armed Forces DNA Identification Laboratory in nearby Rockville, MD for analysis. Results are used for comparison to biological specimens obtained from the remains at autopsy.

Combat deaths in OIF ranged from single gunshot wounds to massive explosions. Deaths resulted from hostile actions, homicides, accidents, suicides, and natural causes. Some deaths were classified as non-hostile, a casualty due to circumstances not directly attributable to hostile action or terrorist activity. The condition of OIF casualties ranged from fully intact bodies to highly fragmented remains, some exhibiting varying stages of decomposition.

There were 135 AFRSSIR record specimens on file to aid in the identification process. Four military casualties and three U.S. civilians were not represented in the AFRSSIR database. Of the 140 casualties processed at the Dover Port Mortuary, 89 were identified by a combination of fingerprint examinations, dental comparisons and DNA testing. Eighteen identifications were made by fingerprints and DNA, ten were identified by fingerprints and dental examination, and six were identified by dental exam and DNA testing. There were 13 identifications based solely on DNA testing, two on fingerprints only, and two independent identifications from dental examination. DNA analysis successfully reassociated 129 fragmented remains to 25 casualties. Five of the human remains sampled for DNA yielded no results or insufficient data to render a conclusion. Three DNA profiles did not match reference samples for any of the U.S. casualties. There were a total of 103 other fragments returned from Iraq that were unsuitable for DNA testing, deemed either inappropriate material or classified as non-human remains.

None of the U.S. Forces who died in the 43 day battle of Operation Iraqi Freedom went unidentified. The military's mandated DNA reference specimen collection program was highly successful in providing direct references of reported casualties for DNA analysis. The AFRSSIR DNA references facilitated rapid testing which yielded full DNA profiles and resulted in expeditious war casualty identification, identification confirmation and reassociation.

Operation Iraqi Freedom, DNA Repository, DNA Identification

B158 A Comparison of Automated DNA Extraction Methods

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This presentation will describe and compare three different automated DNA extraction approaches.

Three automated extraction procedures were evaluated and compared to chelex extraction. The current chelex extraction procedure used at the OCME takes approximately 2 hours to complete 20 samples. If this step could be automated, it would free up the analyst to work on additional tests.

The comparison experiments were designed to address the success rate for small stain sizes and the efficiency of the removal of inhibitors. Bloodstains of 1 µl and 4 µl in size were made on white and dyed cotton cloth, filter paper, suede, blue jeans, and rug. The stains were then extracted using 5% chelex (OCME STR manual, 2003), QIAamp™ by Qiagen, DNA IQ™ by Promega Corporation, and MagAttrct™ by Qiagen.

QIAamp kits automate the isolation of nucleic acids from a wide variety of samples with a 96-well plate procedure. Nucleic acids bind specifically to the QIAamp silica-gel membrane while contaminants pass through. While the extraction yields a large amount of purified DNA, the batch size is not flexible. The QIAamp technology is currently running on a Biorobot 9604.

MagAttract DNA Systems are designed for fully automated DNA purification on a M48 or a M96 robot. The M48 has many anti-contamination features such as an enclosed workstation, a drip tray, and built in UV capability. MagAttract uses paramagnetic particle technology for the capture and release of DNA. The batch sizes of the M48 and M96 robots are flexible.

The DNA IQ™ system is a DNA isolation system and quantitation system designed to yield a preset constant amount of DNA. This constant amount of DNA allows quantitation to become optional on database samples. This system also employs aparamagnetic particle technology that binds and releases the DNA. Excess DNA is removed during the wash steps because of the paramagnetic particles becoming over saturated. The isolation of genomic DNA using the DNA IQ™ System has been automated on the Biomek™ 2000 Laboratory Automation Workstation.

All extracted samples were quantitated using the Quantiblot™ system by Perkin Elmer Applied Biosystems. Selected samples were then amplified using Profiler plus with the product then ran on a ABI 3100 DNA Sequencer.

Data were evaluated based on the amount of DNA recovered, presence or absence of inhibitors, and amplification success rates.

Automation, STR Testing, Extraction

B159 High Throughput STR Testing of Tens of Thousands of 9- 12-Year-Old Bone Samples From the Former Yugoslavia Using a Silica Based Extraction Method

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Attendees will be presented with a review of the International Commission on Missing Persons high throughput bone STR testing facility including optimization of extraction, amplification and the minimization of costs.

The results presented would have benefit to anyone performing STR analysis of difficult samples such as bone. These results may also be of benefit to other forensic projects whose goals are also to use DNA STR tests in order to confirm the identify of mortal remains. These results were obtained from possibly the largest mass identification process ever attempted.

The ICMP has developed a DNA-led identification effort to assist in the identification of the estimated 30,000 – 40,000 persons that went missing during the breakup of the former Yugoslavia. Due to the large number of missing persons and the lack of medical and dental records for this region the strongest piece of evidence that will lead to identification is a DNA STR profile. In the past large scale bone STR testing has not been feasible because of numerous limitations. Some of the limitations to performing large scale DNA testing on bone samples are the high costs, the high rate of failure in the testing process, the large number of loci needed to generate significant results, and the time required for such testing.

To increase the success rate of STR testing on bone samples a silica-based extraction method was developed and has been shown to be much more successful than that of the organic extraction method. To directly compare the DNA isolated by these two methods real time PCR was performed using the Applied Biosystems Quantifiler® kit on the ABI 7700 Sequence detection system. Preliminary results of this comparison show that the ICMP developed silica-based extraction protocol both isolates more DNA than the organic method as well as it reduces the levels of PCR inhibition that are often observed during amplification of DNA from bone samples. Further studies using the Quantifiler kit have

allowed the optimization of PowerPlex® 16 and SeFiler® amplification reactions based on the estimated DNA content recovered from bone samples.

Using this silica based extraction system in combination with the Promega Power Plex® 16 system the ICMP has extracted nearly 22,000 bone samples for around 11,000 cases. Using this system at least 14 loci have been amplified for approximately 10,000 of these cases. For some cases where individual loci failed, the initial testing, attempts were made to amplify these loci using a single primer pair as a monoplex system has some advantages over the 16-plex system.

The average consumable reagent costs per case of bone STR analysis including all consumables is less than $100USD for duplicate bone sample extractions and $85USD for extraction of two teeth. This processing system in combination with the relatively inexpensive cost of labor in the former Yugoslavia has led to a rapid, relatively inexpensive system that is currently identifying 300 – 400 bodies per month.

DNA, STR, Real Time PCR

B160 Recovering Biological Samples From Crime Scene Using FTA Paper

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Attendees will learn to recover biological specimens from crime scenes using a novel approach that could facilitate the future practical work in the future.

This is a practical approach to help in one of the main problems in crime scene investigation and in DNA labs: how to properly recover, store, and analyze biological samples.

Proper collection and preservation of biological evidences recovered from the scene of a crime is crucial to facilitate the analysis and interpretation of all analytical results, including DNA typing.

FTA® paper is a well-known and widely used media to collect and store biological materials for DNA or RNA analysis. Its uses are primarily focused on the generation of clinical and forensic databases, although it has also been used for preservation of other biological materials, such as plant, animal, and bacterial specimens.

One of the main advantages of FTA is its ability to preserve biological materials at room temperature. When specimens are spotted or applied to FTA cards, cell membranes and organelles are lysed, and the nucleic acids are released, causing both DNA and RNA to become entrapped in the fibers of the matrix. FTA cards rapidly inactivate organisms, including blood borne pathogens, and prevent the growth of bacteria and other microorganisms. Therefore, biological samples such as blood or saliva can be preserved at room temperature. It is also important to mention that archived samples are ready for analysis in less than 30 minutes.

Because of the above advantages, we are evaluating the utility of FTA paper as a reliable support to collect and store biological specimens that are usually found and collected at the scene of crime. For this study we have spotted blood samples (1, 5, and 10 microliters) on different surfaces (wood, cotton, tile, glass, and carpet); samples were collected after 3 different periods of time: one day, one week, and one month. Two different methods of recovery are being evaluated. The first method is moistening the FTA paper with sterile distilled water and then pressing the FTA paper on the stain; the second method is moistening the dried stain with sterile distilled water and then blotting it with the FTA paper.

DNA purification was performed following the recommendations from the manufacturer (Whatman Inc., Clifton, NJ), using FTA purification reagent and 1.2 mm punches. DNA analysis was performed using both PowerPlex16 (Promega), and Identifiler (Applied Biosystems). Results were visualized in a capillary electrophoresis system, model ABI-310 (Applied Biosystems).

Results show that FTA paper is an ideal medium to collect dry blood specimens from hard, non-abosrbent surfaces, such as glass, tile, and wood, where it has been possible to recover and amplify DNA from very small samples of blood, as small as 1 microliter. It's also a good media to collect samples from absorbent surfaces such as carpet and cotton, although the performance depends on the size of the stain (amount of microliters of blood spotted). The best approach in our hands is to first moisten the evidence, and then apply and press with FTA paper. We are currently evaluating the usefulness of FTA paper to recover saliva and semen samples from mock crime scenes, with positive preliminary results.

Considering the above mentioned results, FTA offers several advantages as a support for collecting and preserving biological samples recovered from the scene of crime. First, it is simple to recover samples from the crime scene since it is only necessary to wet and apply the FTA paper. Second, it is possible to transport and store samples at room temperature for a long time. Third, the original substrate (the place where the blood was deposited in the crime scene) is preserved, since there is only a transfer of cells from the substrate (i.e., the wood or the tile) onto the FTA matrix. Finally, a fourth advantage to consider is the use of a single method for collecting and storing different kind of samples that would be achieved by using FTA for crime scene collection.

FTA, Evidence Collection, DNA Analyisis

B161 DNA Analysis of Digested Seeds in Forensic Samples

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Seed and other plant materials are valuable evidence not only for linking a suspect to a particular crime, but also important for the verification of an alibi, or to provide new investigative leads during criminal investigations. Currently, microscopic examination of the materials in vomit, stomach content, or feces is the only method of choice for the identification and association of seeds to possible sources.

In recent years, DNA has been successfully extracted and analyzed from a variety of plant materials. Many cases have been solved due to the DNA linkage of plant materials to their source. However, in reviewing the literature, very few studies have been conducted on the subject of recovery and analysis of seed DNA.

Our research results showed that high quality DNA could be extracted from a variety of seeds after they went through the human digestive system. DNA also was successfully recovered from seeds in human feces. A comparison of DNA yield on two types of extraction techniques (Hand grinding, Mechanical crushing-Mixer Mill method) will also be reported. Our preliminary data on DNA analysis with the AFLP technique on 5 types of tomato seeds and 4 types of pepper seeds indicates that DNA-AFLP is a viable procedure for the identification and individualization of seeds in forensic investigation.

Forensic Botany, Seed Evidence, AFLP

B162 Sampling Considerations in the Analysis of Glass Fragments by Laser Ablation Inductively Coupled Plasma Mass Spectrometry (LA-ICP-MS)

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After attending this presentation, attendees will have an understanding of the advantages of the new technique of laser ablation ICP-MS for the elemental analysis of glass fragments with a focus in the sampling strategies that should be taken into account during analysis.

The presentation will describe the advantages of the laser ablation sampling for ICP-MS analysis of glass evidence, including fast analysis time, excellent discrimination power and minimum consumption of sample. The presentation intends to give continuity to the results previously presented at AAFS. Different studies of interest to the forensic practitioner will be presented including sampling strategies and considerations for glass analysis by LA-ICP-MS.

The authors have previously reported the use of Laser Ablation ICP-MS as a powerful analytical tool for elemental analysis of glass. The advantages of LA-ICP-MS include fast, sensitive determinations of the trace metals in glass with a minimum destruction of the evidence. Glass fragments recovered from crime scenes are typically of 0.1 to 1mm in length and therefore in some cases the amount of sample is very limited to perform conventional digestion methods, which consume at least 2-3 mg of glass per replicate. LA-ICP-MS requires ten thousand times less glass consumption per analysis (~250 ng) and therefore the sample remains practically unaltered. However, due to the minute amount of material removed in LA, the analyst should be aware of special sampling considerations such as characterization of the glass fragments originating from the "known" source, fragment size and selection of the area and surface of ablation.

The fact that glass fragments collected from the crime scene and from suspect(s) and victim(s) are random in size does not affect bulk digestion analysis because sample is crushed and homogenized before it is weighed. During laser ablation, small craters (~50µm) are drilled into the solid material and therefore an investigation of the effect of the size of the fragment on the quantification of glass was conducted in order to determine if the interaction of the laser-surface changes significantly with the size of glass. Standard reference materials SRM 612 and SRM 610 were selected to conduct this part of the work in order to account for different concentration ranges and different opacity of the samples. The set under study was comprised of 7 fragments originating from each standard at different sizes and shapes ranging from 6 mm to 0.2 mm in length. The results show that there is not a significant difference in the elemental composition of fragments of different sizes. In addition, a homogeneity study of the elemental composition of glass samples was performed on glass matrices commonly found in crime scenes such as containers, architectural windows, windshields and headlamps. The set of glasses under study was comprised of 56 samples originating from glass containers, 28 samples from automobile windshields, 20 samples from architectural windowpanes and 20 samples from vehicle headlamps. All fragments were selected with a size smaller than 2 mm in length in order to simulate the typical glass fragments transferred from the crime scenarios. A CETAC LSX 500 Nd:YAG laser, 266nm, flat top beam profile was used in single point mode sampling 50 µm spot size for 50 seconds at 10 Hz (500 shots). The isotope ^{29}Si was used as an internal standard and the standard reference material, SRM NIST 612, was used as a single point for the external calibration. The standard SRM 621 was used as another control for the containers set, SRM 1411 for headlamps and SRM 1831 for the automobile and architectural window sets due to their very similar matrix with the samples of interest. For each set of glasses, the mean values and standard deviations of ten replicates (n=10) of a single fragment were compared with the values obtained from ten (n=10) different fragments of glass within the area of interest in order to evaluate whether or not the variation within a glass was larger than the variation due to the method. An additional subset of tempered glasses was examined to perform an elemental composition profile within different depths of the fragments. Single shot (one laser pulse per analysis) was also evaluated and its limitations for the forensic analysis of glass are also presented. The method presented for the analysis of glass by LA-ICP-MS had previously shown to possess the same or better performance than dissolution –ICP-MS methods in terms of accuracy, precision, limits of detection and discrimination power. The results show that glass is homogenous even at the micro-range level allowing LA-ICP-MS as an alternative technique to perform elemental analysis of glass. However, the variation of elemental composition of headlamps and containers is larger over the source than the instrumental variation due to inherent heterogeneity and therefore different statistical tools are recommended to fully characterize glass originating from the known source before the comparison analysis can be made. The proposed method allows reliable forensic comparisons of glass fragments by LA-ICP-MS independently of the fragment size recovered at scene.

Glass, Laser Ablation ICP-MS, Elemental Analysis

B163 Elemental Analysis by LA-ICP-MS at the Netherlands Forensic Institute

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After attending this presentation, attendees will understand the discrimination potential of LA-ICP-MS for the elemental analysis of different types of materials of forensic interest.

This presentation will encourage the adoption of methods with the high discrimination potential for forensic applications rendered by the (LA-)ICPMS technique. This presentation focusses on a few of these applications.

The value of trace evidence has been established for some time through numerous studies and publications. Recovered samples associated with a suspect and samples associated with a known source sometimes may be compared to each other based on the optical and other physical properties as well as the chemical composition of such samples. Moreover, such comparisons have been shown to be useful as a source of investigative information, not only for the associative purpose mentioned above such as relating a suspect to a crime scene but also for reconstruction of events. The significance of the results of these comparisons can only be estimated by the analysis of the information obtained from appropriate databases. The choice of methods to characterize and compare trace evidence depends on, among other factors, the size of such evidence. It is known, for example, when a piece of a material is broken, the fracture surface will often have unique topological features. When the surface is large enough, the features produced by the fracture may be so abundant as to permit a distinctive association between two sections, like in two pieces of a jigsaw puzzle. This physical matching is the most definitive way of relating samples that were once a single piece. However, when the physical matching is not possible other properties can be measured.

The decrease in the variation of physical properties in evidence of the same kind, i.e. by increased quality control by manufacturers, limits the discrimination potential of the methods used to measure such properties. The use and value of elemental analysis for characterization of materials of forensic interest becomes important in such cases. Furthermore, when the dimensions of a sample are small, very sensitive methods are needed in order to measure reliably the elemental composition, in particular at trace levels. The last few years, efforts have been

made by different research laboratories to develop and validate analytical methods with better sensitivity, precision and reproducibility.

Various instrumentation available in forensic laboratories has been used for the elemental analysis of evidence samples (e.g., glass, paints, fibers), among them SEM-EDS, XRF, ICP-AES, ICP-MS and more recently LA-ICP-MS. This last technique combines the sensitivity and precision of ICP-MS with the advantages of laser ablation sampling. With the use of LA-ICP-MS there is no need for laborious and lengthy digestion procedures with dangerous chemicals. In addition, the common analytical interferences that are increased by the presence of solvents are minimised using laser sampling, improving the detection limits of some potentially discriminating elements. The amount of material ablated for the complete analysis is very small (~fg), allowing the analysis (including replicates) of very small samples. The destruction is minimal with craters in the order of 10^{-8} m^2, in contrast to the solution approach where the whole sample to be analysed is irreversibly digested.

For this study, analytical methods for the elemental analysis by LA-ICP-MS of materials of forensic were optimised and validated in our laboratory at the Netherlands Forensic Institute. The system used is an ICP-MS (Perkin Elmer ELAN6100 DRC) in combination with a 3 mJ- 213 nm-laser ablation system (New Wave UP-213). The standard reference materials (SRMs) NIST 612, 1830 and 1831 were used for the development and validation of a quantitative method for glass analysis. The SRM NIST 612 is a synthetic glass of well-characterised trace elemental composition. This SRM was used to select an appropriate elemental menu based on reproducibility and accuracy. The other two SRMs are not certified for all trace elements but they were used for the optimization of the method for analysis of float glass (similar matrix) as well as controls to monitor the stability and performance of the instrument during the analysis. This method was then used to analyse ~200 float glass samples collected by the police from different locations within the Netherlands where a burglary had taken place. Although these samples were not submitted as evidence they are considered representative of possible casework samples. In addition, the refractive index of all the samples was measured using a GRIM II. Less sensitive semi-quantitative elemental composition measurements were performed using XRF. All samples were inter-compared using elemental compositions and refractive index values. These comparisons were performed using the SPSS statistical software package and were used to evaluate the discriminating value of each element measured with the two methods in addition to that for the refractive index. Both the methods and the results of the comparisons of the samples will be discussed in this presentation. In addition, the development and validation of semi quantitative methods for the analysis of other materials of forensic interest such as automotive paints, inkjet inks and amphetamines will also be addressed.

LA-ICP-MS, Elemental Analysis, Trace

B164 Laser Ablation Inductively Coupled Plasma Mass Spectrometry of Forensic Glass Samples

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After attending this presentation, attendees will have been presented with laser ablation-inductively coupled plasma-mass spectrometry as a technique to differentiate glass samples with similar optical and physical properties.

The results from this study will demonstrate that LA-ICP-MS is a fast, accurate, and reliable technique that provides a high level of discrimination in the analysis of glass fragments that cannot be differentiated by other techniques.

This paper will evaluate laser ablation-inductively coupled plasma-mass spectrometry (LA-ICP- MS) as a technique to determine the unique trace elemental signature or fingerprint of glass samples for discrimination, and present criteria and protocols for the comparison and differentiation of glass fragments from different sources by LA-ICP-MS.

Characterization of glass fragments is normally accomplished by measuring the physical and optical properties of density and refractive index. However further discrimination, such as identification of a suspected source of origin, has become more difficult as the range of refractive indices has narrowed within glass subtypes because of advances in glass manufacturing technology.

LA-ICP-MS provides a means for the forensic examiner to assign a probability for positive association of a questioned glass sample based on its trace elemental composition. Knowing trace element concentrations improves the confidence of a match and strengthens the value of evidence presented in court. ICP-MS provides a high level of discrimination for glass samples due to excellent detection limits (10-100 times better than ICP-atomic emission spectroscopy), wide element range coverage, and isotopic information. LA-ICP-MS is rapid, eliminates the need for extensive sample preparation, and is virtually a nondestructive technique, allowing for the possibility of further analysis of questioned samples by corroborative techniques. Furthermore, LA promises to increase the number of analytically useful elements by eliminating problems with some elements due to poor dissolution and contamination. Additionally, smaller samples may be analyzed making the technique applicable to more cases.

This study focuses only on standard residential window and tempered glass, indistinguishable by refractive index measurements, provided by the Illinois State Police Forensic Sciences Command. After the elemental fingerprints (i.e., mass spectra) and concentrations were acquired for the provided samples, the criteria for comparison and differentiation were determined. The primary approaches evaluated for classification/differentiation were: the presence or absence of elements; comparison of the abundance of selected elements; comparison of relative abundance of elements for specific association patterns; and multivariate analysis of the complete mass spectrum.

The multivariate analysis technique used, was Principal Components Analysis (PCA), which is an analysis tool for data compression and information extraction. PCA provides rapid analysis of samples without time-consuming pair-wise comparison of calibrated analyses. In general, PCA reduces a set of data into its most common variables or factors and expresses these variables as eigenvalues or scores that describe the major trends and variations in the data set. The scores can then be graphically used for discrimination of glass samples, since they provide an accurate description of the entire data set.

Glass Analysis, LA-ICP-MS, Chemometrics

B165 Interlaboratory Validation Studies of ICP-AES and ICP-MS Methods for Elemental Analysis of Bullet Lead Alloys

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Attendees of this presentation will learn the relative merits and limitations of using ICP-AES and ICP-MS methods in a forensic laboratory for the sourcing of bullet lead.

Practical information which will assist forensic laboratories in determining the feasibility of utilizing ICP-AES and ICP-MS for elemental analysis of bullet lead in their laboratories; results of interlaboratory validation studies will help support the legal admissibility of these methods for bullet lead comparisons.

Elemental composition of the lead portion of bullets and shot pellets may be used by forensic laboratories for comparison of two projectiles to see whether they may have a single production source. Of

more recent concern is the ability to determine a source, such as country of manufacture, of one or more bullets used in a terrorist event. In an international cooperative effort, NITE-CRIME Network has developed analytical protocols for the use of natural isotopes and trace elements in a variety of materials, including bullet lead. As part of this task, consideration was given to the fact that, while ICP-AES has long been used for the comparison of bullets, quadrupole ICP-MS instruments are seeing growing popularity and may be better suited to projectile sourcing. Interlaboratory studies were conducted using both ICP-AES and ICP-MS to evaluate the performance of each method for this purpose. The results of studies considering the relative merits of combinations of each instrument with dissolution protocols, both with and without lead removal, and direct solid sampling by laser ablation will be presented. Figures of merit, such as precision and accuracy, are related to the specifics of sample digestion and instrumental operating parameters. Specific recommendations will be made concerning some practical considerations in the utilization of these instrumental methods in the forensic laboratory.

Bullet Lead, Elemental Analysis, Interlaboratory Study

B166 IRMS and ICPMS Studies on Packaging Tapes

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After attending this presentation, the participant will appreciate the strong potential of the combination of ICPMS and IRMS techniques, not only for tape investigations but for a wide spectrum of forensic investigations.

This presentation will demonstrate new interesting forensic applications of the (LA-)ICPMS and IRMS elemental and isotopic techniques presently developed. They promise to result in much more strongly discriminating methods for forensic applications. The subject in the present presentation is just one of these applications but is very useful in demonstrating the relevance of these techniques. The relevance is also recognized by the two international forensic networks that have become active in this field: NITECRIME and FIRMS. More information on these networks can be submitted if requested.

Results are presented for tape comparison experiments using the novel forensic IRMS (Isotope Ratio Mass Spectrometry) technique. Results will be discussed and compared with results using other new forensic techniques such as solution nebulisation ICPMS and LA-ICPMS.

Introduction: Brown packaging tape is encountered in 60% of the violent crimes (murder, rape) committed in The Netherlands where tape is found at the crime scene. Normally, the forensic scientist is asked to compare the tape retrieved from the crime scene with tape found with a suspect. At the NFI a combination of visual investigation (physical fit, tape dimensions, colour, morphology), FT-IR and XRF is used routinely to compare tapes. FT-IR can be used to identify the type of glue and backing polymer. A combination of visual comparison and XRF analysis generally suffices to discriminate between different tape products but cannot be used for further discrimination between different batches of one brand of tape product.

Solution: ICPMS In earlier studies, the more varying adhesive layers of the tapes were investigated using both solution nebulisation ICPMS (Inductively Coupled Plasma Mass Spectrometry) and LA-ICPMS. With these techniques trace levels of elements are detected and identified. Solution nebulisation ICPMS experiments, especially, produced very discriminatory results. A ThermoFinnigan HR-ICPMS was used. For solution nebulization measurements, the glue (*ca* 50 mg) was first separated from the backing material through mobilisation in a solvent (methanol, hexane) and then digested in a microwave oven (75 bar, 290 ºC) in a nitric acid/H_2O_2/H_2O mixture. For the three different brands investigated, commercial samples from the same tape product acquired at different times from one commerical outlet and at one time from different outlets could be discriminated on the basis of the solution nebulisation ICPMS results whereas visual comparison and XRF (macro elements) were not sufficient for discrimination between these tapes.

LA ICPMS Laser ablation measurements on intact tape samples of the above rolls were made directly on the glue layer using a 266 nm Nd:YAG laser. Tape samples were placed in the sample chamber and the glue layer was laser ablated. Volatiles and aerosols produced in this way were swept into the ICPMS system (low mass resolution mode). As optimal values a laser pulse energy of 2 mJ, a pulse repetition rate of 10 Hz, a spot size of 80 µm and an ablation distance (lateral shift of laser spot) of 30 µm were chosen. Laser spots were therefore partially (50 µm) overlapping. Signals were integrated for 60 seconds over a grid area of 1 mm^2.

LA ICPMS results for the different rolls of one brand of tape demonstrate for each brand that discrimination power is sufficient to discriminate the rolls but is somewhat lower relative to solution nebulization results. In these experiments all tapes could be discriminated. Upon repetition of the LA ICPMS experiments for the three different rolls of one brand on another day the same distribution pattern is observed. The exact location of the distribution pattern is not exactly the same however, reflecting in our opinion variations in laser pulse energy observed during these specific experiments.

IRMS (Isotope Ratio Mass Spectrometry) focuses on stable isotope ratios of abundant elements in the samples such as H, C and O (O only in the oxygen containing materials). Isotope ratios used were $^2H/^1H$, $^{13}C/^{12}C$ and $^{18}O/^{16}O$. Tape samples were analysed for us at Iso-Analytical Ltd (Sandbach, Cheshire CW11 3HT, UK). The IRMS used was a Europa Scientific Geo 20-20 instrument. All samples were measured in triplicate. Tape samples were prepared for analysis by separating the glue and backing layers which were analysed separately. Also complete tape samples, without further sample preparation, were analysed.

IRMS Conditions: Hydrogen isotope analysis (ca. 6 mm^2 tape sample) was conducted by total conversion at 1080 ºC in a quartz reactor lined with a glassy carbon film, filled to a height of 180 mm with glassy carbon chips. Hydrogen was separated from other gaseous products on a GC column packed with molecular sieve 5A at a temperature of 30 ºC. A Faraday cup collector array was used to monitor the masses 2 and 3. Carbon isotope analysis (ca. 5 mm^2 tape sample) was conducted by EA-IRMS using a combustion furnace, reduction furnace and GC oven temperature of 1000, 600 and 90 ºC, respectively. Oxygen isotope analysis (ca. 22 mm^2 tape sample) was conducted by total conversion at 1080 ºC in a quartz reactor tube lined with a glassy carbon film, filled to a height of 170 mm with glassy carbon chips and topped with a layer (10 mm deep) of 50% nickelised carbon. Carbon monoxide and nitrogen were separated on a GC column packed with molecular sieve 5A at a temperature of 50 ºC.

Excellent IRMS results were obtained. For the three different brands investigated, commercial samples from the same tape product acquired at different times from one commerical outlet and at one time from different outlets could be discriminated on the basis of a combination of the $\delta^{13}C$ and δ^2H results. Alternatively, for the two oxygen containing brands, samples could easily be discriminated using a combination of the $\delta^{13}C$ and $\delta^{18}O$ results. This could be done using either results for the full tape, the glue or for the backing material. Especially the latter is of great value since this means that, together with the glue, all other debris (blood, hairs, fibers) can easily be removed.

Discussion: Comparing IRMS with ICPMS an interesting characteristic is that whereas ICPMS focuses mostly on trace elements and is therefore inherently more sensitive to contamination, IRMS focuses on the abundant elements (H, C and O) in organic chemical samples and therefore is less sensitive to contamination problems. The above results

demonstrate the strong potential of novel forensic techniques such as (LA-)ICPMS and IRMS for forensic investigation of packaging tapes. In our expectation this will prove to be only one example of a wider forensic application of these techniques for forensic material comparisons.

Tape, ICPMS, IRMS

B167 Elucidating the Relative Dependence of Propellant Pattern-Based Muzzle-to-Target Distance Determinations on Variables of Weapon and Ammunition

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The attendee will explore factors that influence the accuracy of muzzle-to-target distance determinations based on target-deposited propellant particle patterns.

Estimates of the distance from the muzzle of a gun to a nearby target at the moment of discharge, based on target-deposited propellant particle patterns (PPP), have figured importantly in shooting investigations for many years. For weapons firing a single projectile, *viz.*, rifles and pistols as opposed to pellet firing shotguns, these estimates are based on an analysis of patterns resulting from the deposit of ammunition derived residues emanating from the muzzle and forcibly deposited on the target. A major part of this pattern is the PPP. For the purposes of this study only the PPP is considered. Metallic deposits such as those contributed by shaved and vaporized lead are not considered. This is also true of deposits due to lubricants and other residues in the barrel. We hypothesize that these non-PPP contributions are too dependent on the condition of the barrel and the nature of the ammunition used for prior shots. The PPP analysis and interpretation require a comparison of the evidence pattern with a series of test patterns produced on a surface or substrate similar to the questioned or evidence surface. Ideally, the test shots are made using the same weapon and ammunition.

In many casework situations no weapon is recovered, although the ammunition used is known or can be ascertained. Here caution may dictate that no attempt be made to estimate the muzzle-to-target distance. However, we postulate that in situations where the ammunition used during the shooting event can be identified and examples acquired, carefully designed test firings can assist in making reliable estimates.

For this paper it was hypothesized that the most critical variable affecting the pattern is the ammunition. It was further hypothesized that nuances in variables related to weapon parameters are relatively less significant. The research in the present paper was designed to test these two hypotheses. Experimentation involving replicate test firings and the digitization of the resulting PPPs produced the data which, was analyzed. Following digitization, each propellant particle pattern was characterized. "Image J," public domain software from the National Institutes of Health was used to determine the Cartesian coordinates for each propellant particle in a pattern. These data were input into the software package Math Cad (Mathsoft®) which was used for the analysis and characterization of the pattern produced by each shot. This enabled the objective comparison of PPPs and allowed any significant pattern differences resulting from the deliberate altering of gun barrel variables to be evaluated in relation to stochasic differences among replicate test shots. The effects of batch-to-batch variations in ammunition were also evaluated preliminarily. Circumstances where reasonable estimates of the muzzle-to-target distances can be made in the absence of the actual weapon used will be described.

Muzzle-to-Target Distance, Propellant Particle Patterns, Gun Shot Residue

B168 Capillary Electrophoresis Analysis of a Wide Variety of Seized Drugs on the Same Dynamically Coated Capillary

Ira S. Lurie, BA, MS, Drug Enforcement Administration, Special Testing and Research Laboratory, 22624 Dulles Summit Court, Dulles, VA 20166*

After attending this presentation, attendees will have learned a simple approach for the capillary electrophoresis analysis of a wide variety of seized drugs.

The methodology presented will greatly simplify the implementation of capillary electrophoresis for a forensic drug laboratory.

Methodology is presented for the capillary electrophoresis analysis of a wide variety of seized drugs on a single capillary, using multiple run buffers and diode array UV detection. Drug types analyzed include phenethylamines, cocaine, heroin, oxycodone, morphine, LSD, psilocybin, opium, and GHB-GBL. Both qualitative and quantitative analyses are achieved using run buffers than contain additives that provide for secondary equilibrium and/or dynamic coating of the capillary. Dynamic coating of the capillary surface is accomplished by rapid flushes of 0.1N sodium hydroxide/water, buffer containing polycation coating reagent, and a buffer containing polyanionic coating reagent (with or without cyclodextrin(s)) or a micellar coating reagent. Dynamic coating with a polyanionic coating reagent is used for the analysis of moderately basic seized drugs and moderately basic adulterants. The use of cyclodextrin in the run buffer not only allows for chiral analysis, but also greatly enhances separation selectivity for achiral solutes. A dynamically coated capillary with micellar coating reagent allows for the analysis of neutral and acid drugs (GHB, GBL and weakly basic, acidic and neutral adulterants). The above approach, which gives rise to a relatively high and robust electroosmotic flow at pH's below 7, allows for rapid, precise, and reproducible separations. For the various drugs examined, excellent linearity and migration time precision and good peak area precision (external and internal standard) is obtained. Quantitative results for synthetic mixtures and seized drugs agree with actual values, and also with results independently determined by other techniques. Both qualitative and quantitative analyses are greatly enhanced by the use of diode array UV detection which allows for automation of both library searches and peak purity.

Seized Drugs, Capillary Electrophoresis, Dynamically Coated Capillaries

B169 Defining Appropriate Peak Ratios for the STR DNA Analysis of Pristine Single Source Samples

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This presentation will impact the forensic community and/or humanity by defining appropriate guidelines for DNA data analysis of pristine single source DNA samples.

In casework DNA samples, the relative peak height or area of heterozygous STR alleles are useful indicators to detect the presence of a potential sample mixture. However, in pristine single source DNA samples, sample mixtures are not common or expected. To date, defining acceptable peak ratios in pristine single source DNA samples has largely been based on the rules used to define mixtures in casework samples. These peak ratios are often defined as the height of the secondary peak in a heterozygous marker to be greater than or equal to 60%

of the height of the main peak. While such a conservative peak ratio may be appropriate for defining mixtures in casework type DNA samples it is potentially restrictive for pristine single source DNA samples. A defined peak ratio of 60% can potentially create unnecessary work for the DNA data analyst by excluding scientifically robust data. The acceptable peak ratio for pristine single source DNA samples should be defined by the accuracy of the resulting STR DNA profile.

We will present the results of a study comparing STR profiles generated from over 130,000 single source DNA samples, in which the acceptable peak ratio will be changed from 60% to a series of more liberal peak ratios. The resulting STR profiles generated from each defined peak ratio will be checked for accuracy. The results of this study will enable the forensic community to define an appropriate peak ratio for heterozygous STR markers, of pristine single source DNA samples, that will produce an accurate profile. In addition, the results of this study will quantify the amount of work saved by employing a more liberal peak ratio for heterozygous STR markers of pristine single source DNA samples.

Peak Imbalance, STR Profiles, Single Source DNA Samples

B170 Fiber Dye Identification by High Performance Liquid Chromatography-Mass Spectrometry (HPLC-MS)

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The goal of this presentation is to present the progress on the development of a mass spectrometry-based method for the forensic comparison and identification of dyes extracted from textile fibers.

The results of this study offer an improved method for single source determination in fiber evidence comparisons. Molecular-level information from MS data opens the possibility for dye identification at the molecular level and the preparation of searchable libraries.

Textile fiber examination is frequently carried out in forensic laboratories to provide physical evidence in crime investigations. An important part of forensic fiber examination involves the characterization of textile dyestuffs. Compared with currently used methods, such as ultraviolet, visible, and fluorescence microspectrophotometry, infrared spectrometry, and high performance liquid chromatography (HPLC); high performance liquid chromatography-mass spectrometry (HPLC-MS) provides unique information about the molecular structure of fiber dyes and makes questioned and known comparisons and/or dye identification highly discriminating.

Determination of the elution times for extracted dyes is one of the key issues in applying HPLC-MS to the analysis of dyes. In the absence of a prior knowledge of a dye's elution time and/or the major ions formed from the dye, HPLC-MS analysis may be impractical, if not impossible, for the analysis of many dyes. This project utilizes tandem UV-visible absorption and mass spectrometry to facilitate the detection of dyes separated by HPLC. With visual information about the color of the textile fibers, the elution of the dyes can be efficiently pinpointed by a single wavelength UV-visible detector. Diode array detectors offer an even broader capability for detecting the elution of multiple dyes. In this way, even dyes that do not show an obvious peak in the total ion current (TIC) chromatogram can be analyzed. The method also allows extracted brightening agents and other non-dye components to be distinguished from the peaks of interest.

An Agilent 1100 MSD quadrupole mass spectrometer equipped with an electrospray ionization (ESI) source and an Agilent 1100 HPLC have been used for this study. The instrumentation allows both positive ions and negative ions to be monitored according to a dye's tendency to form negatively or positively charged species. Separation was carried out with a ZORBAX Eclipse XDB-C18 (2.1 x 150 mm) HPLC column. A mobile phase flow rate of 0.20 ml/min was utilized, and a solvent gradient was used to achieve better separation. Mass spectrometer parameters, which were optimized for sensitivity, included the drying gas flow rate for the electrospray interfase (ESI) at 12.0 L/min, and the ESI spray chamber temperature at 350 ºC.

A number of textile fibers were extracted and the dyes identified using the LC-MS method. Mass spectra of standard dyes and extracted dyes will be presented and discussed. Dye identification is based on multi-analyte ions, including various molecule-related ions and fragment ions. Other advantages of LC-MS, such as isotope information and the comparison of negative and positive ion spectra, will be discussed.

Textile Fiber, HPLC-MS, Dye Analysis

B171 A Computerized System of Human Ear Image and Print Identification

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The authors intend to present to the forensic scientific community a computerized system for the identification of the living or dead from ear images and the identification of offenders from earprints left at scenes of crime.

This system has 2 principal uses. It can be used to search and identify an offender from a known database using an earprint left at a scene of crime. It can also be used to identify an individual purely from an ear image. This could be used at immigration, customs, CCTV, or even the search for a wanted individual any where in the world with a simple photograph been sent to a central database. Therefore the question as to whether an individual is who they say they are can be accompanished with this system.

The ear was first used to identify individuals in the late 19th century when the criminologist Alphonse Bertillion devised a system of identifying individuals using 11 anthropometric measurements of the human body. These included measuring the height of the individual, as well as recording the size, shape and position of the ear on the head. However, the use of ears in human identification was largely abandoned with the advent of fingerprinting in the early 20th century. In the later part of the century there was a resurgence of interest in the use of ears to identify individuals ("earology") although despite the hypothesis that each ear on each individual is unique, the uptake of this area of identification has been slow and controversial with many Courts not accepting ear evidence. This problem is confounded by the lack of peer reviewed, scientific publications of methods used for ear identification. To date, only 2 methods have been published for ear images, those of Alexander and Iannarelli, and there is to our knowledge no peer reviewed published method for earprint identification which, to date, relies on manual comparison of a print from a scene of crime with a known suspects earprint. This one-to-one comparison could bias the interpretation.

The Division of Forensic Pathology, University of Leicester, England, in conjunction with the commercial company K9 Forensic Service Limited, Northampton, England, undertook a project to produce a computerised system of ear image and earprint identification. We first reviewed all available literature on methods used to identify individuals from their ears and realised a paucity of information and techniques. We then considered the anatomy, development, racial, genetic and medical aspects of the ear which may make it unique to an individual. Using volunteers we developed a system for ear image capture using digital photography and collected 800 images (400 right and 400 left ears). All ears were also printed. This formed the basis of 2 databases (800 images, 800 prints). Random ear images and prints known to be in the databases where then searched manually using the identified manual methods to assess ease of use, speed, intra-observer differences and accuracy of

identification. All images were then entered into a computer system to create an ear image and earprint database. The computer system works by allowing the operator to apply up to 20 points to each image in a similar way to the fingerprint system. The software then uses the points to search for the same ear in the database. To enable the programme to work we had to standardize the placement of the points. This required the development of a locating grid to be applied to the ear to ensure that all points, on all ears are placed at the same point. A standardised system was developed for both ear images and ear prints. In the latter cases this is, to our knowledge the first such method to be presented and published.

The system which has been developed works for both ear images and ear prints. It can use complete images or, as often is the case for prints, partial prints. Although the operator still has to confirm the final match, the system is considerably more time efficient compared to manual methods. We have also analysed the differences between left and right ears, males and females as well as racial differences and produced a series of standard ideal ear shapes which can be used for facial reconstruction. Finally, by analysis the position of ear piercings we have identified another identifying feature of the ear and shown why earprints are often incomplete at scenes of crime.

This system has 2 principal uses. It can be used to search and identify an offender from a known database using an earprint left at a scene of crime. It can also be used to identify an individual purely from an ear image. This could be used at immigration, customs, CCTV or even the search for a wanted individual any where in the world with a simple photograph been sent to a central database. Therefore the question as to whether an individual is who they say they are can be accompanished with this system.

Ear Image, Earprint, Computer

B172 Extractionless GC/MS Analysis of γ-Hydroxybutyrate and γ-Butyrolactone With Trifluoroacetic Anhydride and Heptafluoro-1-butanol From Aqueous Samples

Alberto J. Sabucedo, PhD, and Kenneth G. Furton, PhD, Florida International University, University Park-Department of Chemistry CP-178, Miami, FL 33199*

This presentation will describe the development of a technique designed for qualitative and quantitative determination of γ-Hydroxybutyrate (GHB) and indirectly γ-Butyrolactone (GBL) from aqueous matrices without the need for an organic extraction. GHB is derivatized in the presence of water without the need for an organic extraction. This technique offers several advantages such as rapid determination, minimum sample handling, low sample volume, high sensitivity, improved mass spectra for confirmation and indirect determination of GBL concentration.

This may become a general technique in both the toxicology arena and the drug testing community. The technique offers minimal sample handling and excellent detection of a commonly abused drug in our society.

γ-Hydroxybutyrate (GHB) is a DEA Scheduled I drug of abuse commonly spiked into beverages to incapacitate victims of sexual assault. GHB is a challenging drug for analysis by GC/MS because of its small size, charged nature, low volatility and intramolecular esterification leading to γ-butyrolactone (GBL). In this work an extractionless technique has been developed that allows for the use of an aqueous sample for direct derivatization. The technique uses a solution of trifluoroacetic anhydride (TFAA) and 2,2,3,3,4,4,4-heptafluoro-1-butanol (HFB) to derivatize the active hydrogens of GHB. The conversion of GBL to GHB can be forced under alkaline conditions by diluting the sample in 10 mM borate buffer, pH 12.0. Legally GBL found in beverages intended for human consumption is considered a scheduled substance under current analogue law. Spikes of the two compounds into several beverage matrices gave quantitative recovery of GHB by GC/MS. The derivatization produces higher molecular mass products whose fragmentation pattern provides multiple peaks for confirmation and quantitation. The concentration of GBL can also be indirectly determined by the method developed by analyzing an aliquot of the same sample under hydrolytic conditions and in water. Therefore, this extractionless technique is rapid, sensitive and selective for the confirmation of the presence GHB and GBL in commercial beverages.

The current study shows the utility of an extractionless technique for the determination of GHB. The technique can be as simple as taking an aqueous neat sample and performing the derivatization. The dilution with borate buffer is only necessary if the conversion of any GBL to GHB is desired by hydrolysis of the lactone. The derivatization was monitored by full-scan mode to choose the ions with best sensitivity and selectivity. This derivatization technique produces sufficient high abundance fragments to make the identification by selected ion monitoring mode (SIM) easier than derivatizations that produce few and low abundance ions such as BSTFA/1%TMCS derivatives of GHB. Both the esterification and trifluoroacetylation are products of this reaction.

The standard curve has a linear range of 0 to 100 ppm with a correlation coefficient, r = 0.999. A ratio of standard (GHB) to internal standard (GHB-d_6) response was used to correct for variations in the derivatization and chromatographic processes. A wide range 0 to 1000 ppm standard curve gave a coefficient of correlation of r = 0.996. This analysis has a limit of detection (S/N=3) of 50 ppb and a limit of quantitation (S/N=10) of 150 ppb. The precision of the assay is excellent with percent coefficient of variation (%CV) below 5%.

Spike and recovery studies were performed with some common neat beverage matrices with and without alcohol. The recoveries are within 11% of the target value. This is impressive since the sample matrix was not diluted. In addition, the neat rum spiked sample contains approximately 40% ethanol. The next set of studies involved spiking both GHB and GBL into the different matrices and comparing their recoveries against the GHB standard curve. In this set of experiments the 1:10 dilution in 10 mM borate buffer, pH 12 was used to force the hydrolysis of GBL to GHB. GHB recoveries were on average about 100% and the GBL+GHB spiked matrices were on average 106%. The use of selected ion monitoring (SIM) mode for the quantitative analysis increases sensitivity over full-scan mode. The high concentrations encountered in typical beverages can easily allow the analysis to be performed in full-scan mode. The estimation of GBL concentration present in an aqueous solution can also be indirectly determined by submitting an aliquot of the sample to the alkaline hydrolysis and another aliquot to a simple dilution in water. The difference between the two values is negligible if the substance present is only GHB. If GBL is present than the two values will differ accordingly. Several urine matrix spikes were performed and the recoveries were within 15% of the target spiked values. Therefore, this assay may also be used for the determination of GHB in biological matrices.

Analysis of compounds with similar chemical structures included: 4-aminobutyric acid (GABA), diethylene glycol, 1,4-butanediol and gamma-butyrolactone (GBL). These were derivatized and monitored to account for any contribution to the GHB response. GBL was tested without the hydrolysis conversion step of the method to check the percent that converts to GHB in the process. The materials were spiked to a maximum of ten times the upper GHB standard curve concentration. The spiked concentration of the test compound was read from the GHB standard curve and the percent response was calculated from the fitted regression slope of the compound across the range tested. The only compound that gave a significant GHB peak was GBL. The GBL response was approximately 10% under these conditions across a wide range.

Some of the benefits of this method are the lack of an extraction step, very small sample size, the rich mass spectra obtained upon derivatization providing many abundant ions available to monitor by SIM mode, increased sensitivity and ability to detect both GHB and GBL in a complex beverage matrix. The typical analysis involves a significant dilution to get the concentration in the range of the assay. This dilution can be performed with either deionized water or the hydrolyzing borate buffer. The detection of either GHB or GBL in beverages is important in the forensic community because of the legal ramifications and the intended illegal use of GBL as an analogue of GHB. In vivo GBL is converted to GHB thus making the presence in beverages an illegal controlled substance similar to GHB. The conversion step of GBL to GHB allows for chemist not to miss the current trend of spiking GBL in beverages intended for human consumption. The technique requires minimal sample handling and provides reliable quantitation of GHB and GBL.

GHB, GBL, Extractionless

C1 Mold Investigations — What is the Science Behind the Work?

Gary R. Brown, PE, RT Environmental Services, 215 West Church Road, King of Prussia, PA 19406*

After attending this presentation, attendees will have an understanding of how semi-quantitative techniques are used to assess microbial growth problems.

Health effects from mold have received increased public and medical attention. This presentation will impact the forensic community and/or humanity by increasing the understanding of the limits of what can and cannot be measured, which is critical to understanding how this practice area operates.

This paper has several objectives:

- Understanding how microbial growth is measured.
- Understanding how data is interpreted to determine if amplification is occurring.
- Conveying to the participant how microbial consultants interpret all the information from a site to reach decisions on microbial remediation and/or occupancy issues.

The practice of microbial consulting is different from all other environmental practice areas. While the actual mycotoxins associated with molds are not usually measurable, there are direct associations between certain types of mold and health symptoms in humans. Gaining an understanding of this emerging science is fundamental to understanding which molds are and are not of concern.

Mold, Microbial, Amplification

C2 The Analysis of Darkening Agents in Indoor Environments

James R. Millette, PhD and Richard S. Brown, MS, MVA, Inc., 5500 Oakbrook Parkway, Suite 200, Norcross, GA 30093*

The goal of this presentation is to present to the forensic community information about the microscopical analysis of the causes of darkening and discoloration in indoor environments.

This presentation will impact the forensic community and/or humanity by demonstrating forensic microscopical studies which show the dramatic differences between mold, soot and other contaminants that cause darkening and discoloration in indoor environments, thereby helping to provide the scientific information necessary for judicial decisions.

In recent years, toxic mold contamination has spawned a growing number of complaints and lawsuits from Delaware to California. A landmark June 1, 2003, Travis County, Texas, jury ruling decided that an insurance group must pay more than $32 million to a Dripping Springs family because of sickening black mold damage. In New York, class certification was denied in an $8 billion mold case. Concern over mold in indoor environments has clearly become a legal/environmental problem, but the dark discoloration that occurs in residences and workplaces is not always mold. As illustrated by an MVA project, "A Spot Called Ralph," environmental forensic microscopy can provide the scientific data needed to determine the cause of darkening and discoloration. As described in South Carolina's leading newspaper, "A mysterious stain has appeared in the new carpet at the Lexington County's Courthouse. Employees at the courthouse have even given the spot a name - 'Ralph.'" Not only did the stain appear at the courthouse, but after cleaning reappeared and grew in size from about a quarter to several feet in diameter. Testing of the carpet for mold was negative. Because of the unknown nature of the stain, the courthouse offices with the spot were closed as a precaution. A sample of the carpet was delivered to the MVA laboratory for testing. Analysis by polarized light microscopy (PLM) and scanning electron microscopy (SEM) showed that the particles present on the carpet were typical dirt found in offices. A sticky substance holding the particles to the carpet fibers was found to be consistent with corn syrup by Fourier transform infrared (FTIR) spectroscopy. High fructose corn syrup is an ingredient in many soft drinks. The spot called Ralph was probably a combination of typical office dirt and a spilled drink that when not completely cleaned simply spread the sticky substance so the spot appeared to grow.

Black, low temperature combustion soot also causes darkening and discoloration of indoor environments. The difference between mold and soot can be easily seen by microscopy. Some information about the sources of soots can also be determined. Morphology and elemental analysis of soot aggregates by analytical transmission electron microscopy (ATEM) using ASTM D6602 - Standard Practice for Sampling and Testing of Possible Carbon Black Fugitive Emissions or Other Environmental Particulate, or Both, (American Society for Testing and Materials, 2000) can be used to compare with soots from known sources, such as carbon black, fireplace, candles, oil and gas furnaces.

Mold, Soot, Microscopy

C3 The Toxicology of Molds

James S. Smith, Jr., PhD, Oak Creek, Inc., 60 Oak Creek, Buxton, ME 04093-6616*

After attending this presentation, attendees will have a better understanding of: 1) mold growth and the development of mycotoxins; 2) mold-related diseases in humans and other animals; 3) detection of mold and mycotoxin exposure; and 4) the assessment of risk posed by molds and mycotoxins. Dr. Smith will use a case study to illustrate the difficulties encountered in defining mold-related injury.

Over the last few years, insurance companies, landlords, tenants, home owners and others have become acutely aware of the potential health effects and financial liability posed by molds in indoor air. Often such health effects and liability are assumed regardless of the specific mold or molds encountered. This presentation will impact the forensic community and/or humanity by describing the toxicology of specific molds, which is a necessary prerequisite to the evaluation of their potential to adversely impact indoor air quality and pose a human health risk worthy of study and remediation. This presentation provides basic toxicological information about molds required for the evaluation of indoor air environments and understanding the potential for adverse effects in people.

This paper has three objectives: (1) to provide an overview of the toxicology of molds; (2) to identify conditions leading to mold and mycotoxin growth, development, and exposure; (3) to describe adverse health effects attributed to mold and mycotoxin exposure; and (4) to describe the difficulties inherent in demonstrating a mold-related injury.

Recent multi-million dollar jury awards in high profile legal cases involving mold-related injury captured the attention of insurance companies, regulators, environmental firms, realtors, landlords, and the individual homeowner. In the midst of an explosion in the growth of mold-related assessment and remediation services, there is too little emphasis placed on recognizing mold related injury.

Molds are fungi, ubiquitous organisms that make up approximately 25% of earth's living matter. They play an important role in the breakdown of organic matter like leaves, wood, and plant debris. To

flourish, molds require moderate temperatures (i.e., between 40 and 100°F), a nutrient base (such as the cellulose in wood or paper), and moisture. People become exposed to mold and/or mold-toxins (i.e., mycotoxins) through the consumption of mold and/or mycotoxin in foods, having skin contact with mold and/or mycotoxin, and through inhalation of mold spores/fragments and/or mycotoxins. Exposure to mold and/or mycotoxins is associated with immunosuppression, immunodepression, emesis and diarrhea, weight loss, nervous disorders, cardiovascular alterations, skin toxicity, decreased reproductive capacity, bone marrow damage, flu-like symptoms, including sore throat and headache, dizziness, dermatitis, fatigue, and general malaise. Asthmatics tend to be particularly sensitive to mold exposure, with 10 to 32% of all asthmatics showing some sensitivity. Perhaps the most sensitive group of people is those with compromised immune systems.

It is often useful to think of the adverse health effects associated with molds as falling into two basic categories; those caused by exposure to the mold organism itself and those caused by exposure to a mold-produced toxin or mycotoxin. In the former category, direct exposure to molds is known to illicit a wide variety of responses from humans and other animals. These responses include diseases characterized by the growth of mold on tissues (e.g.; athlete's foot) and secondary health effects (e.g.; increased incidence of disease), which may be related to the suppression or depression of immune system function. In the latter category, doctors have used certain mycotoxins to treat bacterial infections (e.g.; penicillin), while inadvertent exposure to other mycotoxins is clearly associated with the development of cancer and even death.

Recognizing mold-related injuries is critical to the identification of mold problems. This is because nearly half of the buildings with mold-related indoor air quality problems do not present visible signs of mold growth. Consequently, environmental companies often recommend thorough and competent testing to evaluate indoor environments for mold. Air sampling alone, however, will not provide sufficient evidence to indicate a mold problem and because there are no official standards or guidelines for regulating molds in indoor air, determining that a mold problem exists can be problematic even with good indoor air sampling information. Consequently, the most important feature of an assessment of a mold problem is the evaluation of mold-related injuries. In this presentation, Dr. Smith will present an overview of mold toxicology with special focus on the difficulties inherent in demonstrating mold-related injury.

Mold, Toxicology, Toxic Molds

C4 Automated Scanning Electron Microscopy of Lead Ore Dust

Richard S. Brown, MS, MVA, Inc., 5500 Oakbrook Parkway, Suite 200, Norcross, GA 30093*

The goal of this presentation is to present to the environmental forensic community the use of scanning electron microscopy (SEM-EDS) as a tool to investigate the particle size distribution of lead ore dust (galena) in a controlled, closed experiment and to determine the presence of lead particles on submitted items of clothing.

This presentation will impact the forensic community and/or humanity by demonstrating the techniques used for criminal forensic science which are applicable to environmental law and litigation. Attendees will gain an understanding of how particle sizing is performed utilizing an automated scanning electron microscope after dust collection from airborne particulates. Sampling procedures for examining clothing and a respirator filter will be shown for the detection of a non-water soluble, high atomic number particulate such as lead sulfide. The size distribution supported claims by the plaintiffs that they had been exposed to respirable lead dust during their workday.

Environmental forensic microscopy is the application of microscopy to the collection, analysis and identification of small particles and the interpretation of any results as they pertain to environmental investigations and governmental regulations. In this example, the forensic environmental microscopist was asked to determine the size of fine particles available in the lead ore concentrate that could potentially become airborne and be inhaled or ingested. Items of clothing, including a respirator worn during a typical workday, were examined for the presence of fine (less than 2.5 micrometer) particles containing lead. The handling of the lead ore concentrate was simulated in a controlled, closed environment to observe and collect samples of any dust produced. The experiment was videotaped and air samples were collected to determine what the airborne particle size distribution could be.

Sections from the submitted clothing and the respirator filter were placed in a solution of water and a dispersant. Particles were separated from their respective substrates by ultrasonicating the sample sections in the water/dispersant solution for several minutes. The resulting particle suspension was deposited onto a polished carbon substrate for analysis by SEM-EDS. Examples of lead-rich particulate were documented. No quantitative measure of the particulate released from the clothing and the respirator was performed.

A glove box was prepared to simulate the handling of the lead ore concentrate. Lead ore concentrate was transferred from one container to another by scooping, pouring and sweeping within the glove box. The glove box was equipped with a clear viewing area so that the handling of the lead ore concentrate could be video taped using a focused beam of light. Particles that entered the focused beam of light were highlighted in the same way as ambient dust is highlighted by a ray of light coming through a crack in an otherwise darkened room. This effect where the fine suspended dust particles are highlighted is known as the Tyndall effect; the reflection of light by particles suspended in a transparent medium. Suspended particles were collected with air filter cassettes present in the glove box during the simulation. Particle sizing over the range of 0.5 to 10 micrometers was performed utilizing automated scanning electron microscopy on the collected air filter samples to determine the size distribution of the lead ore dust generated during the simulation.

Forensic Environmental Microscopy, Lead Ore, SEM

C5 NIST Standard Reference Materials (SRMs) for Forensic Measurements and Analysis

Mario J. Cellarosi, BA, MS, National Institute of Standards and Technology, Gaithersburg, MD 20899-2320*

After attending this presentation, attendees will learn how to use NIST Web-based resources and available NIST Certified Standard Reference Materials which provide the benchmarks of precision, accuracy, and traceability to validate measurements to be used as evidence.

This presentation will impact the forensic community and/or humanity by describing to the forensic community the valuable resources available from the National Institute of Standards and Technology (NIST) on Standard Reference Materials which can be used to validate measurements in forensic evidence.

Presently available NIST Certified Standard Reference Materials (SRMs) related to measurements and characterization of specimens for linkage to forensic evidence are described. The NIST SRMs Web presence and its navigation techniques are also demonstrated.

This paper discusses physical and chemical properties of certified NIST SRMs related to measurements in the identification and/or comparison of specimens to be linked to forensic evidence. NIST supports accurate and compatible measurements by providing over 1300 Certified SRMs with well-characterized composition and/or properties. These SRMs are used to perform instrument calibrations in situ as part of overall quality assurance programs, to verify the accuracy of specific measurements, and to support the development of new measurement

methods. NIST SRMs are currently available for use in areas such as industrial materials production and analysis, environmental analysis, food and agriculture, radioactivity, health measurements and basic measurements in science and metrology. Each SRM is supplied with a Certificate of Analysis. Along with other standardization organizations methods and procedures, such as ASTM and ANSI, NIST has published many articles and practice guides that describe the development, analysis and use of SRMs. These SRMs provide the benchmarks of precision, accuracy, and traceability which validate the evidence.

The measurement of physical, optical and chemical properties of materials samples are often employed to identify the type of material and/or application. Measurements of material properties can be used to track and identify the original producer, the date or period of manufacture and the intended use or application for the material or product. For example, property or chemical measurements and/or the evaluation of materials or product characteristics, in addition to visual markings if present, can establish a link in the chain from producer, fabricator, distributor, vendor, end-use or application, down to a specific geographical area or sample origin.

In the measurement of properties, chemical composition, or characteristics of a material, accuracy and uncertainty terms and traceability statements are of paramount importance in the validation of evidence for forensic investigations. These concepts must be used correctly to avoid possible confusion and inadmissibility of evidence. SRMs and the associated Certificate or Certificate of Analysis documentation state the intended purpose and application of a particular SRM, its certified property value(s) with associated uncertainty (ies), and present technical information deemed necessary for its proper use. The uncertainty attached to a certified value is especially important as it represents a quantity which characterizes the range of values within which the true value is asserted to lie with a stated level of confidence. A NIST SRM certificate bears the logo of the U.S. Department of Commerce, the name of NIST as certifying body, and the name and title of the NIST officer authorized to accept responsibility for its contents. In addition to the certified values, the SRM certificate may contain references and/or other pertinent information and data. Certified values for SRMs with their associated uncertainties, in applicable situations, insure the integrity and the validation of forensic measurements. NIST-certified values are obtained by one or more of the following measurement modes: 1) A definitive (or primary) method using specialized instrumentation capable of high accuracy and precision and whose errors have been thoroughly investigated and corrected; 2) Two or more independent methods at NIST using commercial instrumentation that is calibration based and with differing sources of systematic errors; or, 3) Interlaboratory data from selected laboratories using multiple methods and SRMs as controls. However, the sources of error with the latter mode will generally result in uncertainties greater than those for the other two modes.

There are a number of measurement methodologies related to the determination of materials properties and/or chemical composition. For instance, chemical composition methods cover basic "wet chemistry" procedures and other very sophisticated techniques, which utilize atomic and radiation physics principles, and nuclear interactions that require complex and expensive apparatus. Fortunately, a number of SRMs having components comparable with those of the materials to be evaluated have been established. These SRMs and associated methods or standard procedures are available for equipment calibrations.

This paper will discuss and illustrate the use of a number of SRMs of interest to the forensic community. The discussion will encompass measurement practices, methods, standards, and precision and accuracy considerations to be taken into account for the measurement methodologies employed. This paper will also provide insights on the future needs for SRMs to be utilized in measurements and materials characterization.

Standards, Reference Materials, Calibrations

C6 Recent Advances in High Resolution FT-ICR Mass Spectrometry and Their Applications to Environmental Forensics

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After attending this presentation, attendees will understand the fundamentals of high resolution FT-ICR mass spectrometry. Fundamental limitations of traditional analytical techniques, and how FT-ICR MS overcomes many of those limitations will be discussed.

This presentation will impact the forensic community and/or humanity by describing how the amount of information that can be obtained from complex environmental samples has drastically increased as a result of FT-ICR MS applications to environmental forensics. Thousands of different compounds may now be identified and used for fingerprint-based identification of heavy crude oil or other complex contaminants.

Traditional analytical techniques such as Liquid Chromatography (LC) and Gas Chromatography (GC) have inadequate chromatographic resolution for the baseline separation of all species present in complex mixtures composed of hundreds or even thousands of individual components. As a result, combined techniques (such as GC-MS and LC-MS) are ineffective due to co-eluting species that complicate the mass spectrum and hinder mass spectral interpretation and component identification through traditional library based searches. This is especially true for complex materials that have undergone abiotic or biotic modification in the environment. Furthermore, mass spectrometers commonly employed for GC-MS and LC-MS are low resolution/low mass accuracy quadrupole mass filters or quadrupole ion trap type mass analyzers that are unable to adequately resolve complex mixtures for individual component identification. Even if the traditional analytical techniques succeed in both separating and resolving an individual species in a complex mixture, the low mass accuracy provided by the commonly employed mass spectrometers prevents elemental composition assignment. Fourier Transform Ion Cyclotron Resonance Mass Spectrometry (FT-ICR MS) benefits from ultra-high mass resolving power (greater than one million), high mass accuracy (less than 1 ppm), and rapid analysis; these attributes make it an attractive alternative for the analysis of complex mixtures such as crude oil. For example, we recently resolved almost 20,000 different elemental compositions in a single positive-ion electrospray FT-ICR mass spectrum of a heavy crude oil.

Here we report environmental forensic applications of FT-ICR MS in the compositional analysis of heavy crudes, their water-soluble fraction, and abiotic changes in the crude oil polar species as a function of increased weathering in both soil and water (simulated sea water). High resolution (>300,000) and high mass accuracy (sub-ppm) mass spectra of electrospray (ESI) ionized samples are obtained on a home-built 9.4T ESI FT-ICR MS equipped with a MIDAS data station. Crude oil standards consisted of thousands of peaks over hundreds of compound classes. Five geochemically different crudes were analyzed in an effort to differentiate them from one another based on their compositions provided from the FT-ICR MS analysis. The crudes showed significant differences that directly relate to their geochemical source histories. We also report the compositional determination of water-soluble organics leached from a heavy crude oil. Contrary to previous reports in the literature, the composition of the water-soluble species is very complex and is composed of both the expected CO_2 series (carboxylic acids) as well as higher oxygen containing hydrocarbons and many SO_X species.

Similar weathering experiments in sterilized soil will also be presented. Relevant instrumental advances will be discussed that both expand the compound classes that can be identified and make the analysis more informative and routine. Advances discussed include selective ion accumulation, a new octapole ion accumulator that increases the efficiency of ion ejection, and a new field desorption/ionization/atmospheric pressure ion source. Work supported by ExxonMobil Research and Engineering, NJ, NSF (CHE-99-09502), FSU, and the National High Magnetic Field Laboratory in Tallahassee, FL.

High Resolution Mass Spectrometry, Environmental Forensics, FT-ICR MS

C7 To *Daubert* or Not to *Daubert*? That Has Become THE Question

James S. Smith, PhD, Trillium, Inc., 28 Grace's Drive, Coatesville, PA 19320*

After attending this presentation, attendees will understand the use or misuse of a ***Daubert*** hearing.

This presentation will impact the forensic community and/or humanity by warning expert witnesses and their attorneys about the use of a ***Daubert*** hearing and the gatekeeping, or lack thereof, during trial. The cost, quite often, is a loss.

The Daubert v. Merrill Dow Pharmaceuticals, Inc. Supreme Court decision is 10 years old. It established guidelines for the admissibility of scientific evidence in Federal courts and it has trickled down to most state courts. The judge must be gatekeeper and determine what is reliable evidence and what is junk science. General Electric v. Joiner in 1997 and Kumho Tire v. Carmichael in 1999 were Supreme Court cases expanding the judge's gatekeeper role over all expert testimony. In the Kumho Tire decision, the Supreme Court specifically pointed out that opinion is not science just because an "expert" says so. In other words, when an expert witness starts a sentence with "In my experience....," then the gatekeeper should slam the gate shut. Simply stated, the ***Daubert*** decision requires that opinions of expert witnesses be examined with the same scientific rigor as scientific statements made outside the courtroom.

However, ***Daubert*** hearings occur only when either the plaintiff or the defendant makes a request for the hearing. The following case illustrates the use of the ***Daubert*** hearing, and how the judge was not a gatekeeper.

The plaintiff's expert has good credentials to be involved in an environmental litigation and produces a lengthy, detailed expert report following the Federal Rules of Evidence. The defendant's expert does not have good scientific credentials and produces a two page letter in response to the plaintiff's expert report. The letter is full of blatant inaccuracies about the known published science concerning the contaminants of interest in this litigation.

Depositions of these two experts are taken. The plaintiff's expert can and does support the expert report with literature references and documentation. The defendant's expert either hasn't studied the various issues or cannot make a definitive statement. However, this expert is positive that the plaintiff's expert is wrong.

Now, the surprise is that the defense wants to exclude the plaintiff's expert based on the unreliability of the scientific approach used in this case. This is bolstered by a decision by another judge to disallow a portion of an affidavit written in another case in another state. What followed was a rigorous questioning of the expert fro the plaintiff, by the defense attorney, the judge, and the plaintiff's attorney. If the judge decides to close the gate then this expert's testifying days are over. The expert does survive, but there is no doubt about what that expert will present at trial because it has been cast in stainless steel via the expert report, deposition and ***Daubert*** hearing.

What about the weak, so-called expert for the defense? At trial the plaintiff's attorney will kill him over his inaccurate letter report and lack of scientific knowledge. But, at trial, the testimony has nothing to do with the letter report or deposition question and answers. A surprise demonstration is aimed at the weakest kink in the plaintiff's case, which was really not that weak. Objections do not carry the day and there is nothing available in the trial testimony to allow for a rigorous cross examination.

The ***Daubert*** challenge by one side should automatically force a challenge of both experts. Rigor should not be applied to one side without being applied to the other. Scientific evidence was not fairly presented nor was the gatekeeper aware of the (mis)use of a ***Daubert*** hearing to tip the scales of justice.

***Daubert*, Kumho Tire, Gatekeeper**

C8 A Study of Several Case Histories of Successful Method Detection Limit (MDL) Studies Consistent With 40CFR136, Appendix B

James E. Norris, MS, Severn Trent Laboratories, 900 Lakeside Drive, Mobile, AL 36693*

After attending this presentation, attendees will have a knowledge of the utility of the Method Detection Limit determination under 40CFR136, Appendix B.

This presentation will impact the forensic community and/or humanity by demonstrating a deeper understanding of the limits of USEPA methods in analyses of various substrates.

This presentation addresses several of the 15 Method Detection Limit studies conducted by the author for industrial facilities in four different states. All were successful from both a technical and a regulatory perspective.

The strategic objective of each study was straightforward: to determine a matrix-specific, analyte-specific, method detection limit (MDL) in an industrial wastewater discharge and to accomplish this in a manner consistent with USEPA's methodology given at 40CFR136, Apdx B. Prior to each study, the responsible State (or Federal) permitting agency had been informed of the need and the intent to execute such a study and in no case did the responsible agency veto the necessity of conducting such a study.

This presentation will address the studies of several analytes and methodologies (organic compounds, GC/ECD and GC/MS), non-metals (e.g., Total Cyanide distillation with automated colorimetry), metals (by ICP/GFAA), and pesticides (GC/ECD, GC/MS). A comparison will be made to demonstrate the often dramatic differences in EPA-published MDLs versus those defined in real-world industrial wastewater matrices.

One implication of the matrix-specific MDL is demonstrated by a significant drop in the number of NPDES permit limitation violations.

The introduction by USEPA of the concept of the Minimum Level (ML) as, effectively, a limit of quantitation (LOQ) will be shown to further ease the compliance burden on permitted industries. Unhappily, the EPA has not incorporated the ML concept into binding regulation (as is the case with the MDL) but has presented the ML as mere guidance. Some states (e.g., Texas) have adopted the ML concept and incorporated it into their state water-permitting regulations.

Interestingly, all new and updated 40CFR136 methods include not only the MDL but also the ML for the analytical method. In this paper, the most frequently evaluated MDLs have been one form or other of cyanide (e.g., Total Cyanide, Cyanide-Amenable-to-Chlorination, Weak Acid Dissociable Cyanide).

Impetus to conduct such MDL (and ML) studies resides in the growing tendency of both USEPA and State agencies to set discharge limits below the limits of detection. The success of the various LEAF

(Legal Environmental Advocacy Fund) lawsuits and the rapidly expanding program of re-classification of streams and rivers (leading to Total Maximum Daily Loads) have resulted in water quality driven mass discharge limits which translate into immeasurably low concentrations in wastewater discharges.

Unhappily, many NPDES permit writers do not seem to understand that compliance with a mass-based limit is contingent not only on flow (thus, total mass of wastewater) but upon a measurement of concentration of the offending species. This aspect of the compliance problem will also be addressed in this presentation.

Analytical, Detection Limits, Matrix-Specific

C9 Engineered Containment Systems for Radioactive and Hazardous Wastes — Do Current Approaches Present Opportunities for Future Environmental Forensics?

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The goal of this presentation is to familiarize the audience with the current approach to long-term containment of wastes, the failure of which may require future forensic investigation.

This presentation will impact the forensic community and/or humanity by demonstrating the limitations of current containment systems, some of which may result in the need for future forensic investigations.

The field of environmental forensics has evolved largely as a result of past chemical and waste management practices that have resulted in large scale contamination of surface and subsurface environmental media (surface water and groundwater, soils and sediments). When it became known that these practices were affecting valuable environmental resources, steps were initiated to both restore the contaminated media to an appropriate degree, based on risk and future land use, and to adopt improved standards and practices for the ongoing management of wastes and cleanup residuals. As a result of major technical and economic limitations on implementing remediation, a large volume of these contaminated media will be contained in engineered systems either in situ, using surface and possibly subsurface barriers, or excavated and placed into new engineered containment systems (disposal cells). Given the lifetimes of the radioactive and hazardous constituents (hundreds or thousands of years to essentially forever for stable toxic metals), these engineered systems will have to be monitored and maintained, with ongoing access restrictions (institutional controls), for very long time horizons.

The primary function of an engineered containment system is to prevent radioactive and/or hazardous constituents from migrating to potential exposure points. Institutional controls are also needed insure ongoing monitoring and maintenance and to prevent direct contact with the contaminated media. The design approaches that have evolved rely on a primary barrier system whose main function is to keep infiltrating rainwater and possibly groundwater from contacting the contaminated materials and wastes that are being isolated and transporting constituents to the environment. This primary barrier, in a surface barrier system for example, typically consists of a compacted soil layer, sometimes augmented with bentonite, together with a synthetic membrane (geo-membrane) to keep the soil from desiccating and cracking and to provide an additional layer of protection. Over the years, as experience has been gained, additional layers have been added to protect the primary barrier system from the adverse impact of natural processes such as erosion and bio-intrusion that can compromise the performance of the primary barrier system. The current design approach typically contains several layers and is very expensive to construct (typically several hundred thousand dollars an acre). In some cases, where gases are of concern (e.g., methane, radon), gas barriers or collection systems are employed as well.

While our experience with the current state of the art approaches to system design is limited to a few decades at best, observations of system performance and data are beginning to emerge. These data and observations suggest that there is merit to re-evaluating our current approach. In particular, design approaches that can accommodate a certain degree of environmental change and that do not have to rely on resisting natural processes are generating a great deal of interest.

Also, progress has been hampered, to varying degrees, by the current regulations that call for prescriptive designs (that may not be the best in certain environments), i.e., requiring monitoring of the saturated zone and only thirty (30) years of post closure monitoring and maintenance for facilities regulated under the Resource Conservation and Recovery Act (RCRA). In many cases, particularly at the Department of Energy sites, extensive vadose zones are present that provide separations of hundreds of feet between the engineered containment system and the top of the saturated zone. Monitoring of both the vadose zone and the system itself could provide valuable early warning information concerning system performance.

The authors have spent many years working on both Superfund sites and the investigation and restoration of former nuclear weapons production facilities and are currently evaluating system design and monitoring approaches at a number of sites. The time appears appropriate to determine: the data needed to evaluate the performance of the sites over time; what tools are needed to collect the data; and what needs to be built into the design to help ensure the data are available. Examples will also be provided that illustrate the shortcomings of the current approach and alternative design and monitoring approaches that could provide improved and more cost effective protection over long time horizons.

Long Term Containment, Monitoring Needs, Design Needs

C10 Western Precious Metal Ingots — The Good, the Bad, and the Ugly

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After attending this presentation, attendees will understand the scope of knowledge necessary in the identification of fake precious metal ingots.

This presentation will impact the forensic community and/or humanity by demonstrating breakthrough technology for determining real versus fake historical or modern precious metal ingots.

Historical precious metal ingots have changed hands for millions of dollars between bankers, institutions and collectors. Elaborate fakes have entered the market place, causing significant unrest. Experts have generally been unable to identify fakes until now. Using the gold ingots from the 1857 wreck of the SS Central America as a baseline, studies for the past five years have generated new methodology for determining real historical ingots from fakes.

Scanning Electron Microscopy with Energy Dispersant X-Ray Spectrometry backscatter scans show original textural features of the metallurgical product that can be compared to modern metallurgical pours. Laser Ablation-Inductively Coupled Plasma Mass Spectrometry analyzing major and trace element chemistry is used to compare original historical ingots with questioned pieces. A thorough understanding of the

historical record associated with the companies that poured these ingots is necessary to further interpret the data.

Using this new methodology, several ingots have been determined to be fake, including one important ingot in the Smithsonian Collection.

Precious Metal, Gold and Silver, Fraud

C11 Biomechanical Determinants of Injuries From Low-Level Falls

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The goal of this presentation is to present a review of published scientific research in order to enhance the ability of the forensic biomechanist to determine if a mechanism was present to cause injury in a low-level fall.

Reliance on published scientific research by the forensic community should enhance the ability to accurately assess whether a mechanism of injury was present in a low-level fall. This presentation will impact the forensic community and/or humanity by demonstrating that caution must be exercised, however, when using published data to perform the converse task, that is, to retrospectively predict injury from a given fall. This is very complicated task dependent on many variables including the large number of biomechanical factors affecting injury potential and the wide range of injury types in the literature.

The impact energy available from a standing height fall is derived from a conversion of the potential energy of the body's initial center of mass and can be sufficient to cause significant injury, including fracture of the proximal femur,[1] distal radius,[2] lumbar vertebral body,[3] or skull;[4] but the majority of falls are arrested safely without injury. Fall-related injuries occur when the impact forces and moments exceed an individual's biological tissue tolerance to injury. DeGoede et al.[5] and Robinovitch et al.[6] provide excellent review articles that document biomechanical factors contributing to injury severity in nonsyncopal falls to the ground. This paper will not address all of these biomechanical factors; rather it will highlight some of those factors that have experimental support in the scientific literature.

Direction of fall can influence both the primary location of impact to the body in a fall and the subsequent injuries. Smeesters et al.[7] found that human subjects exposed to trips and unanticipated step-downs during gait usually fell forward or sideways, whereas those exposed to slips more often fell backward or sideways. Hsaio & Robinovitch[8] analyzed body segment kinematics in young subjects during induced forward, backward and sideways falls. In all falls, impact to the outstretched hand(s) was observed. All posterior falls also resulted in contact with the pelvis. In greater than 70% of the falls with pelvis contact, the time difference between hand and pelvis impact was less than 50 ms. The investigators theorized that this short interval between multiple impact points suggested a sharing of impact energy between the upper extremities and pelvis which would likely reduce the injury risk compared to a single impact point. The higher incidence of fracture seen in the elderly population may be partly explained by slower upper extremity reaction times or landing on the hip instead of the buttocks in a low-level fall.

Extremity joint and soft tissue properties also govern extremity impact force, energy absorption and injury potential. Chiu and Robinovitch,[2] using a mathematical model to simulate a forward fall from standing height (0.75m) onto an outstretched hand, showed large differences in the impact response between the wrist and shoulder. Peak impact forces measured in the wrist (2.57 kN) surpassed the average fracture force for the elderly distal radius (2.26.$\pm$ 1.01 kN), but these large peaks were not transmitted proximally to the shoulder. The shoulder underwent larger displacements and absorbed more energy (277 J) than the wrist likely due to lower shoulder stiffness. This would result in a higher potential for shoulder joint injury (e.g., rotator cuff tear or capsular instability). Altering the extrinsic properties of the impact surface with padding reduced the peak impact force at the wrist by about 35%,[9] to a level that might prevent wrist injuries in standing height falls. Unfortunately, padding did not generate a concomitant reduction in force or deflection at the shoulder. A similar phenomenon has been observed in experiments measuring peak head and neck loads following vertical drops on the vertex of cadaveric heads with an average impact velocity of 3.12 $\pm$ 0.18 m/sec onto unpadded and padded surfaces.[10] Padding reduced peak force at the head but increased the impulse and catastrophic injuries in the cervical spine.

Volitional momentum arrest or energy dissipation strategies prior to impact have also been identified in the scientific literature. Robinovitch et al.[11] showed that individuals have some control over the magnitude of impact energy applied to their body during a low-level fall. In their study these investigators simulated different reaction time delays to a fall by asking standing human subjects to fall backward onto their buttocks as softly as possible without use of their hands from 3 different initial backward lean angles (Oº, 5º, and 12º). An increased initial lean angle resulted in significantly increased vertical hip impact velocity and kinetic energy at impact, and decreased energy-absorbing work at the hip, knee, and ankle joints during descent. The increased lean reduced the available reaction time and diminished the subjects' ability to reduce impact energy through a protective "squat" response that consisted of lower extremity muscle contractions. The importance of reaction time was also illustrated in research by van den Bogert et al.[12] who used an inverted pendulum model to show that faster response time was more important than slower walking velocity for successful recovery from a trip in older adults. The results of these studies highlight the importance of intrinsic variables, such as reaction time, strength and flexibility, in determining one's ability to not only avoid falls but also dissipate energy and affect impact severity in a low-level fall.

Anthropometry is a biomechanical variable that also influences injury risk. Research has found a correlation between body mass index (BMI) – weight (kg) divided by height^2 (m) – and ankle fracture severity in low-level falls.[13] A BMI of 18 – 25 kg/m^2 is considered desirable for both men and women. In this study 24 patients with displaced malleolar fractures were matched with 24 patients with undisplaced fractures. The mean BMI of patients with displaced fractures (28.25 kg/m^2) was significantly higher than that (24.58 kg/m^2) of those with undisplaced fractures. These findings suggest that obesity is a risk factor for severe ankle fractures in low-level falls.

Bone properties represent another biomechanical variable that contribute to the risk of injury from a low-level fall. Salminen et al.[14] investigated 50 femoral shaft fractures from low-energy falls in a patient population with an age range of 17-92 years. In 38 patients the fall height was ground level. The significant biomechanical determinant of fracture in this study was the presence in 64% of the patients of at least one preexisting factor, besides age, likely to cause osteopenia, a condition which weakens the mechanical strength of the femur.

In summary, reliance on published scientific research by the forensic community should enhance the ability to accurately assess whether a mechanism of injury was present in a low-level fall. Caution must be exercised, however, when using published data to perform the converse task, that is, to retrospectively predict injury from a given fall. This is very complicated task dependent on many variables including the large number of biomechanical factors affecting injury potential and the wide range of injury types in the literature.

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Injury, Biomechanics, Falls

C12 Decoupling of Lagrangian Equations of Motion to Improve Computational Efficiency and Application to Multi-Body Constrained Biomedical Engineering Systems

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The goal of this presentation is to develop a unique method for formulation of equations of motion based on Lagrangian energy methods that result in decoupling of the equations of motion in the highest order terms. This derivation yields equations of motion that are in a more convenient and efficient form for numerical analysis.

This presentation will impact the forensic community and/or humanity by demonstrating a method which reduces computer processing time by 10-17% which is significant when utilizing a high capacity computer to analyze occupant motion. Computer processing costs are also reduced proportionally.

As simulation of human occupant kinematics becomes increasingly complex, computer processing effectiveness becomes an increasingly important consideration. Decoupling the highest order terms improves the efficiency of numerical analysis, especially for nonlinear systems. More efficient processing yields results in less computer time or with less computer processing capability. This method therefore, may widen the practical use of occupant kinematic analytical tools.

Methodologically, the only work on decoupling equations of motion by Loduha and Ravani (1995) utilized Kane's method. Here, a method for decoupling the equations of motion is derived for the first time for use with Lagrangian energy based methods, commonly used in BioMedical Engineering. Methodology involves mathematical transformation of the equations of motion. Specifically, the equations of motion are decoupled in the highest order via a congruent transformation to a diagonal matrix called the *canonical form of a symmetric matrix under congruent transformations.* This was first attempted by Wade in 1951; here, congruent transformation will be utilized for the first time to decouple Lagrangian equations.

Highest order decoupling of Lagrangian equations of motion for constrained multi-rigid body systems is formulated to create equations of motion that are decoupled in the highest order terms. The practical benefit is less computer processing time, which is most apparent for complex systems. Decoupling the equations of motion in the highest order derivative terms results in a more convenient form of the equations for numerical analysis. Specifically, if the equations of motion are decoupled in the highest order prior to integration, computer processing is more efficient (especially for nonlinear systems) as decoupling of the highest order is no longer required at each step.

Mathematical derivation requires seven steps:

1. Coordinate Selection
2. Lagrangian, Kinetic Coenergy, and Potential Energy Transformations
3. Partial Derivative Transformations
4. Transformed Lagrangian Derivation
5. Transformation of Kinetic Coenergy
6. Transformation of Potential Energy
7. Selection of the Rate Transformation Matrix

In conclusion, a parsimonious side impact occupant kinematics example demonstrates that the selection of generalized velocity components as a function of generalized coordinates indeed results in decoupling of the Lagrangian equations of motion in the highest order. Further, a simplified BioMedical Model shows that the decoupled equations and the coupled equations of motion yield the same result. The difference is the decoupled equations a require 10-17% less numerical processing time.

Mathematical Modeling, Simulation, Human Kinematics

C13 Catastrophic Spinal Injury to Restrained Occupants in Frontal Crashes

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Attendees will learn how restraint system design affects the potential for catastrophic spinal injury through the analysis of fourteen passive seatbelt cases.

This presentation will impact the forensic community and/or humanity by demonstrating how certain seatbelt designs increase the risk of catastrophic spinal injury in frontal crashes.

In this presentation, spinal injury mechanisms related to restraint usage are identified and analyzed. The analysis of fourteen passive seatbelt injury cases reveals how catastrophic spinal injuries are related to the belt fit, torso belt load and belt geometry. Injury locations include the lower cervical and upper thoracic spine. Although such injuries can occur in high-speed impacts to a vulnerable person using an ordinary three-point restraint, such injuries should not occur at lower speeds. Yet, such injuries are not uncommon when automatic or passive belt systems are utilized. Passive systems produce these injuries even in moderate speed collisions. Some injury patterns related to single torso belts have been reported. However, the reported injuries, their mechanisms andlo-

cations are, for the most part, different than those in this study. The current study relates only to catastrophic spinal injury and to impacts less violent than many reported in the literature. Even though these restraint systems have been discontinued (passive belt restraints have been replaced by airbags), analysis of passive belt injuries reveal dangerous design parameters that can be useful in evaluating risk factors in other designs, such as the new all-belts-to-seat designs.

By definition, passive belt systems position themselves on the occupant without any action by the occupant. The particular passive design most frequently associated with these injuries is the passive torso belt that travels on a track along the door or doorframe. This system has a separate manual lap belt, but use of the lap belt does not prevent these injuries.

The mechanism in all cases was neck flexion or flexion with distraction. The injuries were located at or between the C3 and T2 vertebrae. The outcome was paralysis from cord damage at those locations or death. Women suffered the most injuries by a ratio of six to one. The prevalence of women may be related to their typically shorter stature, which can contribute to poor belt positioning, their lower neck strength, and reduced shoulder-belt effectiveness because of the compliant female chest. The age range was 17 to 84 years. But the age distribution indicates, as would be expected, that older individuals were more likely to be injured.

Slightly more passengers were injured than drivers, but the difference was insignificant. The vehicles' change of velocity ranged from 17 to 33 mph. A relationship between injury severity and change in velocity was not apparent in this small data set. The shortest person was 4 foot 10 inches tall, while the tallest was 5 foot 10 inches. The mean height was 5 foot 4 inches, or approximately the average height for a woman. The weight ranged from 100 pounds to 260 pounds and no obvious correlation with weight was found. Nine injuries involved C7; this can be explained by the structural discontinuity that exists between the cervical and thoracic spine at C7. The thoracic spine is less flexible and buttressed by the ribs.

The factors common to these passive restraints that contribute to injury are as follows. The torso belt track mount/anchor and inboard lap belt buckle are mounted forward of the typical D-ring and buckle locations. The upper torso belt anchor is forward of the B-pillar, positioning the torso belt forward of, and often several inches higher than, the occupant's shoulder. This geometry can position the belt dangerously high against the neck of a short-statured occupant. The forward, upper mount also created risk to taller occupants, who have their seats further back. They have to move forward into the webbing before experiencing any restraint. Thus, their chest and neck develop a velocity relative to the belt before belt contact and they strike the belt with force. The reduced length of the torso belt also increases the risk. This short length provides less stretch. As a result, the belt develops high-tension forces. Corresponding high stresses develop in the body under and adjacent to the torso belt path, leaving obvious belt marks high on the upper chest or at the base of the neck.

Contributing to the high torso belt loading and resulting injuries is the forward position of the lap belt buckle. The inboard lap belt buckle is forward and above the seat bite (intersection of seat back with seat bottom) in some vehicles by up to seven inches. With this placement the belt cannot fit snugly against the pelvis. Poor lower body restraint, due to poor lap belt fit or no lap belt at all, allows the lower body to submarine relative to the torso belt. As a result, the torso belt moves up towards the neck and distraction forces on the neck are increased.

Half of the injured individuals in this study were wearing their lap belts. These occupants moved forward several inches before the lap belt provided appreciable restraint. As a result, high torso belt forces developed before the lap belt restraint became effective. Clearly the lap belts included with these passive belt systems are ineffective in restraining the lower body and distributing belt forces to the pelvis. Failure of the lap belt to effectively restrain the lower body resulted in higher shoulder belt forces than would be experienced with a continuous loop three-point belt system. This was confirmed by MADYMO simulation of some cases.(1) MAthematical DYnamic MOdeling (MADYMO) is a human body computer program for simulating three-dimensional injury events. These simulations showed high torso belt loads and the effect of the lap belt buckle location described above.

In summary, the injury mechanisms related to poor belt fit are identified. This study confirms the importance of good belt geometry, fit and design. A restraint system without these qualities can cause unanticipated catastrophic spinal injuries, especially to women.

The authors wish to acknowledge Ann Mallory, Georgina Hackett, Bruce Turpin and Caryn Doller for their work on these cases.

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Passive Restraint Systems, Automatic Shoulder Belts, Spinal Injury

C14 Head Impact by Golf Ball: Digital Data Acquisition and Analysis Compared to Alternative Methodologies

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After attending this presentation, attendees will understand how to quantify head accelerations and head injury criterion from being struck in the head with a golf ball and compare these results to alternative methodologies.

This presentation will impact the forensic community and/or humanity by demonstrating the utility of three independent methods to quantify head accelerations from impact from a golf ball.

This paper presents the analysis used to quantify the head accelerations and head injury criterion from being struck in the head by a golf ball via three methods: digital data acquisition on a Hybrid III, scalp tensile strength calculations and pressure sensitive film.

A 39-year-old female (height: 5' 9", weight: 145 lbs) was hosting a league of 35 to 40 people on a Thursday evening at a golf course. After greeting some of the new players, she proceeded to the putting green where she was standing and looking down at a scorecard. She soon noticed a painful sensation and became dizzy. There was no loss of consciousness. A gentleman from the ninth hole had driven his ball into the trees and did not know where it went. A witness near the clubhouse saw the ball bounce one time and then strike the golf instructor on the top of her head. The instructor was escorted to the hospital by ambulance, where they noted a small hematoma just right from the center-top of the head. X-ray of the cervical spine was negative and brain CT revealed no soft tissue swelling or discoloration.

Using distances measured from the golf course, angle of the golf club face, golf ball lift and drag coefficients, and the equations of motion it was determined that the maximum speed at which the golf ball would have contacted the instructor was 27.5 mph. Using this impact speed, an experiment was designed to drop a golf ball from an equivalent drop height onto a Hybrid III dummy head to measure the resulting head accelerations and the head injury criterion (HIC) value. In addition, contact area was measured on the head form using pressure sensitive film.

Methodologically, instrumentation and equipment used included a tri-axial accelerometer mounted at the head center of gravity of a Hybrid-III female anthropomorphic test dummy, compression 80 golf balls, data filtering at 1650 Hz, and a data collection rate of 10,000 samples per second per channel.

The HIC became a US government standard in Federal Motor Vehicle Safety Standard (FMVSS) 208 in 1972 and it is characterized by the magnitude of linear head acceleration, duration, and indirectly, impulse. Head injury in the form of concussion is predicted by a HIC

value greater than 1000. Six drop test trials were conducted with HIC results of 1.3, 1.8, 1.4, 1.3, 2.0, and 1.7. It was found that the HIC was below the threshold for concussion. HIC was utilized as a means to quantify the accelerations and impulse to the head in this case; however, HIC cannot be used as an injury threshold for all types of brain trauma since one mechanical criterion could not adequately assess risk for all types of head trauma diagnoses. Therefore, the use of HIC was limited to the retroactive quantification of head trauma as in forensics and/or comparative designs of head protection countermeasures.

Contact trauma analysis was to resolve if there should have been tearing of the parietal scalp from the golf ball impact. Using the 27.5 mph impact speed, golf ball contact time, contact area, and mass, the applied tensile load was calculated for the impact: 353.6 pounds/in2. The ultimate tensile strength of the parietal scalp is 569.7 pounds/in2, which would explain why there were no tears or lacerations in the parietal scalp.

The HIC results of 1.3 to 2.0 over 0.5 milliseconds, in conjunction with the lack of physical evidence of brain trauma, support the findings that concussion would not be likely. This was supported by no definitive loss of consciousness at the scene, no tearing of the parietal scalp and no soft tissue swelling/discoloration.

HIC, Head Impact, Brain Trauma

C15 Accident Reconstruction of 14-Passenger Catastrophic Rollover and Analysis of How Occupant Restraints Could Have Prevented Five Fatalities and Four Serious/Severe Traumas Including Analysis of Pediatric Restraint Usage

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The purpose of this study wasto: 1) demonstrate the accident reconstruction and tire integrity analysis involved in determining the cause of this high speed solo rollover accident, 2) analyze seatbelt use, 3) assess the fatalities and serious/severe traumas that could have been prevented with proper occupant restraint use, and 4) demonstrate a unique approach to visual communication.

This presentation will impact the forensic community and/or humanity by demonstrating how: 1) evidence can be utilized to support findings that differed from other authority, 2) occupant trauma databases were supplemented manually with the effect of proximity to crush, 3) kinematic analysis of 14 occupants was simplified by utilizing a roofless exemplar vehicle and 4) interactive presentation programs maximized flexibility (individual occupants could be illustrated in any sequence or in any level of detail).

History: Fourteen church volunteers, ages 5 – 70, were traveling in a 15-seat passenger van. They were proceeding north on a rural highway, a few minutes before 11 PM, when the rollover occurred. The van was traveling at approximately 78 mph, and, due to some driver impetus, it swerved to the right, initiating a right-side leading skid. This led to a clockwise rollover.

Methods: First, the cause of the accident is determined using the physical evidence revealed during the vehicle and scene inspections. Second, the physical evidence in the vehicle and the trauma sustained by the occupants is utilized to determine which of the 14 passengers were restrained. The interior contents and the trajectories of those objects were considered. Lastly, this information, in conjunction with: 1) crush damage, 2) analysis of trajectories/ejection paths and 3) comparison to databases[1,2,3,4,5,6,7,8,9,10,11] of occupant exposure, is collectively utilized to assess the trade-off injuries of those nine occupants that were determined to be unrestrained.

Cause of the Accident: Initially, in the case in question, there was consideration that the front left tire was underinflated, causing steering problems. Testing showed that the rollover could explain a loss of pressure in the tire. Measurement of the roll angle versus lateral acceleration on an equaled loaded exemplar van followed the equation: roll angle = $91.6(g)^{1.4}$. However, the rollover occurred on a relatively straight section of a four-lane divided freeway that required little or no steering input and had a maximum lateral acceleration of 0.07g for a roll angle of 2.2 degrees. In fact, the driver caused the rollover by making an unsafe turning movement while exceeding the speed limit and being inattentive.

Restraint Usage and BioMedical Engineering Analysis: The van is configured for 15 total persons with 15 occupant restraints. There are driver and passenger captain's chairs, three bench seats, each of which with a three-person restrained capacity, and a last row bench seat with four-person restrained capacity. In this case, the entire last row was being utilized for storage and the front two seats were occupied, thereby leaving four people in each of the three middle rows with only three seatbelts available in each row. The child was positioned sleeping over her grandfather's lap.

The subject vehicle was inspected to determine the amount of crush sustained for each individual's seating position and seatbelt use evidence. The seatbelt evidence reviewed in detail is the occupant's restraint use that differs from the MAIT report and the bases for the differences in opinion.

This analysis revealed that there were three properly belted and at most two improperly belted passengers. Nine of the total fourteen occupants were ejected. Seven people died. Three occupants sustained serious injury.

Next, resultant occupant clearances were determined for each occupant's position. The most severe crush was focused towards the left front side of the vehicle.

The trade-off injury analysis utilized a database of collisions to determine the most likely AIS levels, given the change in velocity of the vehicle. The crush intrusion was greatest on the driver's compartment (who was seat belted properly). Given the severity of the intrusion, the occupant would have perished regardless of seatbelt use. The four people in the row behind the driver were unbelted and also perished, most likely from their ejections from the vehicle. If properly belted and seated correctly, only one of the passengers on that row at most would have likely sustained life threatening injuries from the crush. Two ejected passengers resulting in two fatalities from the middle row of seats would likely have been avoided if the occupants had been properly belted. The rest of the passengers would have sustained minor to moderate injuries if belted properly and seated correctly (i.e., using the last row of seats) because there was little evidence of intrusion and force sustained to the rear occupants. Lastly, the pediatric out-of-position occupant was analyzed.

Findings:

- the probable causes of the accident are: inattentive driver and exceeding the 65 mph speed limit. There was no evidence of mechanical failure, maintenance or road condition causal factors for the rollover.
- Five fatalities and four serious/severe traumas may have been prevented by choosing to use the seatbelts properly.

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Rollover, Seatbelt Analysis, Ejection

C16 Changes in Scientific Concepts in Accident Reconstruction Since the 1960s

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After attending this presentation, the accident reconstruction specialist and forensic consultant will be conversant with changes in the practice of accident reconstruction methods, constants, and inputs.

This presentation will impact the forensic community and/or humanity by demonstrating an approach to correct misinformation in the forensic arena. In addition, the younger research engineers in the accident reconstruction field will find the development of the newer research more meaningful.

The purpose of this paper is to help the accident reconstruction specialist become aware of older references and concepts that are often recognized but are in error and need to be updated. Most accident reconstruction is based on applied physics relying on Sir Isaac Newton's three principles. The proposition of this paper is to show that although the basic physics is usually correct, the interpretation of input may give incorrect answers. The method of updating the analytical calculations is to review the latest research from the technical research papers presented by the Stapp Car Crash Conference, the AAAM, Society of Automotive Engineers, and the International Research Organization for the Biomechanics of Injury, as well as technical papers from Canada, Europe, and Australia, together with the research at the Trauma Research Group, Dept of Surgery, UCLA. The questionable inputs and assumptions used for calculations have been printed in a number of accident reconstruction publications and State and Federal brochures. The content of this paper also includes the 1960s and 1970s research by the Trauma Research Group, which showed that some of the input by Northwestern University and many others in the accident reconstruction field was incorrect. The areas and formulae covered in this paper include updated concepts for the prediction of acceleration, cruise, cornering path, cornering acceleration, steering input, hydroplaning, perception reaction time, emergency braking values, impending skid distance, crash events including Barrier Equivalent Velocity, change of speed, direction of impact, principal direction of force and impact duration, peak g versus average g.

The result of each original concept is discussed and the new and improved method of input or calculation follows. A very simple example is to assume a set of four skids of different lengths. Assuming a coefficient of friction of 0.7 g, one takes the average length of the four skids, according to a University Publication, to obtain the pre-braking speed. A better method is to take the longest skid or to take the center of gravity distance from start of skid to point of rest. However, this gives the speed at the start of skid, not the start of braking. It is now recognized that 15 to 20 percent of the braking energy is expended prior to the visible skid marks. This has to be added to obtain the probable cruise speed, which is the speed at the start of braking. The old literature talks about the coefficient of friction of the road. In fact, one needs to know the type of vehicle, such as tractor-trailer combination, light truck, automobile, or sports car, as well as the ambient condition for the particular road surface. A more appropriate term than coefficient of friction is drag factor which is measured in terms of units of g.

There are still states in America who are presenting 0.7 and 0.75 seconds for the daylight reaction time of a driver. The newer research by Olsen and others and the accepted Perception Reaction time in most State Superior Courts, the Criminal and Federal Courts is usually about 1.5 seconds.

The material in this paper has been shown to be enlightening to even the seasoned forensic engineer, as well as stimulating and informative to the younger engineer.

Older References, Reconstruction Updates, Reconstruction Corrections

C17 Air Bag Data: Useful for More Than Air Bag Cases

Holly A. Adams, BSME, ASA, Incorporated, 12015 Canter Lane, Reston, VA 20191*

After attending this presentation, attendees will understand how to use the data stored in the air bag computer to prove other facets of an accident, such as sudden acceleration claims, whether or not cruise control was activated, and identifying a spontaneous or inadvertent air bag deployment.

This presentation will impact the forensic community and/or humanity by providing a greater understanding of the information contained in automobile air bag computers.

THEORY OF THE ANALYSIS: As most of the participants are aware, passenger vehicles equipped with air bags contain a computer as part of the system that, depending on the make and model year, saves various amounts of data. The earliest versions were simply diagnostic units that monitored the air bag components, illuminated a light in the dash and saved a fault code (DTC or diagnostic trouble code) if there was a problem. This first generation also saved a history of the warning lamp ON time. The next generation saves additional information relevant to the deployment of the air bags. This includes sensor closure timing (which equates to air bag deployment timing) and the driver's seatbelt status.

The third generation of air bag computers saves Delta V (change in velocity) or acceleration for the crash event. This technology employs an accelerometer and a deployment algorithm to determine if the air bags should deploy. Vehicles manufactured in the mid-1990s began to use these systems, which are sometimes referred to as single point sensing systems because many of them eliminated forward crush sensors. By the 21st century, this third generation of sensing systems/software has been upgraded to include pre-crash data (GM only). Pre-crash data is a record of the vehicle's speed (both mph and rpm), throttle application and braking (on or off) for a predetermined amount of time *before* the crash

event. This data has become extremely useful to reconstructionists to verify their analysis of the accident sequence.

With the advent of more sophisticated safety technologies, such as side air bags, dual stage air bags and occupant sensing, more information will become available from the air bag computer. Items such as the front passenger's seatbelt status and the front seat occupant's proximity to the air bag will be saved in order to allow the air bag computer to make the decision whether or not to deploy the air bags. This will also mean that having only one frontal air bag deploy in a crash is not necessarily an automatic defect.

Several case studies will be presented in which the air bag computer contained information helpful to a case in which the air bag was not necessarily the primary focus.

Case 1 involved an elderly driver in a parking lot of a post office. The subject vehicle went out of control, through the post office window and pinned another elderly person to the wall, causing fatal injuries to the postal customer. The driver insisted that the vehicle took off and, despite pressing hard on the brake, could not be stopped. The data stored in the subject vehicle proved otherwise.

Case 2 involved a vehicle that became disabled on the highway in a travel lane with no electrical power, hence, no hazard lights. The driver of the disabled vehicle got out of the vehicle and went to the shoulder of the road. The driver witnessed her vehicle get side-swiped twice. A third vehicle (an SUV) came up behind her disabled vehicle and swerved onto the shoulder instead of the other lane. The SUV hit the driver of the vehicle and killed her. The driver of the SUV swore he was going the speed limit and that the cruise control was off. The data stored in the subject vehicle proved otherwise.

Case 3 involved a vehicle driving down a well-traveled dirt and gravel road. The driver claimed that the air bags just went off, causing a loss of control, but ultimately no subsequent accident. The lack of damage to the vehicle and the data stored in the subject vehicle proved that the driver was telling the truth.

Air Bag, Data, Interpretation

C18 Road Rage Caused a Multiple Vehicle Crash

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After attending this presentation, attendees will understand an application of engineering analyses to determine a crash sequence leading to the conclusion that the cause was road rage of a driver whose vehicle was the last one to become involved in any of the multiple collisions.

This presentation will impact the forensic community and/or humanity by demonstrating a basis for accident reconstruction in complex collisions. Elementary calculations may give part of the story, but not necessarily a complete solution.

Background: On a summer night Ms. BB was driving a rented van truck loaded with household furnishings and towing a low bed trailer loaded with a small sedan. She was westbound on I-80 in central Iowa with her son AM as a passenger when she passed a westbound loaded semi truck driven by Mr. DR. A few minutes later and a few miles down the road, Mr. DR passed Ms. BB such that his semi truck was westbound on I-80, generally in front of Ms. BB, who was now in the westbound lane. Mr. MG was driving his luxury sedan with front seat passenger AC westbound on I-80 following Ms. BB. Mr. KP was driving a second loaded semi truck westbound on I-80 in the right lane, following Mr. MG. Shortly after midnight, the front of Mr. KP's semi truck collided with the rear of Mr. MG's luxury sedan. Mr. MG's luxury sedan rotated ½ revolution and its rear end collided with the rear of the trailer and the small sedan being towed by Ms. BB. Mr. KP's semi truck continued forward and its front right collided with the left rear of Mr. DR's trailer.

Ms. BB's van truck came to rest facing WSW in the north ditch, a short distance beyond the beginning of a weigh station exit ramp. Her trailer with the loaded small sedan separated from the van truck hitch and came to rest facing WSW in the north ditch with its left side near the van truck right side. Mr. MG's luxury sedan came to rest facing ENE in the north ditch a short distance east from Ms. BB's van truck and trailer. Rear portions of Mr. MG's luxury sedan were damaged by fire after its two collisions. Mr. KP's semi truck came to rest facing W and straddling the dividing line between the two westbound driving lanes with its trailer partly jack-knifed SW. The rear end of Mr. KP's trailer was a short distance SSW from the front of Ms. BB's van truck. Mr. DR's semi truck came to rest on the weigh station exit ramp facing WNW with the rear of his trailer a short distance due south from the front of Ms. BB's van truck.

Another investigator photographed the accident scene and vehicles within a day or two after the crashes. A few days later, with the investigator's photographs in hand, the author inspected the scene and Mr. MG's luxury sedan. Pertinent measurements were made.

Application of engineering and crash analyses and accident reconstruction methods will be described, and the following results will be presented:

- Mr. KP's semi truck speed was over the 65 mph maximum speed limit. He was in the right part of the right westbound lane turned to the left with brakes applied hard.
- Mr. MG's luxury sedan speed was under the 40 mph minimum speed limit. He was in the right westbound lane near the north shoulder pointed to the right and steering to the left. The space between his vehicle and Ms. BB's trailer was much less than a safe operating distance.
- Ms. BB's van truck speed was under the 40 mph minimum speed limit. The van truck was straddling the north fog line between the right driving lane and the north shoulder, and the trailer was in the right driving lane near the fog line. The van truck and trailer were turned to the right toward the north ditch.
- Two different scenarios were explored for Mr. DR's semi truck actions. In both scenarios his speed was much slower than the 40 mph minimum speed limit, impeding a normal traffic flow. In one scenario he is moving very slowly (less than 15 mph) in the right hand lane before turning onto the weigh scale exit ramp. In the other scenario he is moving to the right at a slightly faster speed and is literally running Ms. BB off the road. In either case he is grossly interfering with Ms. BB's travel path. (Her son and passenger AM stated that he thought Ms. BB had passed Mr. DR's semi truck several miles before the collisions began.)

Crash Analyses, Accident Reconstruction, Road Rage

C19 Air Bag Control Module Response to Multiple Vehicle Impacts

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After attending this presentation, attendees will understand how the timing between impacts, even minor ones, can explain the non-deployment of a frontal airbag in an event that is clearly above the deployment threshold.

This presentation will impact the forensic community and/or humanity by demonstrating the analysis of timing between multiple vehicle impacts, and the ability of airbag control modules to adequately protect vehicle occupants in these common situations.

THEORY OF THE ANALYSIS: The primary function of an airbag control module is to predict impact severity, and to deploy the airbags when necessary. However, when vehicles are exposed to two impacts in

close succession, the airbag control module may not be able to recognize the more severe second impact. Without the benefit of a supplemental inflatable restraint, the seat belted driver can sustain significant head and facial injuries. This paper discusses the phasing of two impacts during which the vehicle's airbags did not deploy.

Prior to a tree impact, a vehicle veered sharply to the right and struck a curb at the roadway edge. The vehicle's momentum was sufficient enough for front wheels to rise over the curb. After the curb impact, the vehicle was involved in a more severe second collision with a tree having a diameter of approximately 15 inches. This tree impact caused considerable property damage to the front centerline of the vehicle. As a result of the tree impact, the driver's head forcefully struck the steering wheel rim. The steering wheel rim was deformed, and both shear capsules were completely separated. The driver sustained a severe laceration to the forehead requiring reconstructive surgery. Witness statements supported by physical evidence on the seat belt system indicate the driver was wearing the available 3-point lap and shoulder belt at the time of collision. However, the airbags did not deploy.

Collision data retrieved from the vehicle's Sensing and Diagnostic Module (SDM) indicated a pre-impact speed of approximately 22 miles per hour. A near deployment event was recorded by the SDM with a maximum velocity change of 0.21 miles per hour at 35 milliseconds after the sensing algorithm was activated (AE). A near deployment event is an impact that is not severe enough to warrant activation of the airbags, but initiates the computer's crash discrimination algorithm. This near deployment event is consistent with the collision severity of a curb strike.

A geometric analysis of the roadside dimensions was undertaken. Based on vehicle specifications, the relative approach angle to the curb, and the location of the tree, the vehicle traveled approximately 5.4 to 7.9 feet between the curb and tree impacts. The time between these two impacts was approximately 168 to 245 milliseconds. Based on the recorded data, the SDM was actively analyzing the crash for 40 ms. Therefore, there was only approximately 128 to 205 milliseconds of time for the SDM to record, reset and resume collision detection before impact with the tree.

Based on published specifications of microprocessors of the type in this vehicle, it takes approximately 10 ms to write a byte of data, and the time required for system reset is approximately 200 to 500 milliseconds. There are a total of 80 bytes of data stored in a near deployment record, of which 56 contained a value other than $FF (the unwritten value). Therefore, the vehicle struck the tree when the SDM was continuing to reset. As a result, the SDM was unable to evaluate the second collision within adequate time to command the deployment of the airbags. The injuries sustained by the driver in this impact would have been significantly reduced by the added protection of an airbag.

Air Bag, Multiple Impacts, Timing

C20 Forensic Testing of Shared Anchor Seat Belt Components

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After attending this presentation, attendees will understand how inadequately designed seat belt components, while saving production costs, can significantly reduce the ultimate strength of the assembly in real world traffic accidents.

This presentation will impact the forensic community and/or humanity by demonstrating how inadequately designed restraint systems can fail in real world traffic accidents.

THEORY OF THE ANALYSIS: Seat belts remain the primary safety device in reducing the risk of ejection in motor vehicle collisions. Ejection increases the risk of serious injury by a factor of 4.5. Pursuant to federal safety standards, hardware for the type 2 upper torso restraint shall be designed and located in the seat belt assembly such that the possibility of injury to the occupant is minimized. However, in real world accidents, it has been observed that some seat belt designs can be inadequate. Failure of seat belts can render vehicle occupants unrestrained, thereby increasing the risk of serious injury and ejection in rollover collisions.

A passenger van with seven occupants was traveling at highway speeds. Suddenly, an impact by a vehicle traveling in the same direction sent the van out of control. The van yawed clockwise, rolled over multiple times, and came to rest in the shoulder. Two rear seat occupants were ejected, one suffering severe head and chest injuries.

Inspection of the two adjacent seat belts revealed physical evidence confirming that the rear occupants were wearing their lap and shoulder seat belts at the time of collision. It was found that both seat belt buckles were designed to be secured to the seat frame by a single webbing strap passing through one bracket. However, it was determined that the stitching used to assemble the component failed, releasing the buckles from their anchorage.

Documentation of the history of this shared anchor component showed there was a design change during the vehicle production run. The former component design used two similar buckles, each attached to an anchor bracket with independent webbing straps. With this design, occupant loading was transferred through the webbing strap to the bracket attached to the seat frame. The redesigned buckle component uses one piece of webbing to attach two buckles to one anchor bracket. The webbing is routed through the two buckles and bracket, and the layers of webbing are stitched together. Documents show this redesigned component produced a 10¢ per end item savings, or a 24¢ per vehicle savings. However, the ultimate strength of the redesigned component is decreased by virtue of the stitching configuration used to assemble the component.

A series of twelve tension tests was conducted on new and used samples to evaluate the effect of loading angles on the failure strength of these two shared anchor component designs. The loading angle is defined as the included angle between the force vectors directed along the individual webbing straps of the adjacent seat belts. Three samples each were tested at loading angles of 60, 90, 120, and 180 degrees.

A rigid beam fixture was fabricated to establish the webbing strap angles of 60, 90, and 120 degrees. The buckle component was secured to the test bench using the factory original anchor bracket. To apply tension to the component, a latch plate was inserted into each buckle, and webbing routed through the latch plate was held by a split-drum grip as specified under FMVSS 209. The rigid beam was attached to the crosshead of an Instron tension-compression machine, and raised at a constant rate of 100 millimeters per minute.

The rigid beam was not used for the 180 degree loading angle. For this loading angle, a latch plate was inserted into each buckle, and webbing routed through the latch plate was held by split-drum grips. One split-drum grip was secured to the test bench. The other web grip was attached to the crosshead, and raised at a constant rate of 100 millimeters per minute.

At a 60 degree loading angle, the former component design did not fail during the test, while the redesigned component failed at an average force of 11,899 Newtons. At a 90 degree loading angle, the former component design did not fail, while the redesigned component failed at an average force of 6,592 Newtons. At 120 degrees, the former component design did not fail, while the redesigned component failed at an average force of 4,467 Newtons. Lastly, at a loading angle of 180 degrees, the former component design failed at a force of 22,153 Newtons, whereas the redesigned component failed at an average force of 2,169 Newtons.

Component designs can significantly effect the strength of seat belt attachments. The test series established that some designs reduce the strength of the seat belt so much they no longer satisfy the FMVSS 209 requirement for webbing breaking strength. Inadequate designs can result in restraint failure when the shared anchor component of adjacent

seat belts are loaded with reasonably anticipated forces. Designers and manufacturers must consider failure mode effects analyses before implementing a component design change in order to reduce production costs.

Seat Belt, Anchorage, Testing

C21 Evaluating the Effect of Assembly Hardware on Breaking Strength of Seat Belt Webbing

Kurt D. Weiss, BSMS, MSME, Automotive Safety Research, Inc., 5350 Hollister Avenue, Suite D, Santa Barbara, CA 93111-2326*

After attending this presentation, attendees will understand the effect of seat belt component designs in relation to reducing the ultimate strength of the seat belt webbing.

This presentation will impact the forensic community and/or humanity by demonstrating seat belt designs which are certified pursuant to federal safety standards can fail at force levels below the intended required values.

The injury-mitigating potential of seat belts in motor vehicles is widely accepted. Seat belts must be certified to conform to all applicable federal safety standards. However, in real world loading conditions, it has been observed that some seat belt assembly hardware can reduce the breaking strength of the webbing, apparently to levels below those specified in Federal Motor Vehicle Safety Standard (FMVSS) 209. Two test series were conducted on new and used seat belt assemblies to evaluate the effect of assembly hardware on the breaking strength of seat belt webbing under reasonably anticipated forces due to occupant loading.

The first series contained four tests to evaluate the breaking strength of the webbing alone, without any effect from the latch plate/buckle component. The webbing samples tested were sectioned from the portion of webbing adjacent to the seat belt retractor. Each end of the webbing was held by split drum grips as specified under FMVSS 209. One split drum grip was rigidly anchored to the test bench, while the other grip was accelerated by a hydraulic cylinder to a speed of between approximately 0.91 and 1.22 meters per second.

To investigate the effect of the latch plate design on reducing the breaking strength of the webbing, a second series of tests was performed. The second series contained sixteen tests on sixteen different webbing samples. Three-point anchoring held the seat belt webbing in a "V" shape, with an included angle of approximately 45 degrees, similar to in-vehicle use geometry. One end of the webbing was secured to a hydraulic cylinder using the OEM anchor bracket to which the webbing was sewn. The hydraulic cylinder provided a pelvic restraint webbing pre-load between 227 and 454 kilograms. The end of the upper torso restraint webbing was held by a split drum grip. The split drum grip was accelerated by a hydraulic cylinder to a speed of approximately 1.5 meters per second.

FMVSS 209 specifies that the webbing of a type 2 seat belt assembly shall have a breaking strength of not less than 2,270 kilograms for the pelvic restraint, and not less than 1,810 kilograms for the upper torso restraint. The first test series showed that without stress concentrations induced by the latch plate, webbing failure loads ranged between 1,887 and 2,209 kilograms. When compared to the requirement of FMVSS 209, these loads are somewhat less than the 2,270 kilograms minimum strength for the pelvic restraint.

FMVSS 209 specifies that any webbing cut by the hardware during test shall have a breaking strength of not less than 1,590 kilograms at a cut in webbing of the pelvic restraint, or not less than 1,270 kilograms at a cut in webbing of the upper torso restraint. The second test series demonstrated that the webbing was being cut by the seat belt buckle hardware. The metal edge of the locking latch plate caused stress concentrations and allowed the webbing to rip much like a ruler is used to tear paper. This metal edge is common to both the pelvic and the upper torso restraint. The measured loads at failure range from 827 kilograms to 1,103 kilograms, and are far below those specified by the standard.

The test series demonstrate that the breaking strength of the seat belt webbing material is dramatically reduced by the locking bar of the latch plate assembly. Some latch plate designs reduce the strength of the seat belt system so that they no longer pass the intent of the applicable Federal Motor Vehicle Safety Standards. This reduction in restraint load capability results in a vulnerability to total loss of seat belt restraint in traffic collisions.

Seatbelt, Failure, Testing

C22 Vehicle Steering Caused by Tire Blowout

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The purpose of this presentation is to provide the forensic community with an analysis of an unusual automotive accident in which a hole in a tire sidewall caused an abrupt turning maneuver.

This presentation will impact the forensic community and/or humanity by demonstrating how a seemingly small defect can have very large consequences.

This paper presents an analysis of the effects of a left-front tire blowout on a 2-day-old 1990 Nissan Pathfinder. The subject vehicle suddenly turned left and struck an oncoming vehicle on a narrow two-lane roadway. Immediately after the collision, the responding police officer discovered a hole in the outboard sidewall of the Pathfinder's left front tire. A major issue of the resulting liability case was whether the accident was due to the Nissan driver's error or was caused by the tire failure. This paper will show that the accident was caused by the tire failure. Specifically, the paper will present evidence that:

- The tire's sidewall hole was not caused by the collision;
- If the hole was present before the collision, the force of escaping air from the hole would have caused the vehicle's front wheels to rapidly steer left; and
- The vehicle did steer left.

The subject tire was examined. It was determined that the sidewall hole was created from the inside of the tire and not by some external cutting object. That conclusion made it likely that the hole was created before the collision, by the following logic: Engineering judgment (unquantified) suggests that the probability was near zero that such an unusual tire failure could occur in a collision event during which the driver also performed an inexplicable steer-left maneuver into oncoming traffic. That is, two extremely improbable events did not occur during the same collision. Based on the following analysis of forces that would have been exerted on the tire by escaping air, it was concluded that the hole appeared in the tire's sidewall and caused the rapid left-turn maneuver into oncoming traffic, which caused the subject collision.

When the hole was created in the tire's sidewall, high-pressure air within the tire escaped through the hole into the atmosphere. Maximum flow rate was achieved when air velocity reached the speed of sound, a condition known as choked flow. Choked flow lasted for about one half second after the sidewall rupture, lowering both the source and critical pressures until the flow was no longer choked. During this time of choked flow, the escaping air developed a force perpendicular to the sidewall of the tire that ranged from 22.5 pounds to 11.7 pounds, creating an average thrust force of 17 pounds. At the Pathfinder's estimated speed of 30 mph, the tire (and the hole) made 2.7 rotations during the half second of choked flow.

A total-station surveying instrument was used to measure the spatial relationships among tire footprint, wheel spin axis, and wheel steering axis. As the vehicle moved forward and the left front tire rotated about its spin axis, the force of the escaping air produced a torque on the steering axis. When this force (i.e., the hole) was forward of the wheel's

steering axis it produced a clockwise (CW) torque (as seen from above) which tended to steer the wheel into a right turn. Similarly, when the force from escaping air was aft of the steering axis, it produced a counter-clockwise torque (CCW) tending to steer the wheel into a left turn. On the subject vehicle, the steering axis was just forward of the wheel's spin axis at the axle, so as the jet of air revolved about the axle it spent a greater amount of time behind the steering axis than in front of it, and the torque-arm from hole to steering axis was larger when the hole was behind the steering axis than when the hole was in front of it. Therefore, the CCW (leftward) steering torque produced by the hole lasted longer and was stronger than the CW (rightward) steering torque as the hole traveled one revolution.

The steering motion of the front wheels under these conditions was dependent on the rotational position of the tire when the hole first appeared. For this analysis, it was assumed that the hole appeared when the tire's sidewall was under maximum stress, i.e., when the hole would have been at the six o'clock position.

In order to quantify the left-steer theory, steering torque was calculated and plotted against time for ½ second, starting with the hole at the six o'clock position. The result was the decreasing-amplitude sine wave shown in Figure 1. Integration of the steering torque versus time curve produced the steering impulse curve shown in Figure 2. The impulse varied in amplitude but always increased a left-turn steer angle. Thus, the wheel always turned to the left during the time of choked flow.

There were no data available on the resisting torques of tire footprints to steering rotation. Common driving experience in the era before power steering revealed very large resisting torques at very slow or zero forward speed, and extremely low resisting torques at higher speed. For simplicity, and recognizing the existence of inaccuracies in this method, analysis of vehicle response to sudden discharge of air through the sidewall assumed zero resisting torque at the tire footprint and from the steering linkage.

This paper will supply the following evidence in support of the above argument:

- Photographic evidence demonstrating that the tire failure originated on the inside of the tire's sidewall;
- An explanation of why the hole in the tire's sidewall could not have been created during the collision;
- An analysis of the forces developed by the airflow through the tire sidewall;
- An analysis and graphical results of the steering torque produced by airflow out of the hole in the tire;
- Graphical results of an analysis of estimated steering wheel position versus time; and
- A representation of vehicle behavior in response to the assumptions of the above analyses.

The subject accident caused substantial emotional turmoil (and physical injury) to the driver and passenger of the Pathfinder. The driver was very relieved to learn the above explanation of the accident. He had been blaming himself for over 10 years for the collision and its resulting harm, even though he knew that he had not steered left into oncoming traffic.

Steering, Tire Blowout, Accident Reconstruction

C23 Trailer Loading Ramp Defects Cause Scissors Lift to Tip When Unloading

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After attending this presentation, attendees will understand an application of analytical methods and simulation techniques in testing hypotheses and demonstrating a physical event where physical tests and reenactments are not feasible. Key frames can be used to demonstrate a sequence of events in a stop-action series of still images even when a scientific animation cannot be produced.

This presentation will impact the forensic community and/or humanity by demonstrating analytical methods and simulation techniques which are useful in understanding phenomena and demonstrating relevant events. They are also effective in testing hypotheses when physical tests or reenactments are not feasible.

Background: A self-employed drywall applicator rented a narrow slab scissors lift for a commercial building job on which he was working. When his need for the scissors lift was finished, he borrowed a flat deck trailer and pickup truck from his business partner to return the scissors lift to the rental dealership. He loaded the scissors lift onto the trailer and drove to the rental dealer accompanied by his friend as his passenger. When he arrived at his destination, he parked the pickup and trailer on the asphalt paved street in front of the rental dealer's establishment. He manually placed the portable loading ramps into position at the rear of the trailer, climbed to the operator's station of the scissors lift, and backed the scissors lift from the trailer onto the ramps. His friend was standing on the street behind the trailer near the left side ramp helping to guide him during this maneuver. While he was backing down the ramps, the left ramp dislodged from its trailer support and the scissors lift tipped onto its left side. He managed to jump from the operator's station to safety. His friend's right foot was pinned and badly crushed between the left side of the scissors lift and the street.

The subject trailer, loading ramps, and pickup truck were inspected, measured, and photographed at the rural residence of their owner. The subject scissors lift was inspected, measured, and photographed at the rental dealership. The incident scene was inspected, measured, and photographed. Since there was less than full cooperation from the owners of the equipment, the various pieces of equipment were not brought together at the incident site. It was judged to be infeasible, and probably too dangerous, to perform a physical reenactment of the incident.

Analytical methods and simulation techniques provide an alternative to physical testing for understanding and demonstrating relevant events leading to tip over. Several key frame "building blocks" used in constructing animations can be derived and demonstrated. Since the elapsed times between these key frames cannot be accurately and reliably determined from the known data, scientific animations cannot be produced to demonstrate motions of the equipment. However, these key frames can be used to demonstrate sequences of events in a stop-action series of still images format.

AUTOCAD 2000 was used to generate 3-dimensional scale drawings and images of relevant features of the equipment involved. These images were combined adhering to applicable physical constraints. Early during the trailer and ramp inspection, it was noted that the tops of the ramps rest in a shallow slot on the rear of the trailer and are held in place by gravity with no locking device. The mechanism of dislodgement became apparent only after detailed engineering analyses as demonstrated by the key frames.

The bottom ends of the ramps are shaped such that the ground support point is actually 6 ½ inches forward from the rear edge of the ramp platform. When a sufficiently heavy load is placed on the rear end of the ramp, this permits the ramp to pivot lifting the front end of the ramp from its support slot on the trailer. A small horizontal movement of the ramp front end will then cause the ramp to miss its slot and fall to the ground when the load is removed. The subject scissors lift wheelbase is 12 ½ inches longer than the length of the ramps; this was a significant feature in causing dislodgement of the ramp during unloading.

Loading Ramp, Design Defect, Tipping Stability

C24 Modern Equipment Control Affects Electrocution Risk

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After attending this presentation, attendees will be able to identify some work place electrical hazards, to expose the elements of electrocution, and provide a comparison of SCR switching and rheostat control to an electrocution.

This presentation will impact the forensic community and/or humanity by demonstrating how to identify some electrical hazards in the workplace, and how the use of modern electrical design techniques may contribute to these hazards.

Proposition/Hypothesis: A fatal industrial accident involving a hot-wire foam cutter indicates a potential increase in electrocution hazard resulting from the use of modern switched-mode techniques in industrial control design.

A salesperson at a foamed plastic plant was using a hot wire cutter to cut to size a stack of three 2" thick panels of structural foamed plastic. It was an extra order which the person was performing alone on a very hot night. He had been working for 17 hours when he was found positioned as though he had tumbled awkwardly into the frame of the cutting table. The coroner reported a cauterized lateral burn on the decedent's face, with charring on the interior of lip and a superficial burn on the thigh corresponding to the frame height. Cause of death was noted as positional asphyxia.

The knob controlling cutting wire heat was found rotated to the zero position; the power switch was on, but the switches controlling cutting wire carriage movement were off.

With the controls in this position, the potential from the cutting wires to ground was measured to be 120 v.

It was surmised that the decedent was sighting the cutting wires to position the work piece when he contacted the topmost of three cutting wires with his sweaty face. This sent an electric current from his head though his neck and torso to his right thigh.

Measurement of the electrical resistance of the body of other subjects demonstrated that an electrical impulse sufficient to affect the heart would have been generated by that contact.

Muscles are electrochemical in nature and, as such, produce characteristic electrical waveforms but can also be influenced and controlled by electrical signals. Muscles and nerves generally reside in a polarized state, poised for action. Once a muscle or a nerve is activated it "depolarizes" thus transmitting the intended signal (for a nerve) or performing a physical contraction (for a muscle). When they recover, by redistributing metallic ions in the body-fluid electrolytes, they are said to repolarize.

Electricity follows the path of least resistance. In living tissue the paths of least resistance are the nervous system, the lymphatic system, and the circulatory system. With regard to the heart and the cardiac cycle, there is significant sensitivity at one particular place in the cardiac cycle referred to as the T wave. The normal cardiac cycle exhibits an atrial depolarization demarking the contraction of the right atrium; this is identified as the P wave. After a variable 125-300 millisecond delay, another depolarization referred to as the QRS-complex, demarks the contraction of the ventricles of the heart. Following the QRS complex by 50 to 150 milliseconds is the T wave, which demarks the repolarization of the cardiac muscle.

Modern defibrillator technology uses IGBT, Insulated Gate Bipolar Transistor, similar to the SCRs used in industrial control, in switched-mode controlled circuitry to produce a stream of pulses between 50 and 60 Hertz to perform cardiac conversion. The term "conversion" in the context of cardiology refers to converting a chaotic or fibrillating rhythm to a regular pacing rhythm. The same stream of pulses can convert a regular cardiac rhythm into fibrillation or from fibrillation to a regular rhythm.

Modern semiconductor components have increased in performance such that with modern pulse-width and frequency-modulation control techniques, the use of rheostats, iron core inductors and transformers which limit the controlled circuit voltage is being supplanted. Such techniques are good in that they decrease the size, weight, and cost of industrial controls; however, the control waveforms bear a significant resemblance to the waveforms intentionally used by cardiac defibrillators.

In conclusion, there is a particular electrical hazard present in the modern industrial environment due to the use of the modern electronic design techniques afforded by improvements in silicon devices.

Other factors in this case are (1) failure to turn off the machine's main switch; (2) two red warning lights were burned out; (3) required warning signs were absent or obliterated; (4) decedent was doing work he was told not to do; (5) decedent was probably affected by the long hours and high heat; (6) decedent was not a regular operator of the machine.

Electrocution, Cardiac, Switched-Mode Control

C25 Electrical Accident, Sabotage, Homicide, or Death by Other Means?

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At this presentation, a case will be presented in which electrocution was speculated to be the possible manner of death. Investigation will reveal whether it was an electrical accident, sabotage, homicide, or death by some other means.

When the Olympics came to Atlanta in the summer of 1996, the city was in a "feel-good frenzy" as a writer in *The Atlanta Journal Constitution* put it. Hundreds of thousands of people, both locals and out-of-towners, were enjoying the "high-octane mixture of athletic excellence and world-class partying."

The Olympic games where held at Centennial Olympic Park, which was constructed specifically for the Olympics but remains a permanent structure of downtown Atlanta.

On Friday, July 26, the ninth day of the 1996 Summer Games, a pipe bomb placed near the main stage in the park exploded, injuring more than 100 people, many of them permanently, and killed Alice Hawthorne, a mother who had traveled to Atlanta with her daughter to see the Olympics. The fatal bombing in Atlanta was a terrorist attack aimed at thousands of innocent persons gathered at the Olympic Park. Eric Rudolph has been charged with the bombing.

He is also accused of the January, 1997, double bombing outside a suburban Atlanta clinic that performed abortions, the double bombing of an Atlanta lesbian nightclub a month later, and the January, 1998, bombing of a Birmingham, Alabama, clinic that performs abortions.

On April 18, 2000, an FBI Agent was suspected to have been fatality electrocuted by means of a sabotaged appliance in his cabin residence in Andrews, North Carolina by Eric Rudolph. The agent was on assignment in searching for Rudolph who is believed to have gone into hiding after the last bombing in the 517,000-acre Nantahala National Forest (also known as the Smoky Mountains) in western North Carolina.

The FBI engaged this forensic engineer to do an investigation to determine if an electric cooking stove or an electric wall heater where the deceased was found sitting against was the cause of a possible electrocution.

Upon examination of the scene by the writer, it was noted that the room and all objects had been black-dusted for fingerprints. The body had been removed as well as the television set, bed covering, clothes and all personal effects.

Visual inspection revealed an older style golden colored four-element cooking stove (with oven) unplugged and moved away from the wall between the bed and kitchen counter wall. The stove had previously been up against the wall and within approximately 1 ½ inches from the

edge of a built-in electric radiant wall heater. Examination of the stove found that all five switches were in the "off" position. Dust and cobwebs were found all over the rear of the stove suggesting no previous recent tampering with the stovetop. The stove was grounded and connected to a three-prong plug without a ground contrary to the manufacturers instructions. While this is potentially hazardous, it was not a factor in this case. One wire from one heating element was found broken off. The rest of the stove remained unremarkable.

The wall-mounted air heater was grounded via a grounding stud. Both spiral resistance-heating elements functioned and were unremarkable. The thermostat control was intermittent and clicks were heard when the control knob was pushed in. The rest of the heater remained unremarkable. The circuit breaker supplying the stove and the heater was also unremarkable.

The local medical examiner had previously hired a local electrician to measure for voltages between the stove and the heater. The electrician measured 36-70 Volts ac. The victim was in contact with the stove and the heater. The medical examiner's investigation upon autopsy revealed that the victim had red eyes and had almost bitten through his tongue about ½ inch from its tip. The head and shoulders were burnt. There was rectal defecation at the time of death. The previous day the victim expressed great discomfort in breathing in a somewhat horizontal position in a dentist chair. The victim's heart was 700 g versus 350-375 g normal weight. He had a "rotten" cold and enlarged lymph nodes. Above all, the victim had been consuming "Ma Huang" an Oriental herbal remedy that contains Ephedra for weight loss.[1]

It was determined by this forensic engineer by use of an electronic equivalent (CSA-STD) of a human impedance model that the voltage between the stove and the heater was non-lethal, non-shocking and was due to stray capacitive leakage currents in the insignificant micro amp range. There was no defect in the stove or heater that would produce shocking or lethal currents to a human body. As well, no evidence of willful tampering or suspicious non-accidental conditions was found.

The coroner's office later revealed that the probable cause of death was due to the effect of "Ma Huang" on previous medical conditions. This was not an electrical homicide.

Eric Rudolph who had been on the FBI's Ten Most Wanted List at the time of this incident was recently captured on May 31, 2003, in western North Carolina.

Reference:

[1] U.S. Food & Drug Administration and National Council for Agricultural Health Fraud.

Electrocution, Homicide, Accident

C26 Latent Failures of Type NM Wiring After Ground Energization

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After attending this presentation, attendees will be able to describe the changes in NM leakage characteristics following destructive ground energization that can lead to both immediate and latent fire scenarios.

This presentation will impact the forensic community and/or humanity by demonstrating that catastrophic failure can result from energized type NM cables well after the insult actually occurred.

Article 240 of the NEC generally provides for overcurrent protection of conductors. Overcurrent protection is usually provided by a Molded Case Circuit Breaker (MCCB) meeting the requirements of NEMA AB-1. The underlying criterion for overcurrent protection is that the protective device will always operate before energy dissipated in the wire by resistive heating will damage the wire. The inverse time-current relationship by which MCCBs operate form the usual basis for this prophylactic scheme. While Article 240 does provide protection for the normally operating facility, it is of no use when energization of neutrals or grounds occur. In particular, there is no protection during the scenarios commonly referred to as "floating neutral" and "energized ground" occur. In these scenarios, current flow is unbounded because there is not the usual corresponding increase in hot lead current.

We describe here several fires which have occurred as a result of both the floating neutral and energized ground scenario. Research is then outlined in which type NM cables were intentionally damaged by injecting onto them ground fault currents for varied lengths of time. Temperature rises on the cables were measured by both conventional thermocouple techniques and by thermography. As part of this testing, we measured changes in leakage. By applying AC power across the hot and neutral leads, and then measuring leakage current in vector form (Real + Imaginary), we were able to plot changes in both capacitance and resistive current flows. Instrumentation for our labwork made use of the IEEE488 bus, and a Vitrek dielectric analyzer. This vector analysis is shown to be superior to conventional megger and hipot testing in terms of its ability to predict failures while not violating Kelvin criterion. Field measurement techniques used by maintenance workers during damage assessment never attain the precision offered by vector analysis.

As a result of the type NM testing and from empirical data, we are able to demonstrate that catastrophic failure and arcing ignition can result from energized type NM cables well after the insult has occurred. In one scenario, a fire broke out within 3 weeks of the inducing of current onto the ground. We describe the analytical tools used to show causation, as well as the evidentiary items that should be searched for when examining a structure for this type of fault. The usual source of energization in these fires results when a neutral is accidentally pulled, or when a utility company (during maintenance procedures) injects current onto the ground lead. The most sobering part of this research is that damaged cables can bring about ignition well after the injury has occurred, and well after any open and obvious defects have been repaired.

Fire, Floating Neutral, Dielectric Breakdown

C27 Swimming Pool Electrocutions Revisited

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The goal of this presentation is to attempt to verify reported experiments as outlined in a paper titled, "Point Source Electrocution in Swimming Pools and Spas," presented at the 2002 AAFS meeting. The tests reported in the paper could not be duplicated and did not conform to theoretical results.

This presentation will impact the forensic community and/or humanity by demonstrating an understanding by which forensic engineers evaluate the nature of swimming pool electrocutions.

Since 1990, the U.S. Consumer Product Safety Commission (CPSC) recorded sixty deaths and fifty electrical shock incidents in or around swimming pools owing to defective or improperly installed electrical equipment. In most of these cases, GFCI devices were not included, and the predominating offending electrical appliances were 120 Volt AC pool lighting fixtures.

In either the home or industrial environment, the presence of water clearly serves to augment electrical shock and electrocution risk. The risk is produced by the reduction in human contact resistance brought about by improved contact coupling between the victim and the electrical source via the water. The National Institute for Occupational Safety and Health (NIOSH) observes that the presence of moisture from environmental conditions such as standing water, wet clothing, high humidity, or perspiration, increases the possibility of a low voltage elec-

trocution.[1] However, despite a large amount of literature and research describing shock risk and the water environment, there is still much misconception among electrical engineers regarding the mechanics of shock in damp or waterwet environments.

Typically, the water used in swimming pools, hot tubs, or spas are not ionic fluids and are thus considered poor conductors. As such, it is not expected to see a substantial current flow between two poles immersed in pool water, as the water provides a relatively high resistance path.

Mathematically, the field produced by a live 120 VAC conductor immersed in a swimming pool is a boundary value problem and is best described though Poisson's equation. The boundary value problem solution describes the field conditions. This equation is derived from Maxwell's Divergence equation. Maxwell's Divergence equation in point form is derived by the application of Gauss' Law to an infinitesimal volume and is stated as:

Equation 1

$$\nabla \bullet \vec{D} = \rho$$

where D = flux density (coulombs/m²)
ρ = charge density (coulombs/m³)

Substituting into equation (1) for the electric field intensity **E** and electric potential V, we obtain Poisson's equation

Equation 2

$$\nabla^2 V = -\frac{\rho}{\varepsilon}$$

where ε = permitivity of the medium (Farads/m)

In free space, ρ = 0 so that equation (2) reduces to Laplace's equation. The nature of the flow of current through a material determines whether the material is a dielectric, conductor, or semiconductor. In liquids, both positive and negative charges are free to migrate. Generally, the conductivity of a liquid is given by

Equation 3

$$\sigma = \rho_- \mu_- + \rho_+ \mu_+$$

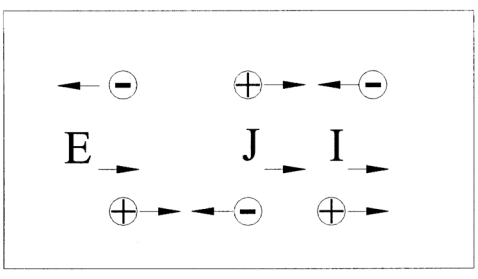
where ρ_- = density of negatively charged particles (coulombs/m³)
μ_- = mobility of negatively charged particles (m²/v•s)
+ = positively charged density and mobility

The first term represents the contribution to the conductivity from negatively charged particles moving opposite to the **E** field and the second term represents the contribution from positively charged particles moving with the **E** field.

According to Kraus[2] water has the following conductivities:

Distilled Water	**$\sigma \approx 10^{-4}$**	**mhos/m**	**Insulator**
Fresh Water	**$\sigma \approx 10^{-2}$**	**mhos/m**	**Poor Conductor**
Sea Water	**$\sigma \approx 4$**	**mhos/m**	**Conductor**

The conductivity of a liquid electrolyte is represented in the diagram below and explains the movement of charges and the relative direction of the fields with respect to the movements of the charges.



Swimming pool water has few electrolytes and is therefore at best an insulator or a poor insulator. Measurements of current flow through pool water should not indicate appeciable amounts. Ground fault circuit interrupters (GCFI) have a threshold current of five milliamperes. Currents above this value are recognized to pose a danger to humans in that they may produce a disruptive effect on the equivalent electric dipole of the heart. This effect can produce death.

The field configuration produced by a live conductor in a swimming pool is dependent on its boundaries. This type of problem may be solved by the application of Poisson's equation, graphically, experimentally, or with an analog or digital computer. Experimental tests were conducted in a 20-foot by 25-foot swimming pool standardized at neutral pH, requisite chlorine level, and room temperature. A voltage source was supplied by immersion of a two conductor energized extension cord near the sutface at a location near the submersible pool light fixture to simulate a failed and hazardous ixture. A 5-foot by 5-foot rectangular coordinate grid was formed. The grid provides voltages and current measurement distance targets to help explain a field map of the energy distribution in the x-y plane of the pool. A human model was simulated in accordance with IEC 479 and UL data to approximate a nominal human surface area. The model, constructed from a twenty-four guage galvanized steel sheet, buoyancy foam, insulators and resistors, was positioned at the various grid nodes while voltage and current measurements were recorded. The findings of the test show that for a substantive shock risk and injury to occur to an immersed human subject, certain physical contact must be made with an energized conductor, regardless of conductor immersion, conductor surface area, or water chemistry, and the water container must present a definite ground. The findings of this test could not reproduce the conclusions reached in a previous AAFS paper and show substantive flaws in the reasoning and the conclusions reached in that paper.

The voltage measurements along the pool grid were essentially insignificant until the probe was very near the source. Similarly, current measurements were in the microampere range under these conditions. Essentially in this case, the tests indicate that physical contact with the source and grounding of the individual is necessary to produce an electrical shock incident. The electric field produced in a water environment is dependent on the energized surface area, the water chemistry, and the characteristics of the ground.

References:

1. U.S. Department of Health and Human Services, Public Haelth Service, Centers for Disease and Prevention, National Institute for Occupational Safety and Health (NIOSH) Worker Deaths By Electrocution - A Summary of NIOSH Surveillance and Investigative Fingings, p.7.

2. Krauss, John D., Electromagnetics, Third Edition, McGraw-Hill, p 123.

Electric Field Intensity, Conductor, Poisson's Equation

C28 Safety Code Violations, Corrections, and Replacements

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The goals of this research project are to illustrate electrical code violations, to demonstrate that code violations do not cause immediate damage and to discuss repair or replacement of violating equipment.

This presentation will impact the forensic science community and/or humanity by educating them about electrical hazards, safety, damage and repair.

A video presentation of an electrical fire scene will be utilized to illustrate electrical safety code violations. The damage caused by the violations will be shown and the repair of the electrical system will be discussed.

One evening the resident of a very fine home in a very exclusive neighborhood returned home. The electric gate at the entrance to the property worked okay. The driveway and property was lit as usual in the evening. However, the resident noticed an unusual glow in the front windows of the house's piano room. Upon entering the house, smoke was discovered but there was no alarm, since the house did not have smoke detectors. The fire department was called to extinguish the fire. Upon arrival the fire department found the fire emanating from electrical wiring within the walls of the building. Normally, the fire department turns off electrical power to a burning building before attacking the fire because it presents a shock and electrocution hazard for the firemen. The contaminants in water are good conductors of electricity and fire hydrants are good ground conductors. This can result in serious injury to firemen. However, the firemen had difficulty turning off the electrical power in this burning building. After turning off the building's main circuit breaker, their thermal imaging equipment indicated that wiring in the walls and beneath the building was still overheating and energized. Subsequently, the fire department turned off the electric power at the building's remote electric meter box and extinguished the fire. The fire department informed the residents of the fire building that the entire electrical system of their home would probably have to be replaced.

The remote electric meter box was surrounded by poison oak. It was corroded with vegetation and insects were found inside. Its cover was not closed and its neutral was not grounded as required by the National Electrical Code. Conductors were found attached to the two pole 200 ampere circuit breaker in the distribution section of the meter box, which fed into the meter box. These conductors were rated at 40 amperes and they would not be properly protected by a 200 ampere circuit breaker. In addition, utility companies do not permit customers to pull conductors through a meter box. The conductors went to a distribution box mounted on the left side of the meter box. However, the conductors could have been used to bypass the meter and steal electricity. These conductors should have been noticed by the utility meter reader and eliminated prior to the fire. Whoever installed the conductors violated the National Electrical Safety Code by working in close proximity to energized electrical conductors. The illegal box attached to the left side of the meter box was corroded with vegetation and had insects inside. It fed electrical power to a duplex receptacle mounted on the support for the meter box. The duplex receptacle previously supplied power to outside wiring. Evidence of burning was found on the conduit to the receptacle. Apparently, the outside wiring powered by the receptacle had overheated and caused a previous fire. Afterwards, the outside wiring was powered by splicing into the main service cable to the building in an underground splice box. The splice box was not sealed to keep the elements away from the splices or the conductors, which were not rated for outdoor or underground use. A number 12 AWG copper wire, which is rated at 20 amperes by the National Electrical Code, was found spliced directly to an aluminum cable rated at 200 amperes. The 200 ampere circuit breaker in the meter box would not prevent the 20 ampere wiring from overheating when current above 20 amperes passed through it. The 200 ampere circuit breaker in the meter box was the only overcurrent protection in the circuit. This explains why the house circuit breakers did not de-energize the outdoor wiring. In addition, it is a violation of the National Electrical Code to splice copper conductors directly to aluminum conductors. The dissimilar metals react and cause connection problems. The outdoor splices were made approximately four years before they failed and caused a problem. A neutral conductor from the house panelboard had been brought out to the splice hole. When the spliced conductors failed, they energized the neutral conductor into the house. The energized neutral conductor in the house eventually found a path to ground in a receptacle in the house. The amount of current in the conductor/wire was only limited by the resistance of the wire and its connections. Therefore, the current exceeded the rating of the wire. The overcurrent caused the wire to overheat and ignite combustible materials located near it. Heat damage was also found in the fire building's main panelboard where the overheated neutral conductor/wire was located. This panelboard contained many electrical code violations. It was not labeled, properly grounded or wired. A subpanel in the building was also defective. Wallcovering material had been sprayed into it while its cover was off. The material would affect the connections in the panelboard and the response of the circuit breakers to overcurrent. Bad connections will overheat and result in electrical breakdown and failure. Non-responsive circuit breakers will permit overloaded electrical circuits to overheat and cause fires.

The repairs to the electrical system involved eliminating the code violations. The wiring through the meter box was removed. The distribution section of the meter box was cleaned out and properly grounded. The outdoor splice box was replaced with a sealed box rated for outdoor use. Outdoor wiring was replaced with wiring rated for outdoor use. The main panelboard in the house was replaced, correctly wired and grounded. The subpanel in the house was replaced.

Code Violations, Electrical Damage, Electrical Repair

C29 Some Comments on the Distinctions Between Experts

David G. Howitt, PhD, University of California at Davis, Department of Chemical Engineering and Materials Science, Davis, CA 95616*

The goals of this research project are to provide some comment on the alternative roles of an expert witness.

This presentation will impact the forensic community and/or humanity by providing information about the role of the expert witness.

Anyone who has been asked the question as to the proportion of work they do for plaintiffs compared to defense attorneys has probably given some thought to this problem of "Seeing Both Sides of the Coin" and wondered if it truly makes any difference. The ways in which I have personally found them to differ are in the nature of the assignment and the level of resources that are brought to the case. Typically as a plaintiffs expert one is trying to find out exactly what happened whereas as an expert for the defense it is usually a case of simply defending against the hypothesis. This is not always true because some defense attorneys like to present an alternative scenario to a jury but in general the approaches are rather different, the expert for the plaintiff is a detective and the expert for the defense is a critic. Doing both is certainly more interesting than being confined to one, but the task of the plaintiffs expert is invariably more difficult and in most cases more rewarding intellectually. The advantage to being a defense expert comes from the fact that it is much easier to be critical than creative which brings us to the subject of resources since despite this advantage there is invariably more time invested by experts in the defense of a case than by the plaintiff. Indeed things are usually on a much less grandiose scale when working for the plaintiff and this probably has more to do with the distinctions in the way subrogation firms and defense attorneys conduct business than legal strategy. The team concept is generally more common as a defense strategy but is used by both, particularly when multiple defendants or plaintiffs are involved and they pool their resources. Even with large insurance companies as a plaintiff there is a tendency to stress frugality presumably because the good name of the organization is not at stake. Also when there are multiple experts they tend to be brought in at different times in plaintiff cases but all at once in the defense strategy, which creates a different type of working environment. Indeed I think it is fair to conclude that the work of the plaintiff's expert is not only inherently more difficult but it is also performed under more difficult circumstances.

A final question that one might address is whether there is any difference in the reliability of experts hired by plaintiffs as opposed to defendants. We have all probably come across some pretty strange theories in the course of civil litigation, which raises some serious questions about the professional competency of some experts, but the ones I have

come across have been about equally divided between the two camps. Some examples that I will be happy to share include the spontaneous separation of gases and the explosive defoliation of chickens but there are also some examples where the scientific distinctions are so nice that one could not confidently expect to be able to satisfactorily explain them to a jury although they are nonetheless still very wrong. From my own experience. However, I have generally found that about half of the cases brought to me by plaintiffs have merit and this proportion is unchanged in the cases that are also brought to me by defense attorneys. How this reflects on the difference between being an expert for the Plaintiff and opposed to the Defense is probably worthy of some discussion.

Expert, Plaintiff, Defense

C30 Arson/Murder - Expert Witnesses - Biased Opinions

Marshall L. Smyth, BS, Smyth Consulting Engineering, 809 N Shepherd Hills, Tucson, AZ 85710*

After attending this presentation, attendees will understand that the modification of current sex offender program protocols for correctional populations to meet the growing number of sex offenders being identified in psychiatric centers. Enhanced program development centers can better serve this population by providing an effective treatment protocol; better serve the courts by proving more informed opinions regarding the risk of re-offending; and better serve the community by safeguarding the inappropriate discharge of individuals who are likely to re-offend.

This presentation will impact the forensic community and/or humanity by demonstrating the severe consequences of prosecution fire investigator overreach in determining the causes of two high profile Arson/Murder cases in which the author testified as a defense expert witness.

These two Arson/Murder cases involved different defendants (John Henry Knapp in Arizona and Ernest Ray Willis in Texas), and widely separated times. Each residence involved in the fire experienced Flashover and Post Flashover burning in rooms of the residence. Nearly all of the burnable materials in the rooms of origin were destroyed during the fires.

The evidence and representative fire tests performed by the defense after the initial trials and convictions indicate the prosecution's fire investigators misinterpreted the burn patterns and misidentified the cause of each fire.

These experiences indicate that the misinterpretation of floor and low level burn patterns resulted from one or a combination of the following:

1. Excessive freedom allowed experts in their testimony, now being curtailed by the effects of:
   a. Federal Rule of Evidence 702, *Daubert v. Merrill-Dow Pharmaceuticals* case, Benfield v. Michigan Millers Mutual Insurance Company case, and perhaps others
   b. The advent of the National Fire Protection Association's *"NFPA 921 Guide for Fire and Explosion Investigations"* a science based, consensus derived, authoritative guide, first issued in 1992 and now undergoing its fourth update
2. Failure to perform representative corroborative tests or analyses
3. Failure to appreciate the dynamics of Flashover and Post Flashover combustion
4. A lack of understanding of the impact of burning floor carpet, carpet pad, combustible wall paneling, celotex ceiling tile and furniture upholstery on the development of a room fire
5. Lack of engineering/scientific training and experience
6. Arrogance
7. The halo effect of being a member of the "Good Guys" team ordained to rid the world of the "Bad Guys"
8. The pressure to convict applied by prosecutors

Two individuals were wrongly convicted of arson and murder. Both were sentenced to death. Both have survived by the skins of their teeth because of outstanding and very expensive pro bono efforts, in the John Henry Knapp case by Attorneys Larry A. Hammond and Colin F. Campbell of the law firm of Meyer, Hendricks, Victor, Osborn & Maledon, Phoenix, Arizona, and in the Ernest Ray Willis case by James S. Blank of the law firm of Latham & Watkins, New York, New York.

John Knapp was finally freed after three trials, many appeals, and a post conviction evidentiary hearing.

Ernest Willis is still on death row after one trial, many appeals and a post conviction evidentiary hearing. His case is being reviewed by the Federal Western District Court of Texas, Pecos Division.

Fire Investigation, Expert Testimony, Biased Opinions

C31 Effects of Analytical Variability for Calibrated vs. Uncalibrated PAH on Hydrocarbon Source Recognition Methods

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After attending this presentation, attendees will learn of implicit limitations of hydrocarbon analytical data used for identifying hydrocarbon source contributions when applied to determining natural resource damage assessment following accidental release of petroleum hydrocarbons.

This presentation will impact the forensic community and/or humanity by demonstrating that the limitations inherent in the usual GCMS method used for analyzing environmental samples for evidence of contamination by petroleum products are rarely recognized by experts who interpret these data. The analytical reliability of the alkyl-substituted polycyclic aromatic hydrocarbons (PAH), which contain most of the information for identifying hydrocarbon sources within the PAH class of hydrocarbons, is substantially lower than for the parent homologues, but these data are usually interpreted on the implicit assumption of equal reliability. This presentation will demonstrate how this lower reliability constrains valid interpretations of these data, which should help practitioners to avoid invalid conclusions regarding hydrocarbon source contributions in natural resource or property damage assessments from chronic or catastrophic releases of petroleum products.

Hydrocarbon source identification for samples contaminated by petroleum products usually relies on data produced by gas-chromatograph/mass spectrometer (GCMS) systems. A single GCMS analysis produces a wealth of data, and may include results for dozens of hydrocarbon analytes in each of three classes: the polycyclic aromatic hydrocarbons (PAH); the normal and branched alkanes; and the alicyclic hydrocarbons, or biomarkers. Analysis of the biomarkers is often definitive, because these compounds are environmentally persistent and are characteristic of the geologic age and conditions during formation of the petroleum products in question. However, the concentrations of biomarkers in crude oil is low compared with the PAH or other alkanes, and they may be absent entirely from the more volatile fractions of refined petroleum products. This limits the utility of the biomarkers for hydrocarbon source resolution to environmental samples that are heavily polluted by crude oil or its less volatile refined products, such as the bunker oils. In other cases, useful information for source identification may be limited to the PAH and the other alkanes, and these may be altered by weathering processes following introduction into the environment.

Weathering processes often lead to rapid degradation of the alkanes, especially the normal alkanes, while alteration of PAH concentrations is usually slower and more predictable. Hence the PAH are often the primary focus of efforts to deduce hydrocarbon source contributions in samples that are not heavily contaminated. Analytically, the

quality of PAH results may distinguished according to the availability and use of authentic calibration standards. These standards are available for many unsubstituted and for some alkyl-substituted PAH, permitting fairly rigorous identification and measurement of these PAH in environmental samples. Unfortunately, the most abundant and persistent PAH in crude and refined oils are the more substituted PAH, which comprise multiple isomers for which authentic calibration standards are rarely available. The identification, measurement and detection limits of these alkyl-substituted PAH is therefore less certain, and their measurement usually relies on response factors that are assumed to be identical to either the un-substituted parent PAH or the most similar alkyl-substituted PAH for which a calibration standard is available. Actual detection limits for these uncalibrated alkyl-substituted PAH are necessarily higher than those of corresponding un-substituted homologues, because the analytical signal is spread among numbers of isomers that increase sharply with increasing alkyl substitution. The limitations imposed by these considerations on efforts to deduce hydrocarbon source contributions to contaminated environmental samples are largely unknown.

In this presentation I compare the variability of calibrated and uncalibrated PAH in a large series of reference samples for the Exxon Valdez oil spill, to evaluate how differences in data quality between calibrated and un-calibrated PAH affect methods for assessing hydrocarbon source contributions. The reference samples were all analyzed by the same method at the same laboratory. Coefficients of variation for the calibrated PAH are typically 10% - 15% for the calibrated PAH, increasing to as much as 50% for the most substituted PAH. This increasing variability constrains the resolution of both analyte ratio methods and of multivariate statistical methods for deducing hydrocarbon source contributions. These limitations are illustrated by comparison with results for hydrocarbons in benthic and riparian sediments from the northeast Gulf of Alaska (GOA). The hydrocarbons in these GOA sediments may be from a collection of closely related sources that preclude weathering alterations following introduction to the environment, and so provide a rigorous test of hydrocarbon source discrimination methods. Analyte ratio results from the reference sample set are compared directly with those from the GOA sediments. Comparison of results for a multivariate statistical approach, which makes much fuller use of the available information than do analyte ratio methods, is accomplished by combining the Aitchison metric applied to hydrocarbon concentration pattern differences among samples, with hierarchical cluster analysis. Results of these comparisons provide an example of the inadequacy of these approaches (especially the ratio methods) to detect hydrocarbon source contribution differences that actually exist in the field, when these sources are closely related geologically and the hydrocarbon analytes are limited to the PAH.

Hydrocarbon Source Identification, Polycyclic Aromatic Hydrocarbon, Oil Spill

C32 Principal Component Analysis: Mathematics and Voodoo

Willem A. Schreuder, PhD, Principia Mathematica, 405 Urban Street, Suite 305, Lakewood, CO 80228*

After attending this presentation, attendees will understand the mathematical principles behind principal component analysis (PCA), where it is appropriate to use PCA and how to debunk misuses of PCA.

This presentation will impact the forensic community and/or humanity by demonstrating the proper application of PCA and by debunking abuse of PCA.

Principal Component Analysis (PCA) is one of a number of methods that can be used to reduce the dimensionality of data. The purpose for reducing the dimensionality by PCA is to determine vectors of maximum variation in the data, so as to better distinguish between data.

PCA has been used in the environmental field to distinguish compounds of different origins. However, as with many statistical techniques, the practitioner is often poorly familiar with the technique and relies on a computer program to perform the analysis. The purpose of this paper is to describe the mathematics behind the technique, what it is that the computer programs do, and how to interpret the results.

A case study will be used to illustrate the proper and improper use of PCA.

Principal, Component, Analysis

C33 A Baseline Study of Measurement Uncertainty for Peak Ratios of Isoprenoids and PAHs

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After attending this presentation, attendees will understand that when using ratios to identify or differentiate between oils and fuel types it is necessary to take into account the variability or experimental error inherent in the methodology(ies) used. Measured and potential error terms for the use of peak ratios for identification and differentiation of fuels will be illustrated and discussed.

The members of the forensic community attending will be more wary of accepting at face value, ratio comparisons for the purposes of identifying and differentiating between contaminating hydrocarbon fuels. We hope to inform participants that there are questions of variability and experimental error that need to be addressed when interpreting the data.

Several methods for the identification of petroleum products have been proposed and adopted by professional organizations recently [ASTM 5739-00, Nordtest Method NT CHEM 001]. Peer-reviewed journals have published papers describing similar methods for characterizing and differentiating oil sources. These methods generally compare the relative abundances of two or more compounds, which are assumed to be distinctive and characteristic of the samples: hereinafter this approach will be referred to as comparing “peak ratios.” Peak ratio methods have some acceptance within the scientific community, and the results of peak ratio analyses have been used successfully in litigation. However, no study has been presented which quantifies the uncertainty of the measurements, and there are no criteria to compare peak ratios within any of these methods. The fundamental questions, “How much variation will be found in the peak ratios for the same material?” and “How much difference must exist between peak ratios to distinguish different materials?” have not been addressed.

This presentation will describe our investigation of the uncertainty of peak ratio measurements for isoprenoids (nor-pristane, pristane, phytane), and for polycyclic aromatic hydrocarbons (PAHs) and their alkylated homologues. Isoprenoids, a group of branched alkanes structurally based on isoprene, do not biodegrade readily in the environment and are therefore often used to distinguish middle distillate fuels (diesel, heating oil, fuel oil). AHs are cyclic compounds based on conjoined benzene rings. It is generally assumed that the larger PAHs (four or more rings) are highly resistant to degradation in the environment. PAH patterns which can be compared as a series of ratios have been used to distinguish between samples of different oil sources.

Ratios are usually calculated based on peak heights or areas from a gas chromatogram, generally using a flame ionization detector (GC-FID) for the isoprenoids, and a mass spectrometer (GC-MS) for the PAHs. All instrumental analyses are subject to experimental error. Analyzing the same sample or sample extract multiple times on the same instrument will produce a range of results. The range of results, and hence the uncertainty of the peak ratio measurements, increases as other variables are introduced to the analysis, e.g., sample extraction, sample

concentration, instrumental method, data analysis methods, etc. This investigation evaluated the uncertainty of peak ratios with respect to concentration, instrumental methods, and data analysis methods for GC-FID and GC-MS analyses.

The GC-FID investigation evaluated the measurement uncertainty for the peak ratios of the isoprenoids nor-pristane, pristane, and phytane in a regular automotive diesel fuel (Texaco). The Texaco fuel was used as a reference material in our laboratory for three years. It was analyzed at concentrations ranging from 1000 to 50 µg/g (ppm) on two GC-FID instruments.

The GC-MS investigation evaluated the measurement uncertainty for the peak ratios of the PAHs, parent compounds and alkylated homologues in various crude oils. Multiple Agilent GC/MSD systems were used to perform the analyses in two different laboratories.

Good Laboratory Practice (GLP) requires that results be reported with an "error term" (the result obtained, plus or minus the statistically determined measurement uncertainty for the analytical technique). Error terms readily show the variability inherent in a measurement procedure. When peak ratios are used to differentiate between materials, the reliability of the numbers used to generate the ratio must be assessed. One ratio calculated from the heights of two peaks in a single chromatogram of one sample at a specific location does not address variability: that single ratio cannot reliably be compared to a similarly generated ratio for another sample to distinguish different contaminants.

The Federal Rules of Evidence include, under Rule 702, assessment of whether testimony is based on methodology that is scientifically valid and can be properly applied to the issue at hand. Considerations bearing on this assessment include not only peer review, publication, and existence of standards, but also the known or potential error rate for the methodology used.

While peak ratios can be a very powerful tool for forensic environmental chemistry, in order to be scientifically supportable and defensible an explicit statement of the measurement uncertainty must be included with the result.

PAHs, Ratios, Isoprenoids

C34 Benzofluorene/Methylpyrene Ratios as a Source Identification Tool

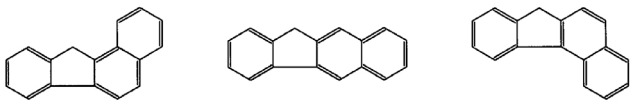
David R. Craig, BS and David M. Mauro, MS, META Environmental, Inc., 49 Clarendon Street, Watertown, MA 02472*

The objective of this paper is to present data in support of the use of benzofluorenes and methylpyrenes as a means of tracing environmental contamination to its source.

This presentation will impact the forensic community and/or humanity by describing how to improve the accuracy and reproducibility of environmental source identification.

Polycyclic aromatic hydrocarbons (PAHs) often drive costly site investigation and remediation work. Former manufactured gas plant (MGP) sites frequently are contaminated by PAHs from one or more sources depending on their operational histories, and in many cases the nature of environmental work at MGP sites can depend on identifying the sources of the PAHs. However, identifying the sources of PAH contamination at MGP sites is complicated by the numerous possible PAH origins. Common anthropogenic sources of PAHs include coal tar and coal tar products, refined petroleum products, MGP wastes, exhaust from heating systems, vehicular emissions, and others. PAHs also are created naturally by forest fires and, in some cases, synthetically by bacteria and algae. As PAHs weather and commingle with PAHs of other origins, as is typically the case in industrial soils and urban sediments, identifying their sources proves increasingly difficult.

Current approaches for identifying sources of PAHs in soil, groundwater, sediments, and surface water at former MGP sites have largely relied on the molecular fingerprint or the relative abundance of individual PAHs or groups of PAHs[1]. However, this approach suffers from two major problems: first, there are many sources of PAHs and their PAH patterns can be very similar, and second, environmental weathering (dissolution, evaporation, and chemical and biological transformations) can alter the PAH patterns and confound their interpretation. Recent studies have shown that certain ratios of PAHs and alkylated PAHs are relatively insensitive to environmental weathering processes and can be used to distinguish separate sources with similar PAH patterns even in weathered samples. For example, the ratio of benzo(b+c)fluorene to total monomethylpyrenes was found to vary little in coal tar-contaminated sediments that had weathered to various degrees (unpublished). The benzofluorenes/methylpyrenes ratio (BF/MP) depends on PAH formation conditions and is measurably different among different PAH sources. For example, the BF/MP ratio of a coal tar sample was found to be approximately 3.9 while that of a former MGP tar was about 1.5.



This presentation reports some of the results of research to identify effective environmental forensic methods for application at former MGP sites.[1] The application of extended PAH profiles (EPA 8270 modified) and the use of various PAH ratios, especially BF/MP ratios for the determination of PAH sources in non-aqueous phase liquids (NAPLs), soil, and sediment will be discussed.

Reference:
1. "Chemical Source Attribution at Former MGP Sites," EPRI Technical Report 1000728, December 2000.

PAHs, Environmental Forensics, Source Identification

C35 When is a DNAPL a DNAPL?

James S. Smith, PhD, Trillium, Inc., 28 Grace's Drive, Coatesville, PA 19320*

After attending this presentation, attendees will understand that the USEPA rule of thumb for the presence or absence of a DNAPL is not always valid.

This presentation will impact the forensic community and/or humanity by demonstrating the need for an environmental forensic scientist to use analytical chemistry methodologies that detect and identify hydrocarbons associated with chlorinated organic chemicals.

The USEPA and hydrogeologists have for a considerable length of time considered the presence of a chlorinated solvent as a dense non-aqueous phase liquid (DNAPL) in an aquifer when the groundwater concentration of the chemical exceeds 1% of the equilibrium solubility of that chemical.[1] For example, the equilibrium solubility of trichloroethene (TCE) in water is 1,100 mg/L (ppm). Therefore, if TCE is found above a concentration of 11,000 µg/L (ppb) in a monitoring well, then it is reasonable to conclude that the TCE is present in the aquifer as a DNAPL. Certainly, if the TCE is a DNAPL and is sinking through the aquifer material, then remediation is going to be difficult at best and impossible at worst.

But, is the high "hit" really a TCE DNAPL? Everyone seems to agree that TCE is more dense than water with a density of 1.47 g/mL. Also, most environmental professionals know that TCE and other chlorinated solvents have been and are used as degreasers. Many of these degreasing uses have been in metal fabricating industries where the chlorinated solvents were used in vapor degreasers. This use was usually followed by a recycling of the solvent by distillation leaving a hydrocarbon-solvent mixture waste. If this mixture is the material in the environment, then there could be three completely different scenarios:

1. The mixture density is less than 1 g/mL. This material is a light non-aqueous phase liquid (LNAPL). The LNAPL contains TCE, for

example, at concentrations exceeding 11,000 µg/L yet it is not a DNAPL.

2. The mixture density is greater than 1 g/mL. This material is a DNAPL, but it will act differently than a pure TCE DNAPL. For instance, a TCE-alkane wax mixture will act like a DNAPL with a high viscosity whereas pure TCE would move further and faster due to its low viscosity.

3. The mixture starts being transported on the water table as an LNAPL because the mixture has a density less than 1 g/mL. As the mixture is transported, the hydrocarbon aerobically biodegrades and the density of the mixture changes to a value greater than 1 g/mL and begins to sink into the aquifer. The smear zone can promote this phenomenon.

The environmental professional should always test the hypothesis that there may be a hydrocarbon portion of a chlorinated solvent release to the environment. Remediation costs depend on it. Several case studies will be discussed where high concentrations of chlorinated solvents in groundwater are not due to DNAPLs. Also, the use of the chemical concept of partition coefficient will be used to show the fate and transport of the chlorinated solvent.

Reference:
1. USEPA Evaluation of the Likelihood of DNAPL Presence at NPL Sites National Results, EPA 540-R-93-073, PB93-963343, page xi, September 1993.

Chlorinated Solvents, DNAPL, LNAPL

C36 Is Amorphous Silica Gel Non-Toxic? Differences in Dose: Exposure Route and Physical Form

James S. Smith, Jr., PhD, Oak Creek, Inc., 60 Oak Creek, Buxton, ME 04093-6616*

After attending this presentation, attendees will have a better understanding of how the toxicity of a substance changes with route of exposure and physical form. Dr. Smith will use two case studies involving amorphous silica gel ("ASG") or silica aerogel ("SA") to illustrate how changes in the route of exposure and a material's physical form can alter its ability to cause adverse health effects.

This presentation will impact the forensic community and/or humanity by demonstrating how information relating to exposure route and an agents physical form can determine the type and severity of toxicological effects observed in exposed people. Understanding these concepts is essential for regulators involved in the evaluation of agents for the protection of human and environmental health, interpretation of regulations concerning pesticide use, and in the use of expert witness testimony for effective risk communication. This presentation provides a basis for understanding these concepts, applying them to the evaluation of compound toxicity, and for use in risk communication.

This paper has three objectives: (1) to define the qualities of dose that makes a substance a poison; (2) to illustrate how toxicity of ASG is determined by route of exposure and physical form; and (3) to illustrate how such dose information can be abused in legal proceedings.

Toxicologists often say that "the dose makes the poison." This implies that all substances are toxic and that it is the magnitude of the dose that determines whether a substance is either safe or toxic. Although true, there is much more information required about the "dose" of a substance that determines whether a substance is a poison than simply its magnitude.

In the last 30 years of cleaning up hazardous waste sites, federal and state regulators and even some toxicologists have confused the amount of a substance in environmental media with the dose. By definition, dose is the amount of a substance that reaches the organ ("target organ") where the material has the toxic effect of interest. Consequently, dose is often adjusted to reflect the fraction of the substance in soil or water that is able to enter the body (i.e., bioavailability) and reach the target organ of interest. For example, generally less than 25 percent of the arsenic found in soil is absorbed form the gastrointestinal tract after ingestion. Furthermore, it is well recognized that the amount of a substance that is able to reach the target organ differs with different routes of exposure (i.e., ingestion, dermal contact, inhalation, and injection). For example, where nearly the entire injected dose of barium reaches the target organ, less than 10 percent is absorbed through the skin. Finally, the physical form of a substance can have as much to do with its relative bioavailability and toxicity as does the magnitude of its dose. For example: although the U.S. EPA assumes that all arsenic compounds have toxicity equivalent to the mass of arsenic in those compounds, their toxicity differs with respect to their relative solubility. In another example, only asbestos fibers of a certain size are associated with the development of cancer in the lung. This presentation discusses how the route of exposure and the physical form of ASG can combine to result in adverse health effects.

ASG is sold to end users as a non-toxic "natural" substance with a variety of uses, including use as a food product additive, in paints, cosmetics and in pharmaceuticals, desiccant, and pesticide. For the vast majority of these uses ASG is essentially without toxic effect to the end user, but for at least one specific use, ASG poses a health hazard to people. Although silica is a "natural" element in the environment that is commonly associated with beach sand, soils, and rock, ASG is a man-made product that is radically different from the many silica products we are familiar with (i.e., window glass, ceramics, and silica wafers used in the electronic industry). Toxicologists have long recognized the seriousness of the health consequences associated with crystalline silica exposure; silicosis. Because chronic exposure to ASG exposure does not result in silicosis, many business concerns have labeled it "non-toxic."

Dr. Smith explores ASG toxicity under different exposure routes and physical forms commonly used in product formulations. Dr. Smith uses two case histories to illustrate how dose information is abused in legal proceedings and proposes several approaches to educating jurors to minimize dose information abuse.

Amorphous Silica Gel, Silica Aerogel, Silica

C37 Air Samples Collected in Tedlar® Bags

Engrid S. Carpenter, BS, Trillium, Inc., 9312 Highland Gardens Road, Baton Rouge, LA 70811*

After attending this presentation, attendees will understand the implications of sample handling, storage conditions, and holding times on samples collected in Tedlar bags and Summa canisters.

The impact of this presentation is to allow for a more informed choice regarding the use of Tedlar® bags or Summa canisters to accurately and cost effectively assess a site.

The purpose of this paper is to present results for air samples collected in Tedlar® bags and Summa® canisters in support of an on-going monitoring program. Implications of sample handling, storage conditions, and holding times on both sampling devices will be discussed.

A three-day holding time from the date of sample collection is specified for all samples collected in Tedlar® bags. Air samples collected in Summa® canisters are considered stable for up to fourteen days from the date of sample collection. Vapor permeation values are provided for many of the volatile organic compounds collected in Tedlar® bags because the manufacturers are aware that permeability is inherent to this collection device. Summa® canisters are not permeable. So, why would you use Tedlar® bags to collect air samples? Usually costs are the deciding factor. Tedlar® bags can be purchased at a fraction of the cost of Summa® canisters. In addition, shipping of Tedlar® bags is signifi-

cantly less than the cost of shipping the much heavier Summa® canisters. Tedlar® bags for trace analyses are disposed after use while Summa® canisters must be decontaminated after each use and shipped back to the field, both of which incur additional charges. But are we sacrificing a true assessment of a site to save money?

For an on-going project, samples of untreated influent and treated effluent are collected on a daily basis in Tedlar® bags or Summa® canisters. Method TO-15 is used to analyze the samples for chloroform and carbon tetrachloride. Occasionally, Method TO-14A was used to analyze the samples when the dedicated Method TO-15 instrument was not functioning properly. A reporting limit of 0.50 parts per billion by volume (ppbv) was used for both target analytes and a calibration range of 0.50 ppbv to 40 ppbv was employed for this project. Many of the samples for this project required significant dilution to obtain concentrations of carbon tetrachloride within the established calibration range of the instrument.

Initially, the daily influent and effluent samples were placed in the same sample cooler for shipment to the laboratory. When collected in Summa® canisters, concentrations in the influent sample were consistently and significantly higher than in the effluent sample demonstrating that the facility was using an effective treatment process. However, when the daily samples were collected in Tedlar® bags and shipped together in the same sample cooler, the target analyte concentrations were very similar in the influent and effluent samples. This suggested that either the treatment process was not working properly or that an equilibration of chloroform and carbon tetrachloride concentrations was occurring between the Tedlar® bags. The client was requested to place each Tedlar® bag in its manufacturer's original box immediately after sample collection. When the separate boxes were submitted to the laboratory for analysis, the concentrations of the target analytes in the influent samples were again consistently higher than in the effluent samples.

Subsequently, during the course of the project, it was noted that the concentrations of chloroform and carbon tetrachloride were again very similar in the influent and effluent samples collected in Tedlar® bags. The client was contacted and we were assured that the samples collected in Tedlar® bags were being submitted to the laboratory in separate boxes. The laboratory was then contacted to see if any changes had been made to the laboratory sample-handling process. It was discovered that during sample log-in, the Tedlar® bags were currently being removed from their boxes and the samples were placed side-by-side in the air lab until analysis. The laboratory was requested to replace each Tedlar® bag in the box it was received in until analysis. After this procedure was implemented, the concentrations of the target analytes were again consistently higher in the influent samples.

Using four years of data, we have also observed declining concentrations of carbon tetrachloride between samples analyzed within one day of sample collection and the same samples re-analyzed between two and six days after sample collection. In some cases, the concentration of chloroform increased, suggesting degradation of the carbon tetrachloride, but in most cases the concentrations of both carbon tetrachloride and chloroform decreased, suggesting loss of these volatile compounds from the Tedlar® bags. No losses of similar magnitude were noted in the samples collected in Summa® canisters. It is apparent that Tedlar® bags are far more permeable than most people think

To increase the chances of getting an accurate measure of the target analyte concentrations, samples collected in Tedlar® bags should be shipped in their original boxes, scheduled for next day receipt at the laboratory, and analyses should be performed as soon as possible after sample receipt. To minimize cross contamination as well as loss of volatile organic compounds, we feel the use of Summa® canisters is far preferable for the collection of air samples.

Tedlar® Bags, Summa Canisters, Air Samples

C38 Vapor Pathway Measurement Strategies/Lessons Learned

Dominic L. DiSalvo, BA, ME, Malcolm Pirnie, Inc., 104 Corporate Park Drive, White Plains, NY 10602*

After attending this presentation, attendees will have an understanding of sampling and analytical strategies used to measure volatile organic compounds in soil vapor and crawl spaces below occupied buildings.

This presentation will impact the forensic community and/or humanity by demonstrating the importance of developing detailed sampling and analytical strategies for measuring vapor pathways.

This presentation will provide an overview of sampling and analytical strategies used to measure and evaluate volatile organic compounds (VOCs) in potential vapor pathways from contaminated groundwater/soil to indoor air. These strategies are based on experience gained by Malcolm Pirnie in vapor pathway measurements on a wide array of sites with groundwater and soil VOCs. Unfortunately, the same VOCs (such as tetrachloroethylene – PCE) that are found in contaminated groundwater and soils may also be found in the occupied space in buildings from other commonly used sources, such as dry cleaning brought home by a homeowner. This complicates the identification of the source of the VOC in the indoor air and its impact on the occupants. Therefore, indoor air sampling is considered a last resort, and is typically preceded by extensive subsurface soil vapor investigations that can assess a VOC levels below the ground surface.

The first step in developing the sampling and analytical strategy was to establish the criteria to be used to evaluate if a vapor pathway exists and if so, what information is needed to estimate indoor air quality and potential health risk. Health risk-based VOC screening levels for indoor air and attenuation factors for projecting the impact of soil vapor on indoor air quality were determined, then the laboratory requirements for vapor analyses, including methodology, method detection limit (MDL), and quality assurance/quality control (QA/QC), could be established. Since the MDL selected for the project was below the parts per billion range by volume, special consideration was given to the sampling train (Summa canister with accoutrements) selection and laboratory certification process to assure cleanliness.

The second step was to understand the site and local area environmental conditions that can cause or contribute to a vapor pathway. These included soil conditions down to groundwater, building construction, subsurface preparation (backfill), utilities, proximity to the contaminated groundwater or soil, and meteorological conditions. Once these environmental conditions were understood and screening levels established, Malcolm Pirnie developed a sampling plan to collect representative samples of air located below the building and in ambient air and, on occasion, inside of buildings. This included sampling the air in open and closed crawl spaces beneath structures plus soil vapor in soils beneath slab-on-grade residential/industrial foundations using soil probes angled beneath the foundations or inserted below the foundation through holes drilled through the foundation. The sampling location selection and preparation was crucial to establishing representative samples of existing vapor pathways with minimum disturbance of on-site conditions.

The implementation of the sampling and analytical plan required significant logistical coordination and project oversight. The preparation of clean sampling trains and their monitoring during sampling were critical to the success of the plan. Integrated sampling (over 8 to 24 hours) limited potential room for error in sampling train flow calibration and tightness testing. Outside sampling also was influenced by weather conditions. The cases that will be discussed allowed Malcolm Pirnie to test the sampling trains to their extremes while providing the needed analytical data.

Malcolm Pirnie has used the expertise gained sampling vapor pathways on contaminated sites to develop more efficient, effective and

representative sampling and analytical strategies. The lessons learned from vapor pathway measurements have been shared with regulatory agencies and should assist the profession to provide guidance on sampling and analysis.

Vapor Pathway Measurements, Soil Vapor, Gas Screening

C39 When Timing Is Everything: How Historical Aerial Photography Established Timing of Industrial Activities Resulting in Environmental Damage

Kristen K. Stout, BA, Environmental Research, Inc., 5267 John Marshall Highway, Suite C, Linden, VA 22642*

After attending this presentation, attendees will understand the value of using historical aerial photography in environmental litigation.

The presentation will introduce the community to a cost-effective, unbiased source of information that can be used to determine the timing of environmental damage for allocating costs associated with environmental remediation.

Learning Objectives: This abstract presents two examples in which historical aerial photography was used to determine the timing of environmental damage in Areas-of-Concern (AOCs) at a large chemical manufacturing facility.

Method: Comparative stereoscopic analysis of a series ofhistorical aerial photographs to determine when specific chemical manufacturing activities started. Using geo-referenced digital images to precisely track changes in the deposition and removal of materials over time to determine when contaminated soil was placed in a specific area.

This abstract illustrates how the timing of waste disposal and industrial activity at a major chemical manufacturing facility was determined through detailed stereoscopic analysis of historical aerial photography. The photographic analysis was conducted in support of litigation resulting from the chemical company's claims against insurance companies for costs associated with environmental investigations and remediation. The insurance policies were in effect during specific time periods; claims associated with activities or events outside those time periods would not be covered.

The chemical manufacturing facility is located in the Mississippi River flood plain in Louisiana. A series of levees, canals and ditches control periodic flooding that occurs along the river. Operations at the facility began in 1958 with chemical production and storage infrastructure located in the southern and southeastern portion of the property. Over the course of several decades, additional production plants and storage infrastructure, rail lines, and canals were constructed, primarily moving in a north to northwesterly direction across the property.

Sixty-five dates of photographic coverage spanning the time period from 1952 to 2001 were acquired and reviewed to document features and conditions of interest and to study change over time. Many of the photographic images were geo-referenced to aid in a detailed sequential comparison of specific areas.

The aerial photographic analysis focused on specific AOCs at the facility. One of the major AOCs was a vinyl chloride plant reportedly constructed in the mid- to late 1970s. Leaks in storage and feed tanks were discovered in the late 1980s and early 1990s, along with free phase product in the ground. The company asserted that the leaks resulted from faulty tank construction and would have occurred shortly after the plant went on-line; however, it did not provide any definitive documentation as to when the plant went on-line.

Based on the analysis of several dates of aerial photography flown in the 1974 to 1980 time period, it was concluded that the plant was still under construction as late as July 1977. High resolution aerial imagery flow on July 6, 1977, provided the critical visual evidence. Various plant structures and pipe galleries were not completed. Stacks of pipes, beams and other construction material were visible in many locations around the new vinyl chloride plant, along with construction equipment. Furthermore, two impoundments at the plant were still under construction.

As of July 6, 1977, much of the ground surrounding the structures appeared rough and uneven, with several mounds of earthen material. In later dates of photography, the plant yard had been graded and a cover material of some type (probably gravel or crushed shell) had been applied.

The insurance policy ended before July 6, 1977 (i.e., before the plant went on-line); and therefore, the release occurred outside the policy period.

Another AOC was located south of the main chemical manufacturing facility on the river side of a levee. Contaminated soil was discovered adjacent to two borrow pits. The two borrow pits were separated by a narrow strip of land that served as an access road from time to time. The entire area was flooded on a regular basis and was highly susceptible to erosion during these periods.

In 1986, the company discovered contaminated soils in the area between and to the east of the two borrow pits. A portion of the area was excavated and backfilled. Analysis of the contaminated soil indicated the presence of organic compounds. Three follow-on soil boring investigations were conducted in 1986, 1987 and 1993 to define the vertical and horizontal extent of the contaminated soil.

The company indicated that sporadic dumping had occurred in the general area located along the riverside of the levee during the 1950s and 1960s. Initial review of historical aerial photographs from the 1960s showed filling and dumping of unconsolidated material in several locations. However, further analysis of later dates of photography revealed that this fill material was physically removed and/or eroded away during river flooding.

The approximate areal extent of the contaminated soil, as derived from maps produced during the three investigations, was registered to a 1984 geo-referenced digital image of the AOC. This was the closest date of aerial photography that pre-dated the initial investigation and subsequent partial source removal. The resulting composite map was digitized to create a geo-referenced spatial foot print of the contaminated soil. This spatial foot print was overlain to earlier dates of geo-referenced imagery, from which changes in the terrain due to anthropogenic activity and natural forces were tracked. From this detailed and precise comparison of sequential dates of aerial photography, it was ascertained that the contaminated soil identified in the investigations was placed in the AOC in the early 1980s, and possibly, to a lesser extent, in 1974. This was significantly later than originally purported.

These are but two examples in this case where detailed analysis of historical aerial photography was used to determine the timing of environmental damage for environmental cost recovery litigation.

Aerial Photography, Environmental Damage, Cost Recovery Litigation

C40 Passing the Buck (Around)–Using Forensic Environmental Evidence to Allocate Environmental Cleanup Responsibility and Costs Among Potentially Responsible Parties

John B. Robertson, BS, John B. Robertson Consulting, 40107 North 3rd Street, Desert Hills, AZ 85086*

The goal of this presentation is to demonstrate concepts and parameters for applying technical environmental investigation approaches and results to establishing the relative degree of responsibility among parties responsible for environmental harm at Superfund-type sites, using right and wrong examples and case histories.

This presentation will impact the forensic community and/or humanity by providing help to environmental site investigators and those involved with developing and negotiating cost allocations for Superfund-type sites with constructing and applying the most appropriate, justifiable, and equitable technical basis for allocation and to acquaint listeners with some possible new and innovative approaches.

Allocation of responsibility and response cost among potentially responsible parties at federal Superfund and equivalent state-program environmental cleanup sites is probably the most contentious and litigious aspect of those programs. The process is made difficult and complex for several reasons, including: parties rarely are willing to accept *any* responsibility for an abandoned contaminated site (partly because of the joint and several liability aspect of Superfund); every party that does accept some responsibility naturally wants their share to be the smallest; CERCLA and state regulations provides little guidance on how allocations should be done; every site is unique in the circumstances that led to the state of contamination and the history of owners, operators, generators and transports; every site is different in terms of the technical evidence that reveals the history and causes of contamination driving the cleanup.

Despite these difficulties, responsible parties can usually be made more accepting of responsibility and of a fair allocation share if an appropriate allocation model is developed, based on equitable principles and defensible technical parameters, that can be reasonably supported with site-specific environmental evidence. This presentation will explore some successful and unsuccessful allocation models and why they succeeded or failed, together with the types of forensic evidence that has proven to be most useful in allocation cases.

The most fundamental principle driving fair and successful allocations is that of cost causation: the parties that contributed most to the environmental harm that is driving cleanup costs are the parties that should pay the most. Often, a simple volumetric allocation is attempted, if appropriate evidence exists. However, seldom is sufficient waste volume evidence available to allow a volume-only based allocation to be done fairly. Other parameters than can be useful in the allocation formula include time of involvement in the site, relative portion of the site occupied or used, types of activities at the site, waste management practices, timing of waste releases at the site, and characteristics of the hazardous materials/wastes handled at the site.

The greatest challenge, of course, is developing convincing evidence that indicates each party's relative role in causing the harm. That is where the bag of forensic investigation/analysis tools comes into play. Some of the investigative tools and types of evidence that have proven to be most useful in developing and applying allocation models are the following:

- determining three-dimensional distribution of key contaminants in soil and groundwater
- reconstruction of the historical spread of contamination from sources using historical data and computer models
- using historical aerial photos to identify source areas, parties, times of releases, and other evidence
- interviewing former employees and other witnesses to past activities
- using information from similar analogue sites
- researching old operational manuals, policies, and guidance documents
- applying geographic information system (GIS) technology to data compilation, analysis, and display
- assessing relative toxicity, mobility, and persistence of different contaminants in the mix

Several interesting case histories will be used to demonstrate how these and other lines of evidence have been used and misused to allocate cleanup responsibility and costs.

Environmental Cleanup, Cleanup Cost Allocation, Environmental Forensics

C41 Cosolvency

James S. Smith, PhD, Trillium, Inc., 28 Grace's Drive, Coatesville, PA 19320*

After attending this presentation, attendees will understand that water insoluble organic chemicals are rarely made more soluble in water when co-deposited with a water-soluble solvent(s).

This presentation will impact the forensic community and/or humanity by explaining that higher than expected concentrations of a water-insoluble organic chemical in water should not be attributed to cosolvency without extraordinary proof.

Cosolvency has been used to explain why water-insoluble organic compounds are found at concentrations significantly above their equilibrium water-soluble concentrations in groundwater. This has been especially true for polychlorinated biphenyls (PCBs). For example, assume that PCBs and a chlorinated solvent such as trichloroethene (TCE) were discarded together. Now, in a groundwater sample from the monitoring well, one finds concentrations of PCBs that exceed the water solubility for PCBs. The explanation used for the higher than expected concentrations of PCBs is cosolvency. In other words, it was assumed that higher concentrations of PCBs such as Aroclor 1260 in water were caused by the ability of TCE or another solvent to carry the PCBs into the water solution and hold the PCBs in a soluble form.

However, research and recent publications[1,2,3,4] show that cosolvency rarely occurs and certainly not with TCE and PCBs. What does occur is that the solvent "salts out" or decreases the water solubility of the PCBs. The equilibrium solubility of PCBs is lowered by the presence of a solvent in the groundwater until the solvent reaches percent values. The solvent does not increase the solubility of insoluble materials such as PCBs in the groundwater.

Is that the end of the story? Of course not. In another example, the Stringfellow lagoons above Glen Avon, California, contained cutting oils that migrated through the aquifer. How is that possible? Cosolvency is the answer here. At the Stringfellow site, there were high concentrations of detergents from water-soluble cutting oils which were used to solubilize oil in water. They continued to do their job in the aquifer material. Although these oils were never reported on the laboratory data sheets from analyses of the water being transported through aquifer material from the lagoons toward Glen Avon, they were confirmed to be present based on the total ion chromatograms from the semivolatile organic compounds analyses.

It is obvious that forensic investigations need to consider cosolvency, but the regulatory analytical chemistry tests required for an investigation are not always the tests necessary to demonstrate cosolvency. Cosolvency must be carefully proven scientifically before it is used as an explanation for the forensic investigation.

[1] Coyle, G.T., T.C. Harmon, and I.H. Suffet, "Aqueous Solubility Depression for Hydrophobic Organic Chemicals in the Presence of Partially Miscible Organic Solvents," Environmental Science & Technology, Vol. 31, pp. 384-389, 1997.

[2] Munz, Christoph and Paul V. Roberts, "Effects of Solute Concentration and Cosolvents on the Aqueous Activity Coefficient of Halogenated Hydrocarbons," Environmental Science & Technology, Vol. 20, pp. 830-836, 1986.

[3] Groves, Jr., Frank R, "Effect of Cosolvents on the Solubility of Hydrocarbons in Water," Environmental Science & Technology, Vol. 22, pp. 282-286, 1988.

[4] Ulrich, Glenn, "Fate and Transport of Ethanol-Blended Gasoline in the Environment," Governer's Ethanol Coalition, pp. 15-16, October 1999.

Cosolvency, Water Solubility, Salting Out

C42 An Adaptive Sampler for Human Scent Measurements in Field Forensics

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After attending this presentation, attendees will understand several approaches to volatile organic compound analysis in the field for forensic purposes, as well as new instrumentation developments that facilitate these analyses.

This presentation will impact the forensic community and/or humanity by demonstrating how the miniaturization of detectors will help drive the commercialization of small, low power, light-weight instruments for near real-time field analyses.

The FBI's laboratory division and other operational units within the FBI require rapid and reliable volatile organic compound (VOC) analyses in the field to assess human scent collection instrumentation and improve their overall response strategy and effectiveness for chemical vapor determinations. Trace detection of VOCs captured via scent pads or emanating from clandestine human burials in the field has been difficult and current methods rely heavily on the use of canines. Because canines are subject to exhaustion and maintenance an improved methodology for screening large areas is required.

The Counterterrorism Forensic Science Research Unit (CTFSRU) has developed a new adaptive sampling and analysis approach to trace VOCs detection for field applications. The adaptive sampler is based on the use of a front-end solid phase microextraction (SPME) array that passively extracts volatiles from large air volumes. The sampler is coupled to a microconcentrator for overall flow matching and is interfaced to a low thermal mass (LTM) gas chromatograph (GC) employing both mass spectrometric (MS) and pulsed Helium ionization detection. SPME was selected as a passive air extractor because the technique requires neither power nor solvents for sample collection or preparation, and the array device can be made compact. Trapping, desorption, and subsequent microconcentration efficiencies will be presented for quantitative VOC studies. The theoretical aspects of SPME indicate that in all but the smallest of samples, sample size (i.e., volume of water or air) does not affect the sample loading onto the fiber. However, analyte concentration and sampling conditions do affect quantitative fiber loading. Currently GC/MS is used in the laboratory to confirm the identity of a standards mix as well as a spiked scent pad; however, data from this new small, lightweight, and low power prototype sampler will be used to improve GC/MS field systems.

The laboratory division and forensic community should benefit from these method and instrumentation developments because it will help reduce the time for mixture analysis of the various organic matrices, including semivolatiles as well as volatiles, typically encountered by responders and analysts in the field.

VOCs, Scent, Adaptive Sampler

C43 Certified, My (Beep)!

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After attending this presentation, attendees will understand that certification of a laboratory by some agency does not guarantee that the results they produce will be valid.

This presentation will impact the forensic community and/or humanity by demonstrating that analytical results can be wrong even when they are reported by a "certified" laboratory.

Why on earth would anyone want to validate pH data? It's a no-brainer, right? You get the meter ready, standardize with a couple of buffers and start analyzing. This is not rocket science.

Well, let's just pretend that you are asked to validate, for some unknown reason, the pH data for a set of samples. And say those samples happen to be soils. Everything looks good in the raw data, the standards look good, replicate readings are close, and the de-ionized water gives consistent readings. Not much to say. It looks like the results are good. But wait, the results on the summary forms in the data package don't agree with the results on the final reports. As a matter of fact they differ by two, three, even four pH units. Not only that, but the laboratory also gave sample-specific reporting limits for pH and they vary from soil sample to soil sample. What happened? You won't believe the answer to that question. Maybe validating that data wasn't such a bad idea after all.

Next, we're looking at data for volatile organic compounds by EPA Method 524. The laboratory purges 25 mLs of a water sample and analyzes it with a benchtop mass selective detector (MSD). The calibration curve is established between 0.5 ug/L and 50 ug/L. That means, from the instrument's point of view, the calibration represents a range of 12.5 nanograms to 250 nanograms of the target compound in the column. That's a reasonable range for most compounds on an MSD.

But what is the lab reporting? In this particular instance, the laboratory reported carbon disulfide in one water sample at 0.041 ug/L and 1,1-dichloroethane at 0.077 ug/L in another. Both results were qualified as estimated, as they well should be, but what about these numbers? According to the calibration, they can't accurately quantify anything below 0.5 ug/L. So why are they reporting a result down to 0.041 ug/L? Another good question, with a not-so-good answer.

The laboratories that reported the results described above happen to be "certified." But what , exactly, does certification mean? When you are remediating a site, reporting data to an agency, or using data to support some other action on a project or site you will often hear, "we used a certified lab," or "we want to make sure the lab is certified," or "you need to use a certified lab, we'll only accept results from a certified lab." Okay, so you used a certified lab, but does that mean you're going to be getting good results? Maybe. Maybe not.

The incidences described above, as well as a number of other common and uncommon laboratory mistakes gleaned from experiences in data validation, will be presented to illustrate that results can be wrong, even from a certified laboratory.

Certification, pH Analysis, Calibration

C44 Forensic Investigation of an Underground Gas Main Explosion

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The goal of this presentation is to present a case study of a forensic investigation into the explosion of a buried section of a town gas distribution system.

This presentation will impact the forensic community and/or humanity by illustrating how forensic scientists can complement structural design and civil engineers, as well as gas safety experts, in determining the cause of engineering failures.

Background

The explosion occurred in a single-story seafood restaurant erected on a 35-cm thick reinforced concrete (RC) floor slab on land reclaimed from the sea 30 years ago. This concrete base had two layers of reinforcement bars (re-bars) and was supported by large pilings driven into the ground. As a result of soil settlement, there was a void of 30-50 cm under the monolithic concrete slab, apparently extending throughout the entire space under the restaurant. The rear area of the restaurant was a fairly open concrete structure with corrugated iron roofing, false ceiling and thin-walled partitions.

The underground town gas main entered the restaurant at the rear area. The piping consisted of two levels of 4-inch gas pipes joined together by an inclined spigot. At the upper level, the inclined spigot was connected by a spigot-and-hub joint to a horizontal pipe, both of which were embedded in a concrete channel in the RC slab. The town gas in the main contained hydrogen (62%), carbon dioxide (18%), carbon monoxide (6%), methane (5%), pentane (5%) and traces of nitrogen, oxygen and a malodorous mercaptan. Although this pipeline was still charged, it had been capped for three years. The restaurant had converted to using LPG cylinders in a manifold in the kitchen and dining area.

In response to a major leak in the underground water main, located in the open dining area, two workmen opened the water valve pit, ventilated it for an hour and began working around the leaking water valve. About 30 minutes later, as they were hacking tiles in the pit with an iron spike and an electrical drill, a series of explosions occurred, The first explosion occurred in the valve pit, followed by a series of directional explosions moving underground towards the rear of the restaurant where the town gas main was located. The explosions covered the premises with debris, smoke and dust but no fire resulted. The injured workman recalled smelling cooking gas immediately after the first explosion.

The explosions damaged the ceiling, roofing and walls, popped floor tiles, and dislodged furnishings. The rear area where the underground town gas main entered the premises sustained the most severe damage. The explosion broke the concrete channel in which the gas pipe was embedded, exposing the 45^{o} elbow (bend) attached to a horizontal pipe, and a void underneath with a disconnected inclined spigot partially buried in subsided soil. The horizontal pipe attached to the elbow was partially resting on the lower layer of re-bars. The upper layer of re-bars had been cut and removed to create space for embedding the horizontal section of pipe during installation.

The explosion also dislodged the LPG cylinders which were all intact and clearly not the cause of the explosion. Except for two blown out sewage inspection chamber (IC) manhole covers in the open eating area, all of the manhole covers were intact, and waste-water in these ICs was found to be free-flowing. Property management personnel indicated there was no foul smell coming from the underground sewage system before the explosion.

The town gas company promptly shut off the gas supply to the area after the explosion. Two structural engineering consultants hired by the gas company to investigate the incident independently concluded that the separation of the 45^{o} elbow joint was sudden, was unlikely to have been caused by natural soil settlement, and was a result rather than the cause of the explosion. One consultant dismissed the possibility that the explosion was due to leakage of town gas.

Key issues

- Our lab was tasked to verify the consultants' findings and examine the following issues:
- Was the dislodged joint caused gradually and progressively by the settlement of soil? Or was the joint failure sudden and catastrophic?
- Was the explosion caused by methane produced either by the reclamation soil in-fill or underground sewage system?
- Was the explosion caused by town gas leaking from the gas pipeline?

Analysis of residual gases

Holes were drilled at 5 locations through concrete floor and the void underneath these holes was analyzed for hydrogen and methane but none was detected. Less than 50 ppm methane (well below the 50,000 ppm LEL for methane) was found in the IC manholes. Soil samples collected from around the damaged gas pipe, and from the water valve pit, were examined for methane, ethane, propane and butane, but none was detected.

Examination of the dislodged joint

The inclined spigot and the 45^{o} elbow attached to the horizontal pipe were cut and brought to the lab for further examination. The cut-out spigot was not deformed or dented. However, its inner surface and end (circular ring) were rusty.

The 45^{o} elbow (bend) had two hubs, one of which was attached to the horizontal pipe. A flexible optical fibre scope revealed rust spots and patches on the interior surfaces of both the hub and the pipe, indicating the presence of moisture and oxygen within the piping system for some time. In addition to rust spots, the interior walls of the hub had a circular arc of rust corresponding to the end of the spigot. This arc of rust, evidently formed by prolonged contact with the end of the spigot, was not concentric, indicating that the spigot was not aligned axially to the hub.

The joint was mechanical with a seal effected by compressing a wedge-shaped annular gasket of elastomeric material, partially lined with lead sheath, onto the jointing surface in the pipe hub and the outside of the pipe spigot, by means of a pressure gland and a series of bolts and nuts. This joint was carefully dismantled and examined. Rust and fine soil particles were found on the tapered inner surface of the hub where the gasket had been in close contact with the iron surface. The gasket had suffered extensive wear and tear. The elastomeric material was permanently deformed and flattened. The lead sheath was torn and severely thinned out on one side, and stained with rust or brownish soil stains. The lead layer had buckled furrows with dirt and fine soil between the lead and elastomeric layers, indicating that the seal was not gas-tight. The furrows evidently resulted from the spigot end pressing against the top part of the hub, creating a disproportionate amount of pressure along the top of the annular gasket, which thinned and extended out the lead along its circumference, creating folds in the wider available space. The inner surface of the gasket indicated uneven contact with the spigot end and the gasket was not evenly seated around the entire joint.

Findings

The most probable cause for the explosion was a damaged gasket resulting from a badly aligned and severely stressed joint. This faulty gasket was not gas-tight; the leak led to a diffusion and accumulation of town gas in the connecting spaces between the monolithic concrete slab and the subsided soil. The electric drill ignited the flammable gas and triggered the explosion, which generated a significant expanding force in the underground space, lifting up and breaking the weak concrete floor channel bearing the horizontal pipe. The uplifting raised the horizontal pipe and attached elbow, and created a sudden longitudinal pullout force, which caused a sudden axial withdrawal and separation of the 45^{o} elbow joint.

The misalignment of the joint was probably due to the settlement of soil under the buried inclined spigot, which drastically reduced support for this underground segment. Severe stress was created at the elbow joint because the embedded horizontal pipe and the elbow were firmly supported by the lower layer of re-bars in the concrete channel, whereas the inclined spigot pipe being inadequately supported, was sinking. The weight of this partially buried spigot in subsiding soil created a concentration of stress on the joint.

Conclusion

Our investigations revealed departures from industry practices concerning installation of the joint and support of the piping system. Failure to account for soil settlement and provide adequate long-term support for the inclined spigot and lower level of pipes resulted in misalignment and sagging. Although gas pipelines are commonly designed for 50 years of service, the forced dislocation (deflection) of the piping and fittings eventually took the joint to its limit, creating leakage paths between the spigot pipe and the gasket. A continuous outflow of town gas ensued as the pipe was pressurized.

Detailed examination of the joint was crucial in this case, over and above general observations about damages and speculations over different possible contributing factors. This case illustrates how forensic scientists can complement structural design and civil engineers, as well as gas safety experts, in determining the cause of engineering failures.

Gas Pipe, Stressed Joint, Gasket Failure

C45 Virtual Loosening of Fittings From Elevated Temperatures

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After attending this presentation, attendees will have a basic understanding of why threaded fittings may be loose after being subjected to elevated temperatures, such as from exposure to a fire.

This presentation will impact the forensic community and/or humanity by demonstrating the importance of applying engineering sciences in fire investigations to correctly analyze and interpret the evidence.

A fire occurs at a property supplied by natural or LP gas. Following the fire, investigators test the gas system, find leaks, and ultimately implicate the gas company or pipe installer for faulty workmanship. Was the connection indeed loose prior to the fire? Barring unforeseen circumstances (tampering), the fitting was likely leak-free at the time the fire started, particularly if proper leak tests were performed at the time of installation. The naïve investigator reasons that the only way for a fitting to be loose is for it to have been loose prior to the fire, but it is not the torque that should be of sole interest after the fire, rather the number of threads engaged. The number of threads engaged becomes the only reliable method of estimating the pre-fire engagement torque.

Looseness in pipe and tubing fittings post-fire must be carefully scrutinized before an assumption of pre-existing leaks can be made. Investigators must understand that sufficient heating of threaded metal fittings, as in basic heat treatment processes, relieves stress in the metal. Stress in the metal is what allows a fitting to become tight and "leak free." Heat from a fire, if not sufficient to completely melt the fitting, can allow the metal to re-crystallize, thus softening and relieving stress in the fitting. This results in a virtual loosening of the fitting, although no rotation or unscrewing of the parts has occurred.

Experiments conducted with various flare and pipe fittings of different materials showed that brass flare fittings, a form of compression fitting, "loosened" to the greatest degree with the lowest temperature exposures. Steel pipe fittings required the greatest heat exposure and resulted in the least effective "loosening." "Leak free" fittings with known, standardized initial torques were subjected to elevated temperatures for various times. After removal from the elevated temperatures, the fittings were tested for leaks and post heating torque values. These results demonstrate how stress-relieving processes can, and do, occur in environments like house fires. The simple engineering process of stress relief and how it relates to threaded fitting tightness must be understood by investigators involved with testing gas systems following fires in order to properly interpret the fitting conditions, and how they relate to pre-fire conditions.

Loose, Fittings, Fire

C46 Bad Science From Big Brother

Beryl Gamse, PhD, Jean L. McDowell, BSc, Derek T. Nolen, MS, and Nestor Camara, McDowell Owens Engineering, Inc., 1075 Kingwood Drive, Suite 100, Kingwood, TX 77339*

After attending this presentation, attendees will have an appreciation for the need to critically evaluate published research, particularly that done by authoritative agencies.

This presentation will impact the forensic community and/or humanity by illustrating the importance of preventing unreliable reports from being used as the basis of opinions in litigation.

It is essential that we, as scientists and engineers, do good science. It is especially important when this science is the basis of our opinions that we present to lay people in the course of litigation. It is also incumbent upon us to be vigilant in detecting bad science that may become current and the basis of opinions in the future, particularly if the bad science carries the imprimatur of a federal regulatory agency.

As part of a project to develop standards addressing the potential hazards of clothes dryer fires, the Consumer Product Safety Commission conducted a program that resulted in the publication, "Final Report on Electric Clothes Dryers and Lint Ignition Characteristics," May 2003. In the test program, a great deal of effort was put into establishing some of the operating characteristics of several electric clothes dryers and demonstrating certain conditions under which lint, taken from a clothes dryer lint screen, will burn when positioned on or near an energized clothes dryer heater unit that had been removed from a dryer and placed in a special test chamber. Very little of the report was devoted to lint accumulation, apparently because very little accumulated during their testing. The report indicates that: 1) lint collects on the heater unit housing in locations and at densities similar to the samples tested, 2) large clumps of lint can become located within a few inches of the heater unit entrance along its longitudinal axis , and 3) the lint so located could ignite and create larger fires in the cabinet or downstream of the heater unit in the clothes-filled tumbler drum, at the lint screen, and/or in the exhaust vent. There was nothing in the report that established that lint, similar in density and quantity to that used in the lint ignition tests, could become positioned relative to the heater unit as it was in the tests. In fact, our experience in laboratory testing under realistic operating conditions and examining dryers after years of service in homes contradict the first two items. Thus, the report gives a false impression relative to the hazard of dryer fires.

In addition to not establishing the lint accumulation, the test conditions for ignition of that accumulated lint were not valid.

The test chamber for lint ignition tests was essentially a horizontal wind tunnel with the dryer heater unit mounted with its longitudinal axis and internal air flow vector horizontal and its sides isolated from the test chamber walls. In most dryers the unit is oriented vertically and one of its sides is in contact with the metal tumbler support bulkhead. Neither the flow field nor the heater unit surface temperature distribution were documented in the actual dryer, therefore the flow fields and distributions created in the test chamber could not be validated.

Our testing has shown that, in operating dryers of the type tested by CPSC, the flow is downward in the cabinet, opposite to that used in their ignition tests. The downward flow continues past the heater inlet with only a portion of air being drawn into the heater. The general downward flow prevents any lint that is more than a few inches below the inlet from possibly being drawn into the heater unit. Thus, no lint accumulated on the bottom of the cabinet can be drawn to the heater. Also, the orientation of the gravity vector in the test chamber is incorrect. A clump of lint that is somehow located in the limited in-draft at the entrance to the heater unit may be too dense to be drawn into the unit if the unit is oriented vertically but not if it is located horizontally. These factors make their testing and conclusions relative to lint ingestion problematic, if not invalid.

The configuration used for the ignition of materials downstream of the heater has no relationship to an actual dryer. The target material, lint or cotton toweling, was placed immediately downstream of the horizontal heater unit in a 4-inch diameter duct. The air flow speed across the target material, which restricted the cross-section of the duct, was not reported, but was probably significantly higher than the 800 sfpm at the heater inlet. This air flow would, and did, fan any smoldering embers into flames. In an actual dryer, the exhaust of the heater passes through a perforated metal wall before reaching toweling-type materials, then traverses the tumbler plenum and, in some designs, another perforated metal wall to reach lint on the collection screen, and then pass through a centrifugal blower to reach any lint deposits in the exhaust vent. The perforated metal walls act as spark arresters eliminating most, if not all, of the lint embers. The directed airflow goes to essentially zero in the plenum chamber of the drum. The only air movement would be due to

the tumbling clothes, which would probably beat any surviving embers out of existence. The survival rate for lint embers reaching the lint screen or beyond would be negligible. No explanation is given as to how lumps of lint could make their way into the heater unit. Even if one accepts that somehow clumps of lint are ingested into the heater unit, it must be demonstrated in an actual dryer that embers from it will survive in sufficient size and quantity to cause ignition of material downstream of the heater unit.

The report covers a large number of tests which are described in great detail; many data are presented which are analyzed and discussed extensively. The extent of the discussion and the fairly attractive presentation of the voluminous data divert the readers' attention from the fact that, though what is presented follows the two subjects mentioned in the title of the report, "Electric Clothes Dryers" and "Lint Ignition Characteristics," no valid connection is made between the two. The testing program and report are examples of bad science.

Dryers, Flint Fires, CPA Safe

C47 Variation in Performance of Residential Smoke Detectors — Safety Concerns Due to Unpredictable Behavior

B. Don Russell, PhD and Carl Benner, MS, Texas A&M University, 238 Wisenbaker, MS 3128, College Station, TX 77843-3128*

The goal of this presentation is to educate forensic engineers as to the wide variation in performance of commercial residential smoke detectors under similar fire conditions as an aid to forensic investigation.

This presentation will impact the forensic community and/or humanity by describing how the performance evaluation of smoke detectors will help educate forensic scientists and engineers who are called upon to perform first fire analysis of detector performance and circumstances of injury to fire victims. The performance data will also assist fire safety professionals in determining ways to improve the performance of smoke detectors, thereby increasing public safety and reducing the loss of life and property resulting from fire.

This paper presents the results of an extensive research project evaluating residential smoke detectors under controlled fire tests. The performance of residential smoke detectors has been extensively documented using full scale testing. Fire scenarios include those typical and expected in residential environments under circumstances that pose hazard of injury or death to residents.

Commercially available, UL-listed smoke detector designs from multiple manufacturers have been tested in large quantities under a wide variety of fire scenarios. Specific emphasis has been given to the performance of same make/same model detectors under similar fire circumstances. The objective is to determine the statistical predictability of the performance of detectors as purchased, installed, and used by the public, as a function of various fire scenarios common to residences in the United States. The results are presented blind, without specific reference to manufacturer, and without identification of a specific product.

The test protocol utilized requires testing of unmodified, unaltered smoke detectors purchased commercially. Detectors were purchased in multiple units of the same make/same model for comparison purposes, but no attempt was made to control for date of manufacture or shelf time prior to sale. Smoke detectors were installed in a full-scale residence utilizing the manufacturer's recommended installation instructions. Fires were set in the residence consistent with foreseeable fire scenarios in private housing in the United States. A common fire scenario to which detectors were tested is smoldering/burning furniture or bedding.

The full-scale residence was instrumented to provide detailed parametric information documenting the progression of the fire. Computer based instrumentation records such parameters as temperature, obscuration in multiple locations, and the performance of individual detectors in response to smoke production. For each detector, performance criteria were recorded and documented to include the time each detector takes to respond to the fire and the obscuration levels in and around the detector and in the residence at the time each smoke detector responds. From these data, relative comparisons were made between same make/same model detectors and different make/different model detectors in all combinations. These data were then used to draw conclusions with respect to overall performance, efficacy of the detectors for providing home safety, and the predictability of smoke detector performance based on fire type.

The intent of this paper is to educate forensic investigators and forensic engineers concerning the actual performance of smoke detectors in residential fires as compared to the performance that is expected by the public or by engineers and fire scientists. The results of research to date show wide variation in performance by units of the same model or essentially same model of detector, making prediction of behavior difficult in post fire analysis. The characteristics and factors affecting performance and variations in performance are described and presented. Specific case studies are reviewed with research data from actual fire tests presented and discussed. Overall performance of detectors as a function of tenability parameters, such as obscuration, is presented.

Smoke Detectors, Fire Detection, Fire Safety

C48 Analyzing a Starter-Generator Failure on a Turbo-Prop Aircraft Engine

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The goal of this presentation is to describe a unique item of electrical equipment which performs two separate tasks in the operation of small turbo-prop and turbo-jet aircraft engines. While in flight, function lights indicated a problem had occurred with the electrical generator on one of the aircraft's engines, so the airplane made an emergency landing. Instead of waiting for a certified FAA mechanic to inspect the engine the next morning, a cursory inspection was made by the pilot, and finding nothing obviously wrong, he attempted to restart the engine and the result was disastrous.

This presentation will impact the forensic community and/or humanity by demonstrating why an operator of any equipment should always rely on the vehicle's instruments, and not try to out-smart those instruments.

There are thousands of one and two turbo-prop engined aircraft flying today. Should a pilot, having seen a generator malfunction light illuminate during flight and tried to trouble-shoot the problem, it could have roved to be disastrous to life and aircraft. Manufacturing defects have largely been engineered out of present day Starter-Generators and thus contributing to greater safety for passengers and crew while flying small jet-powered aircraft.

A chartered Piper Cheyenne aircraft was returning to Sarasota, FL, from Miami, FL, when the pilot noticed a generator red "NO-CHARGE" light illuminate. He immediately changed course and landed at Naples, FL, airport. He removed the left engine covers and visually inspected the auxiliary equipment in the left side PT6A-41 engine, and in particular, the AUXILEC Starter-Generator. The pilot determined the brushes were not worn away and that they were functioning correctly, and after taping other relays in the generator circuit he decided to restart the engine. After a second or two, and with the generator light still on, the starting mechanism completely seized.

The subject Starter-Generator, DC Aircraft, was an AUXILEC Model 8013C. Its operating specifications as a starter were 36 volt max. at 1000 amp max., and as a generator its output was 30 volt at 200 amp, with a shaft speed of 7000/12150 rpm.

From the air-intake end of the PT6A-41 engine, which faces rearward, the compressor turbine was connected to the outside of that gear box. The two shafts were linked together through bevel gears which had an approximate 3:1 gear ratio. During the engine starting procedure, the starter section of the unit is powered from the battery and it runs-up the compressor to approximately 30,000 rpm and then the engine's operation is commenced by the introduction of fuel to the combustion chamber and energizing the ignitors. A generator reverse current relay senses a reduced current requirement in the armature series field coils, and that relay switches to the output from the shunt-field armature coil in the then driven Starter-Generator.

The illumination of the generator charge light during flight was indicative of an electrical fault, which can often be traced to heat damage to insulation on electrical components, and lead to electrical shorts, or electrical/mechanical malfunction between the brushes and the commutator. After an emergency landing the pilot removed the engine covers, and with a flashlight and screw driver he proceeded to inspect the then exposed commutator end of the starter-generator where most electrical faults have historically been found. In the subject case nothing was found to be out of order, so the pilot then attempted to restart the engine. After several seconds of applying battery power to the starter, the armature abruptly stopped turning, and it was only then that the pilot realized the futility of trying to restart the engine, and so he left it to be inspected by a mechanic the following morning.

A partial tear-down found the bevel drive gears in the assessory gear box had been electrical-resistance welded together. Further, four (4) lengths of the forward facing beryllium-copper (Be-Cu) armature retaining ring were recovered from the inside of the front housing. The armature series-field coil windings and the shunt-field coil windings had been rubbed, or machined, to expose bare copper wire.

Rubbing-wear signatures were observed on one portion of the armature's circumferential surface as well as on one portion of the facing surface in the stator. Those rub marks indicated the armature had rotated in an elliptical pattern for a considerable period of in-service time. The temperature excursions due to frictional rubbing of the metal components in the armature and stator were accompanied by thermal expansion, heat treatment and oxidation/corrosion of the metal parts. At a late stage in the stator-generator service life the armature ring cracked all the way across its width, starting at one of the incipient cracks in the surface of the hydrogen-embrittled Be-Cu ring - as determined by SEM/EDS analysis.

The longest piece of the Be-Cu ring had been bent into a "J" shape with the hook-end around the shaft and the free end long enough to make contact with the bare copper ends of the armature coils. The shunt-field coil had been partly shorted to the armature shaft by the "J" piece, causing the generator light to illuminate. During normal engine operation, the starter series-field coils are disconnected from the battery, so no serious damage was done when the bare copper wire ends of the starter coils were also shorted by the metal "J" piece.

When an attempt to restart the turbine was made, the full charge of the battery was shorted across the metal "J" piece to the armature shaft. However, the path of least resistance to the "engine ground" was through the bevel gears in the auxiliary gear box. They became welded together, and their seizure caused considerable damage and expensive repairs to both the accessory gear box and to the compressor turbine.

The case went to trial, and the verdict was that the starter-generator failed due to a manufacturing defect, but all other repair costs were the responsibility of the pilot/owner, who should not have attempted to restart the engine.

Turbo-Prop Engine, Starter-Generator System, Beryllium-Copper Armature Ring

C49 The Characterization of Binary-Output Walkway-Safety Tribometric Instruments by Characteristic Functions

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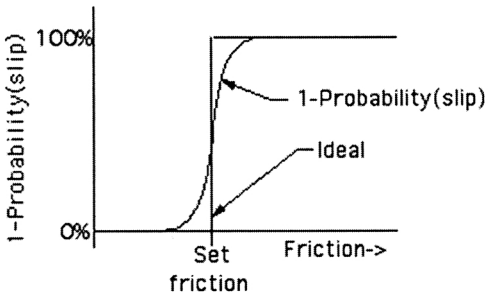
After attending this presentation, attendees will learn about using logistic regression parameters to characterize the response of binary-output tribometers. This information can be used to determine if different tribometers give equivalent results.

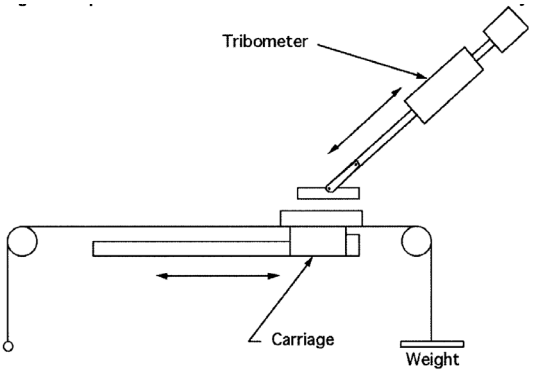
This presentation will impact the forensic community and/or humanity by demonstrating a method of characterizing walkway safety tribmeters that give binary, i.e., slip/no-slip results. The characterization gives insight into the accuracy and repeatability of the tribometer.

One way of broadly characterizing tribometers is to classify them as to whether they give a quantitative or a binary output. A drag sled, for example, gives a quantitative output (the measurement of the relative lateral force is an indicator of the friction). The Portable Inclinable Articulated Strut Tribometer (PIAST) is an example of a tribometer that gives an output in binary form. The carriage is set and locked at a given slip angle and the test foot is released. Either the test foot slips or it does not slip (and hence, the output is binary). Ideally, the tribometer will slip 100% of the time at available-friction values below the 'set' friction value and never slip at available-friction values at or above the set friction. (The 'actual friction' is a function of the friction measuring system, so comparisons of characteristic curves generated by different types of tribometer should be approached with caution.)

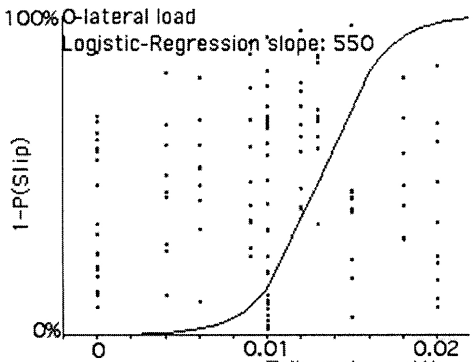


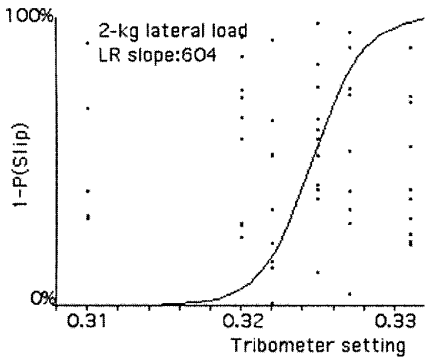
As with any idealized phenomenon, what we observe in fact is only an approximation to this idealization. What actually occurs is that there is no sharp-cornered vertical line delineating the slip/no-slip boundary. Depending upon the tribometer and the test conditions, the actual boundary has both a slant and rounded corners; at any given friction value near the actual-friction value, there is a finite probability, p, that the tribometer test foot will slip and a complementary probability, $1-p$, that it will not.

A statistical tool that can characterize such situations is Logistical Regression (LR). LR uses the occurrence or non-occurrence of a qualitative variable (here slip or no-slip) as the dependant variable and a set of continuous parameters as the independent variable set. (Here, the friction of the tribometric system is the single independent variable.) Essentially, LR uses a least squares, maximum likelihood approach with the negative sum of the logs of the probabilities attributed to the response levels that actually occurred at each observation. (Note that, because all probabilities are between 0 and 1, all the logs are negative.) The regression parameters can be used to characterize the tribometric system.



The experimental set-up is as follows (all stationary parts except the platform rail have been omitted for clarity). A level platform is constrained to move in a rectilinear fashion by low-friction instrument bearings bearing against a platform-support rail. To this platform, attached by string and pulleys, is a counterbalanced weight platform. When the platform is weighted to simulate a lateral force, it rests against a stop; the tribometer exerts a lateral force in a direction opposite that of the force exerted upon the platform by the weight. When the tribometer is released, the test foot contacts the platform, which is covered with double-stick tape, so as to eliminate all lateral force except as provided by the weight and the dynamic effects of the tribometer. The tribometer is set at a given level and repeatedly released. The dependant variable is recorded for each trial, i.e., slip/no-slip. The tribometer setting is varied and the process repeated. The weight is varied from the point where the carriage slips each and every time to the point at which the carriage never slips. The resulting data is analyzed using logistic regression. (Vertical load = 5.23 kg.)





Forensic Engineering, Walkway-Safety Tribometer, Slip-and-Fall Accidents

C50 Walkway Slip-Resistance Tribometry With Elastomeric Test Feet

Robert H. Smith, PhD, PE, National Forensic Engineers, Inc., PO Box 82486, Kenmore, WA 98028*

The goal of this presentation is to inform the forensic safety community that situations exist in which the classical coefficient of friction equation can be inappropriate for use in quantifying walkway traction characteristics.

This presentation will impact the forensic community and/or humanity by demonstrating application of a methodology which will allow calculation of the adhesion component of elastomeric friction on a scientific basis.

In walkway slip-resistance metrology a constant coefficient of friction equation is utilized as both the empirical and rational relationship to quantify the traction characteristics of surfaces encountered during walking. However, rubber is widely employed in footwear. In 2001, various types accounted for 55.3 percent of worldwide shoe heel and sole material usage. It has been shown repeatedly that rubber exhibits a decreasing coefficient of friction with increasing applied load. Many pedestrians experience this situation in everyday ambulation. When such occurs, the friction coefficient will not only decrease, but vary with pedestrian weight. It has also been shown that decreasing friction coefficients can be produced in the testing regimes of certain static and dynamic tribometers utilizing elastomeric test feet. Although use of constant coefficients to quantify walkway skip resistance in comparison to the generally accepted standard of 0.5 has been employed for many years, they have been justified only on an empirical, experiential basis. Use of constant elastomeric coefficients in such circumstances has not been scientifically justified. A comprehensive foundation for application of static and dynamic friction theory applicable to the elastomeric materials involved in walkway slip-resistance metrology has not been presented.

A review of the literature revealed that constant coefficients of friction have been utilized in walkway slip-resistance metrology since about 1930. At that time, Hunter designed his articulated strut tester to measure the angle at which a leather test foot slipped on selected walkway materials when an 80-lb weight was applied. The tangent of the slip angle was taken as the coefficient of friction. The constant coefficient of friction equation (Amontons' law) was originally developed in classical metallic theory in which the static and dynamic coefficients equal the tangent force resisting slippage of smooth, contacting metal surfaces divided by the normal load. Application of constant coefficients in the assessment of walkway safety presumably arose from their wide application in metallic, machinery operation where minimization of metal-to-metal contact resistance is desired. In such circumstances, contacting asperities on the metal surfaces are predominantly in the plastic range. The significant friction forces developed between these asperities comprise atom-to-atom adhesion. This mechanism is characterized as cold welding. When a shoe heel is an elastomer, its deformation during ambulation will likely remain elastic. Furthermore, because of their elasticity, elastomers experience both atom-to-atom and van der Waals adhesion.

Considerable investigation has been carried out on frictional characteristics of elastomers employed in fields other than ambulation safety. Findings from these efforts have applicability in walkway slip-resistance tribometry. An empirical and rational relationship, derived from the Hertz equation, has been developed for quantifying friction force generation when coefficients of friction decrease. The physical mechanism at work in these circumstances involves real areas of contact, or near contact, of elastomeric asperities and a smooth walking surface, where either type of adhesion develops. When applied normal loads increase, the areas of contact, or near contact, also increase. As a result, the friction force increases. However, its rate of increase can be less than that of the applied load and their ratio falls. Thus, a decreasing coefficient in these conditions does not indicate decreasing frictional resistance.

When applied to elastomeric materials, the Hertz equation takes the form FT = c(FN)m; where FT is the developed, tangent, friction force, c is a constant associated with the Young's moduli and Poisson's ratios of the two materials involved, FN is the applied normal load, and 2/3(m(1. It must be emphasized, however, that the Hertz equation quantifies only the adhesional component of friction. Other friction force mechanisms exist when elastomers slide on a harder surface. The Hertz equation should be applied only after the frictional resistance arising from the other mechanisms is identified, quantified, and subtracted from the total, measured tangent force. This capability awaits development of a reasonably complete understanding of elastomeric friction as it applies to pedestrian ambulation.

Variable Coefficients of Friction, Elastomeric Shoe Heels, Walkway Slip Resistance

C51 Human Posture Control: Preparation Gait to Avoid Slips and Falls

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After attending this presentation, attendees will understand the preparation gait on the slippery floor.

This presentation will impact the forensic community and/or humanity by presenting the outcome of a study which will provide new knowledge regarding control mechanisms related to the slip/fall. A better understanding of these mechanisms will allow for the prevention of injuries occurring from the slip/fall to be approached with a behavioral strategy. The new information from this study could also be used to develop walking algorithms for a humanoid robot and/or an artificial leg research.

Serious injuries resulting from slips and falls are a common source of economic loss in society. Data from the Bureau of Labor Statistics in 1996 indicate that 11% of fatal and 20% of nonfatal workplace injuries are due to falls. Although much research has been examined on how to reduce the slip/fall for several decades, there is a lack of detailed understanding of the cause of the slip/fall and possible injury mechanisms.

There are three general research approaches in the slip/fall research area: the environment-centered, i.e., measurement of the floor slipperiness; the human-centered, i.e., perception/detection for the floor slipperiness; and the human/environment interaction-centered approach. This study will take the third approach. The research will focus on how humans control the body segments in order to avoid the slip/fall when a task's goal is to traverse safely over the slippery floor.

To successfully walk on a slippery floor, the most critical factor is the maintenance of body balance and continuous forward walking at the same time. From the biomechanical point of view, the human body is built for mobility rather than stability. Running needs the extreme of mobility, keeping a marginal stability, while walking on the slippery floor needs the extreme of stability, keeping a marginal mobility. Thus, postural control mechanism which is initiated from the central nervous system needs a control strategy according to the environment and/or the task given. There are two control strategies for controlling the body and interacting with environments: feedback and feed-forward control strategies.

Feedback control requires information on the comparison between the output of on-going movements and the predefined goal. Humans collect this information through the afferent sensory system, and use it to correct the movement of the next step. While servo-machine systems can achieve certain goals using this control strategy, there are two problems in biological control systems: transmission delay and information process overload. To cope with these disadvantages, humans use a feed-forward control strategy. The feed-forward control requires a model of future movements, the current state of the environment, and the future goal.

For instance, when a slippery surface is anticipated and the goal is to go over the surface safely, the feed-forward control strategy activates a specific movement program of the future, that is, adaptation strategies, to the slippery surface. As the environmental condition changes, humans have to change some locomotor functions to optimally adapt to the situation. This study will examine how a slippery surface affects the preparation gait approaching the slippery surface. The objective of this study is to investigate the preparation gait on the slippery floor:

- to build an equation of motion for walking on normal and slippery floors.
- to simulate this model using control theory.
- to establish hypotheses as to how preparation gait is changed according to different adaptation strategies (foot stationary and foot sliding strategies).
- to verify preparation gait through comparing the simulation and the experimental results on human subjects.

The method of this study will include an experiment and a computational simulation. In the experiment, the subjects will be recruited from healthy young students at TTU. Subjects will perform tasks under conditions that include various walking speeds and degrees of floor slipperiness. Data will be collected by two force plates and a high-speed camera system. In the simulation, since the coordination of each body segment is a very important factor, the 2-body segments (lower and upper extreme) model will be used.

Walking Model

The walking model has three body parts: two links and a foot (Figure 1). Two joints represent the hip and the ankle. The lower and upper links represent the leg and the upper body of the human, respectively. The sources of movements are joint torques (t_1 and t_2) and thrust force (F_{TH}). This model is used to simulate human walking in the sagittal plane during the weight acceptance phase, that is, time duration from the heel contact to the middle of the single leg support phase.

The equation of motion consists of two parts: the rotational dynamic of the two links and the slipping dynamic of the foot. The equation of motion of the links is expressed as follows:

C52 Prediction of Slip Events During Walking: An Analysis of Utilized Coefficient of Friction and Available Slip Resistance

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After attending this presentation, attendees will understand how measures of available floor slip resistance and peak utilized coefficient of friction (COF) relate to the probability of a slip occurring during walking on a level surface.

This presentation will impact the forensic community and/or humanity by demonstrating that knowledge of an individual's peak utilized COF and the available friction (as measured by the variable incidence tribometer) can be used to predict the probability of a slip event during level walking in young adults. As measures of static coefficient vary across tribometers, the relationships reported in the current study will likely apply to the variable incidence tribometer only. However, other tribometers could be assessed using similar procedures to determine their ability to predict slip probability.

Introduction: A slip is likely to occur when the utilized coefficient of friction (COF_U) of an individual exceeds the available slip resistance of the floor surface. Floor surface slip resistance is commonly measured using a device called a tribometer, but different types of tribometers often yield measurements that do not correlate well with each other. Although several standards have been developed for tribometers that measure static COF, it is unclear to what extent static COF measures can be used to predict the probability of a slip occurring. The purpose of this study was to investigate the relationship between static measures of slip resistance (measured using a variable incidence tribometer) and peak COF_U (as measured from a force plate) on the probability of a slip occurring during level walking.

Methods: Twenty-eight healthy males (mean age = 27.4 ± 4.4 years; mean mass = 86.3 kg) and 24 healthy females (mean age 25.0 ± 2.7 years; mean mass = 63.3 kg) participated in this study. Ground reaction forces (AMTI force plates; 1200 Hz; 4th order, 45 Hz low-pass Butterworth filter) and kinematic data (VICON Motion Analysis, 6-cameras, 120 Hz) were recorded simultaneously as subjects walked at a self-selected speed along a 10-meter walkway. All subjects wore Rockport walking shoes and ambulated under conditions of normal and reduced floor surface slip resistance. Subjects were not told during which trial the contaminant (WD-40) would be applied, nor the location of the contaminant application. To ensure safety during testing, subjects wore a fall-arresting body harness attached to an overhead trolley which traversed the length of the walkway. The available slip resistance of the floor surface was measured using a variable incidence tribometer. The ratio of shear to vertical ground reaction forces obtained from the force-plate was used to calculate the COF_U throughout stance for each subject. During weight acceptance, the peak COF_U resulting from a shear force that would contribute to a forward foot slip was identified. To determine the relationship of the observed slip events to the calculated *slip resistance difference* (i.e., the difference between available slip resistance and peak COF_U) logistic regression analysis was performed. A second logistic regression determined the relationship of the observed slip events to knowledge of only the *available slip resistance*.

Results: Fourteen of the original 52 subjects were excluded from final analysis as they either perceived in advance that the surface might be slippery (n=3) or they did not fully step on the force plate where the contaminant had been placed. On the average, the self-selected walking velocity of the remaining 38 participants was 96.6 ± 13.0 m/min, the mean peak COF_U was $\mu = 0.21 \pm .04$, and the average available slip resistance was $\mu = 0.23 \pm .04$. Fourteen of thirty eight subjects (37%) experienced a heel slip during the trial in which the contaminant was applied. *Slip resistance difference* was a significant predictor of slip outcome ($p = 0.004$). Overall the model correctly predicted 89.5% of the slip outcomes, and accounted for 48.5% of the variance in slip outcomes ($R_L^2 = .485$). In the second model generated, *available slip resistance* also significantly predicted slip outcome ($p = 0.012$). Overall, the second model correctly predicted 78.9% of the slip outcomes, and accounted for 16.2% of the variance in slip outcomes ($R_L^2 = .162$).

Discussion: The results from this study indicate that the available slip resistance, as measured by the variable incidence tribometer, can accurately predict slip events. Knowledge of the available slip resistance, in combination with an individual's peak COF_U allowed for the greatest accuracy in predicting slip outcome (89.5%). With knowledge of only the available slip resistance, the accuracy of prediction was reduced to 78.9%, over the range of floor surface slip resistance values evaluated in this study ($\mu = 0.15$ to $\mu = 0.31$).

Conclusions: Knowledge of an individual's peak COF_U and the available friction (as measured by the variable incidence tribometer) can be used to predict the probability of a slip event during level walking in young adults. As measures of static coefficient vary across tribometers, the relationships reported in the current study will likely apply to the variable incidence tribometer only. However, other tribometers could be assessed using similar procedures to determine their ability to predict slip probability.

Coefficient of Friction, Slip Probability, Variable Incidence Tribometer

C53 Effect of Test-Surface Texture on Slip Resistance in Walkway-Safety Tribometry Testing

David Fleisher, MS, PE, 550 Pinetown Road, PO Box 908, Fort Washington, PA 19034; Mark I. Marpet, PhD, PE, St. John's University, 300 Howard Avenue, Staten Island, NY 10301*

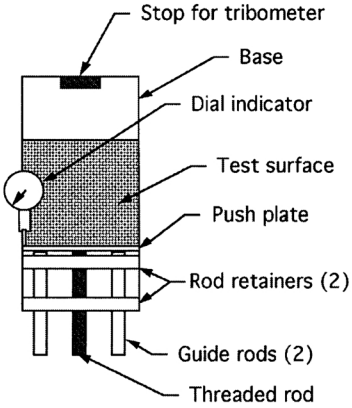
After attending this presentation, attendees will understand how surface texture impacts walkway-safety tribometry testing, and strategies to minimize the effect of surface-texture caused variation. A test apparatus designed to systematically advance the test surface is discussed, and its use in characterizing frictional variation with test-foot position is explored for a given test sample.

This presentation will impact the forensic community and/or humanity by contributing to the body of knowledge of Walkway-Safety Tribometry. The question of what type of test surface is 'smooth enough' to give consistent results without explicitly accounting for the surface pattern or variation is unsettled. This paper sheds light upon that issue.

The measurement of the slip resistance between the test foot and test surface using walkway-safety tribometric instruments (WSTs) plays a significant role in evaluating whether or not a surface and/or shoe-bottom material is safe under a given set of conditions. It is important that any test conducted reasonably approximate conditions encountered by pedestrians. One potential factor that could affect tribometric results is texture in the shoe bottom or on the floor surface, compared with their analogs in testing: the test foot and the test surface. The impact of texture might increase or might decrease the safety of the pedestrian relative to what the test shows. For example, texture in the shoe or floor might enhance drainage of liquid contaminants, making the pedestrian safer than what would be expected from tests; texture might, because of scale effects, cause mechanical interlocking between the test foot and test surface, indicating a slip-resistance value higher than a pedestrian would

realistically encounter. The effect of surface texture on slip resistance has not been systematically explored.

We have developed a simple apparatus to systematically explore the relationship between test-foot position and friction. It consists, as shown in the plan view, of a plywood base to which a metal tribometer stop and two rod retainers have been fastened. Three rods pass through the retainers: one threaded rod in the center and two guide rods (to prevent the assembly from 'walking.') The guide rods are rigidly fixed to the push plate; the threaded rod is allowed to bear against the push plate. The position of the push plate is advanced by turning the threaded rod, and indicated by a dial indicator.

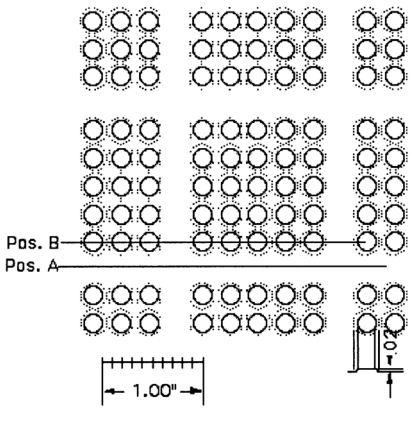


In one test (many more will be presented at the meeting), a dot-pattern floor was tested using a Slip-Test Portable Inclinable Articulated Strut Tribometer (PIAST). Two test positions were utilized: Position A where the trailing edge of the 'heel-weighted' test foot struck between the sets of dots, and; Position B, where the training edge of the test foot struck across the rear set of raised dots. The following results were obtained (See Table 1):

Table 1: Test results

	Position A	Position B
Sample size	10	10
Mean Slip Resistance	0.811	0.833
Standard Deviation	0.010	0.015

A two-Family F Test on the standard deviations revealed no significant differences ($p = 0.13$). A two-Family t-test on the means (equal variances) revealed the two positions to have generated significantly different results ($p < 0.001$). In plain English, the position of the test foot as it struck the surface had a small, but real, effect on the test results, and, at least for this surface, should be explicitly accounted for in the test design.



Walkway-Safety Tribometry, Surface Texture, Slip and Fall

C54 An Audit-Based Architecture for Tribometric-Test-Data Verification

Mark I. Marpet, PhD, PE, St. John's University, 300 Howard Avenue, Staten Island, NY 10301*

After attending this presentation, attendees can expect to be familiar with the concept of audit-based test architecture and to understand how such an architecture can be implemented, using as an example Walkway Safety Tribometric-test (WST) equipment (devices to measure walkway friction).

The impact on the forensic community and/or humanity will be twofold: first, it will give the forensic community an awareness of issues in the legal community's acceptance of test data; secondly, it will suggest a method using multiple not-eraseable semiconductor memory to make test-data alteration far more difficult.

Test results are routinely challenged in the courtroom. Questions such as who conducted a test, when exactly was the test conducted, and so forth are routinely asked. On one level, this information is brought forth to lay an appropriate foundation, to show that the tests are legitimately conducted. On another, these questions are asked to root out inconsistencies, variations, or discrepancies, even trivial and inconsequential ones, that can be used to challenge the validity of the tests.

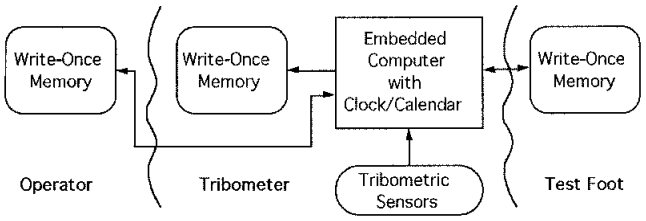
It cannot be ruled out that there exist a limited number of sophisticated and determined actors that can alter test data so that the detection of a test-result alteration becomes difficult or, perhaps, impossible to detect. Consequentially, no test result is ever completely beyond challenge. When the recording of test data is accomplished using a pad and pencil (or pen), as it is with most walkway-safety tribometers, test-result alteration is rather simple. On the other hand, it is possible, using both the standard 'paper-trail' concept and current technology, to make a test result very, *very* difficult to alter without detection. This paper discusses one approach to accomplish this, using multiple, write-once semiconductor memory devices in a manner that makes the cross-checking of the operator, instrument, test times, etc., with the test results, something essentially unalterable, which should greatly simplify the question of the provenance (factors relating to the origin) of the tests.

By way of background, a write-once memory device is an integrated circuit that, like an electronic odometer, has memory packets that cannot be rewritten once written to. In the same manner that an electronic odometer cannot be 'run backwards,' results recorded upon write-once memory chips cannot be altered once written. By embedding serial numbers on each memory chip, it would be nearly impossible (which is not the same thing as impossible) to replace the memory chip with one having altered information.

The procedure for making a test system highly resistant to results tampering is to (a) identify each element in the system that is essential to system integrity, (b) supply each of those elements with a device having a write-once memory and, (c) have each of the identified elements of the test system communicate with the other elements at test time and mutually record the data and results in each of the write-once memory devices.

In WST testing, our example, the tribometer, the test technician, the test foot, and the date and time of day are essential elements of the testing. The tribometer would be fit with sensors that track test results (for example, many tribometers give results as a length or angle measurement, which is directly related to a slip-resistance value) and an embedded computer having clock/calendar and data-logging capabilities. The operator can be supplied and the test foot can be equipped with write-once data-loggers that are written to be the computer in the tribometer. Because the data-logging circuits for the operator and the test foot do not contain an embedded computer, they can be both small and inexpensive (the size and cost of a car-door remote control 'clicker'). Schematically, the arrangement is as follows:

* Presenting Author



The embedded computer creates, using a hashing or similar algorithm, a test code that will encapsulate the date, time, tribometer serial number, operator serial number, and test-foot serial number. That, along with the set of test results, is recorded in the three write-once memories. These memories can be printed out, providing a convenient test-record, and can be read by a properly equipped and programmed computer, providing an essentially unalterable snapshot of the information contained in the write-once memories. Some information, e.g., certification data for the operator, test instrument, or test foot, can be kept within the write-once memories for the operator, test instrument, or test foot respectively, and not written across the memories.

Obviously, this is a very flexible scheme, not restricted to tribometric instruments, and not restricted to the tribometer/operator/test-foot combination described above. For example, this architecture could be implemented on blood-alcohol testing instruments, where the instrument, the operator, the calibration references, and the test results could all be concurrently written with the test results. In tribometric testing, temperature and relative humidity can be automatically recorded; more blue-sky-like, a compass circuit could give test direction, a GPS module could give approximate test location, and so forth, with the extent of test-parameter recording automation limited essentially by cost.

This architecture, because background and test-result data are automatically recorded on a number of not-necessarily co-located data-loggers, it makes inadvertent transcription errors impossible and the altering of already-written data essentially impossible. It is not, however, resistant to deliberate fraud. Two examples: (a) This described system is incapable of preventing a given operator from lending (or an unscrupulous person from temporarily 'borrowing') the operator's data-logger. Running with this, one could resort to fingerprint or retinal scan identification, to show that the operator is (at least) present, but cost would rise substantially if such measures had to be taken. (b) The clock/calendar could be deliberately mis-set in order to deceive. That is limited—like the entries in a laboratory journal—by the sequential nature of the not-rewriteable entries. To further prevent time/date tampering, the program that sets the date and time could be programmed to accept data only from a list of internet-based NTP time servers (http://www.ntp.org/), making it more than rather difficult to deliberately set an incorrect time.

Slip-and-Fall Accidents, Walkway-Safety Tribometry, Forensic Engineering

C55 Semi-Automatic Reconstruction of Fragmented 2D Objects

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The goal of this presentation is to present an overview of the existing state-of-the-art and our currently ongoing research concerning several semi-automatic techniques for the reconstruction of fragmented 2-D objects.

This presentation will impact the forensic community and/or humanity by providing a better understanding about the design and use of computer tools for 2-D object reconstruction.

In this paper we present an overview of several theoretical and implementation-related issues and techniques regarding the process of digitally reconstructing fragmented 2-D objects. These objects can include, e.g., broken pieces of relatively flat or 2-D artifacts, or, torn or ripped-up documents recovered from a crime scene.

First, it is important to note that we present a brief overview of the existing literature that discusses several (semi) automatic solutions for solving the well-known toy-problem of reconstructing digitized jigsaw puzzles and several related applications, i.e., the reconstruction of 2-D fragmented objects. Next and fairly generally speaking, we center the body of this presentation around our ongoing research, following a decomposition of the given problem into four important subproblems. These subproblems are: (i) object digitalization and segmentation, (ii) local shape-based matching of fragment contours, (iii) global reconstruction strategies for combining multiple fragments and (iv) accurate realignment and positioning of the fragments within a single digital image canvas.

Object digitalization and segmentation is an important step since it is a required preprocessing step for obtaining a computer database of a given set of fragments. Note that such an all-digital approach avoids continuous handling of the original forensic evidence. Additionally, a computer-based reconstruction of, e.g., a ripped-up document, does not require any form of adhesive tape or glue. Finally, electronically re-editing (e.g., drag-and-drop puzzling), multilayer overlaying of investigative annotations (e.g., high-lighting important regions), and unlimited reproduction of any of the (partial) reconstruction results can be implemented easily.

Local contour matching of each pair of fragments is generally considered an efficient method for roughly matching fragments with each other. This process is typically based on some simplified mathematical measurements yielding a set of shape features that can be used to describe the outline of each fragment. The local fragment pairing step can then be realized by performing a so-called string matching process, i.e., we search for strongly resembling segments within the contour feature vector. For fragment contours that show almost no curvature features, this process can be rather difficult. Fortunately, some other or higher level information can be used to simplify the problem further; e.g., real straight line contour segments can be detected to yield a classification of all fragments into three different types: corners (two straight line contour segments forming a right angle), edges (single straight line contour segment) or internal fragments (``randomly'' shaped contours).

Additionally, we have successfully implemented a multi-resolution strategy for accurately repositioning and combining fragments by computing a minimal pixel-counting gap and overlap contour fitting function. This fitting function was also adapted and extended to be able to compensate for areas that sometimes need to have a maximum overlap, e.g., when the tear-line of two paper fragments has considerable width (and is showing the inner fibers of the paper on the two corresponding matching sides of each of the fragments).

For arriving at global reconstruction solutions we have implemented several strategies that build upon the local contour matching cost function results and the higher-level information about the type of each fragment (corner, edge or internal fragments). If we consider, e.g., the fragmentation of a rectangular object, edge and corner pieces can be reassembled first to form a rectangular frame of fragments. This reassembly process can then be implemented as a Traveling Salesman Problem which can be optimized using a well-known graph-based optimization strategy.

Finally, the accurate realignment and positioning of the fragments on a single image canvas is discussed. This can again be realized using the multi-resolution overlap-gap computation process and several possible strategies for determining the order in which the fragments are con-

sidered and embedded within the image canvas. Although this component does result in additional computational complexity, the quality of the more accurate global reconstruction results justifies its use.

Several excellent reconstruction results, as well as some of the remaining problematic issues are discussed and illustrated. Additionally, a few prototype GUI tools that can be used to build a more flexible framework for enabling interactive and semi-automatic reconstruction of a given set of fragments, are demonstrated.

Object Reconstruction, Object Recomposition, Digital Image Processing

C56 Computer-Modified HD-Video Allows Extension of Previous Range of Visibility Studies While Applying Accepted Foundation Procedures

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The objective of this paper is to report on the integration of improved video and related computer technology into existing, long-accepted visibility study preparation and presentation methodologies. The result has been an incremental extension of the types of visual environments which can be reproduced with substantial similarity for admission as visibility evidentiary exhibits in court.

This presentation will impact the forensic community and/or humanity by demonstrating that the improved video technology allows a much more accurate depiction of an extended range of visibility conditions that may be encountered during incidents under investigation or in litigation.

Visibility studies — depicting what is available to be seen by a driver (or other witness) with normal unimpaired vision under conditions similar enough to those obtained at the time of the subject incident to be relevant — have been routinely admitted in evidence in state and federal courts throughout this country since the 1960s. Proper foundational expert testimony details basic information such as the proper viewing distance for a life-size image and correct angular perspective; analyzes the significance of such factors as expectancy, the average human horizontal angle of view compared to that presented in the visibility study, and presents a discussion of any similar factors. There have been many articles published concerning visibility study methodology; a coordinated set of presentations appeared in the peer-reviewed abstracts of the 11th Meeting of the International Association of Forensic Sciences in Toronto in 1987 at which three experts in human factors psychology, reconstruction engineering, and engineering photography made presentations regarding the accepted methodology for preparing and introducing visibility studies in evidence (1,2,3).

The methodology for preparing visibility studies evolved steadily through the direct collaboration of engineers and scientists in several fields, along with independent work by numerous others (See *e.g*. Klein *et al*., 4). A great deal of this work related to the methods and related technology for depicting visibility under nighttime or other reduced visibility circumstances in a manner which would be routinely admissible as evidence in court. The methods for accomplishing accurate nighttime films, which have resulted in routine admissibility of such visibility studies were developed on a case-by-case basis with engineering photographers Paul Kayfetz, Michael Mayda, Bruce Kayfetz and others working with human factors psychologists Dr. Albert Berg, Dr. Slade Hulbert, Dr. Herschel Liebowitz, Dr. Kenneth Ziedman, Dr. Robert Post, Dr. Richard Olsen, Dr. Paul Olson, Dr. Thomas Ayres along with lighting experts such as Michael Janoff and Eugene Farber (5,6,7).

The accepted foundation method for calibrating nighttime visibility studies involves controlled observations at the scene being compared to exemplar 4x5 color Polaroid photographs which are annotated for observed levels of detail, and then used as controls for producing and verifying the level of detail depicted in the relevant areas of the final visibility study under courtroom viewing conditions. This methodology has been described in peer-reviewed literature by a range of engineering photographers, reconstruction engineers, and human factors psychologists who have been involved in developing or utilizing the technique.(8,9,10; also 4) This represents a huge advance over the traditional practice of the past century in which a photograph was normally admitted based on the testimony of the photographer that "it is a true and accurate representation of what I saw."

In the 1980s the author worked with ophthalmologists to adjust visibility studies made using film to depict measured reduced levels of visual acuity. An example which the author prepared involved a motorscooter operator with previously-measured 20/200 vision whose passenger had 20/400 vision. A nighttime 16mm motion picture visibility study was prepared illustrating visibility for a motorscooter operator with normal unimpaired vision striking the side of a slowly-moving freight train crossing his path. Working with the ophthalmologist co-expert, the image was then degraded to depict respectively the vision of the motorscooter operator and his passenger (using a Snelling chart which had been filmed for calibration). This was repeated with a film which had been taken with additional warning devices added at the railroad crossing to show what effect, if any, these would add in warning a driver with this level of vision at night that he was encountering dark box cars across his path. The entire study was routinely admitted in evidence in a California court. Modifications of this type to visibility studies were limited in scope because of the relatively limited alterations which could be made to *film* in a controlled, quantified manner.

Motion picture film and still photographic film were the most technically usable media for visibility studies until significant improvements in *video* which became available only in the past year. This is because 16 mm film has more than 25 times the pixels (resolution units) than does VHS video. Recently, however, HD-video became available in camera configurations which could be used for taking visibility studies in the field. This format has the same pixel count as 16mm film, but appears much "sharper" because there is no apparent grain. (This difference is extremely significant in nighttime applications where highspeed 16mm film has a distracting grain pattern).

The primary conclusion of this paper is that the improved video technology (HD-video systems) allows an extension of this previously-practiced interaction between the visibility study preparer, other experts and eyewitnesses to depict more accurately an extended range of visibility conditions encountered during incidents related to investigation or litigation.

When HD-video is being taken, a waveform monitor can be employed which allows calibration of brightness ranges and color ranges and quantified control in all areas of the image. Once in the computer, extremely precise programs are available for measuring and adjusting densities, brightness, color ranges, and other parameters overall, locally frame-by-frame or pixel-by-pixel. The level of control that is available with various programs to adjust lighting or to depict atmospheric conditions is unlimited. The result is that with proper foundational input and controls, using eyewitnesses or experts for validation, conditions prevailing at an original accident scene can be replicated more precisely than with the previous purely-photographic tools.

Four examples of visual situations shown briefly during the oral presentation of this paper will illustrate its objective:

1. *Fog*: During daylight hours a passenger car was proceeding in dense fog reaching to and moistening the ground. The car struck the side of a tractor/trailer pulling forward from a stop sign across the path of the car. Immediately after the collision the driver of the big rig, standing at a known position on a traffic island, took a series of photographs looking down the length of his rig with a series of signposts showing in the photographs. The rear of his rig and certain of the signs disappeared in the fog at ascertainable distances. The police, who arrived within minutes, backed away from a particular sign along the path of the striking car and measured that it disappeared in the fog at 120 ft.

HD-video was taken with a 90 degree horizontal angle of view from the driver=s position in an identical car on a sunny day following the path leading to collision. Separately, a topographic survey of the intersection and

the approaching highway was used to create an accurate scale "universe" of the accident scene in the computer. A three-dimensional scale model of the particular big rig involved in the accident was built in the computer and rendered photorealistic using photographs of the accident vehicle. A three-dimensional "fog program" was then used to generate the same density of fog as measured by the investigating officers and corroborated by the accident-time photographs. The drivers-eye HD-video was "camera-matched" frame-by-frame with the computer universe of the accident scene using a program which photogrammetrically tracks dozens of landmark features appearing in the video. The big rig was caused to accelerate in the computer from the stop sign through the point of impact as the car arrived at collision, consistent with both the reconstruction analysis and crash tests done by various experts involved in the case. The resulting drivers-eye visibility study showed the fog-filled scene through the entire front windshield substantially-similarly to that measured and photographed by witnesses minutes after the actual accident.

2. *Sun glare*: The author was requested in June to prepare a visibility study for trial in a few weeks. The issue was a driver's visibility of a pedestrian with the setting sun on the horizon just behind him in a December accident in a parking lot. HD-video was taken at the accident location with the June sun still high overhead on the collision course with an exemplar pedestrian. Hours later the setting sun was videoed at the accident altitude (on a path adjusted at a 50 degree angle to the north) traveling at the same speed in the same parking lot. The exemplar pedestrian again was walking at the same respective angle to the car on the collision course. Portions of the two videos were combined in the computer so that the buildings, hills and other fixed features of the original accident were preserved, but the glare on the windshield and hood, reflections on the pavement, and the lighting on the pedestrian with the December sun position on the horizon directly ahead of the car were accurately depicted in the final composite. The foundation testimony for admissibility included not only testimony from the experts preparing the visibility study, but that of the investigating police officer who drove the same route two minutes after the accident and wrote in her report "the glare was so strong that at 5 mph I almost struck the people standing over the body."

3. *Smoke and flames*: A wind-driven grassfire adjacent to an interstate highway was a factor in multiple collisions and deaths. An issue was the appearance of the fire and smoke to approaching drivers in different vehicles, at various times over several miles. Lines-of-sight over a crest on the approach were an issue.

HD-video was taken from several exemplar big rigs, a school bus, and a witness truck approaching the fire/collision scene on the paths and at speeds consistent with witness testimony. Video was also taken from each illustrating moderate deceleration to a stop on the shoulder after topping the last crest before reaching the fire. Video was taken from numerous witness= positions looking at the fire area from various directions.

A three-dimensional Auniverse@ compositing the huge fire and smoke plume as it progressed across many acres and during some ten minutes was prepared; (the size of the file was more than 100 gigabytes!). It was based on an extremely high-resolution set of aerial photomaps; aerial and ground photographs of the burned area; extensive topographic surveys, three still photos showing the smoke and flames; photogrammetry locating the flame front, smoke position and height; field sampling, fuel testing, computer modeling, and a fire/smoke progress report by a fire scientist; and the integration of information from written statement and deposition transcripts of dozens of eyewitnesses who viewed the fire and smoke from different directions.

The elegance of the three-dimensional computer universe of the fire/smoke is that any viewpoint can be "dialed in." The view from a witness' position can be rendered, the resulting moving video image shown to the witness, and the entire universe modified if necessary based on the response. This process can be repeated with various witnesses until a consensus universe still consistent with the physical evidence is achieved.

Once the computer universe has been conformed to the physical evidence and the best consensus of witness= testimony, the driverseye HD-videos are composited with the computer universe of the fire/smoke to show photorealistically what it looked like to a given driver at the time he was approaching from seven miles away and driving into and through some quarter-mile of smoke and adjacent flames. Video-fire/smoke composites from various witness viewpoints, along with related still "video captures" also assist in foundation testimony for admissibility.

4. *Horse vision*: A race horse bolted while being exercised on a track and ran at full speed into a green fence against green foliage under subdued, early morning lighting. HD-video was taken from the horse's eyelevel traveling on the path that he had been following. HD-video still footage was also taken at measured points along the path. From these points HD-video still footage was taken of color and grey scale charts. These were computer-modified with a computer algorithm by an animal vision physiology professor who has analyzed and tested equine spectral and acuity visual response.(11) His computer modifications of the HD-video color chart and still frames provided a guide, when followed quantitatively with the calibration devices available in the HD-video computer processing programs and equipment, to conform the visibility study moving video to the professor's analysis of what a horse would have seen following this path under these lighting circumstances. Additional HD-video exhibits were then prepared inserting, with identical adjustments for "horse vision," various white warning rails and other safety devices which racetrack design experts testified should have been in place on the fence in order to show they would have been visible to a horse.

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Visibility, Photographic Simulations, Computer Simulations

C57 3D Computer Models Used as an Investigation Tool in Forensic Investigations

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After attending this presentation, attendees will understand the value of using 3D computer models in forensic investigation.

This presentation will impact the forensic community and/or humanity by demonstrating a variety of important uses of forensic photography.

The value of the use of 3D computer models in forensic investigations is discussed. Examples of cases are given in which 3D computer models are used to get more information about the position and/or size of an object seen in a picture and as a tool for scenario testing.

Photographs and video footage are a 2D representation of the 3D world. One way to get more information from these 2D images is the use of 3D computer models. With software like 3D Studio Max it is possible to construct a 3D model and place a virtual camera. This camera can be placed anywhere in the scene, so it is also possible to place a virtual camera at the location of the original camera that shot the original image. The positioning of this camera can be done automatically by the software since it is provided with a camera-match algorithm that calculates the camera position and Field Of View on the basis of corresponding points in the original image and the 3D model. By superimposing the original image over this virtual camera view of the 3D model it is now possible to place 3D objects in the model and see them in the original image at the same time. If one of the degrees of freedom of the object in the original image is known the 3D object can now be placed at the position of the object in the original image. By this the position and/or size of an object can be determined.

The uncertainties in the extracted information using this method are caused by:

- errors made in the 3D model
- lens distortion of the camera that shot the original image
- errors made in position and FOV of the virtual camera
- positioning of the 3D object

The last two errors are not just caused by measuring errors, but are also dependent on the interpretation of the image by the investigator. For this reason it is recommended that a measurement should always be repeated by a second independent investigator.

An estimation of those errors can be done by making reference images with the original camera system. When taking these reference images one should place objects of known size at a known place in the vicinity of the place of interest from the original image. By measuring them later in the 3D model one can estimate the errors. To keep the errors low it is important to avoid getting information from outside the boundaries of the 3D model, since the propagation of errors outside this volume can be enormous.

Examples of the use of this technique are the estimation of the height of a robber, the speed of a motorcycle or the reconstruction of a bullet trajectory in shooting incidents. We dealt with cases from CCTV-recordings of shooting incidents in which one could not see the shooting itself, but the impact of the bullet was visible. With the reconstruction of the bullet trajectory it was possible to point out the position of the shooter. The advantage of the use of a 3D computer model in these kind of cases is that it can also be used as a visualization tool.

3D computer models can also be of help in the visualization of complex incidents. This visualization can help the investigators to understand what happened but can also be used as a scenario testing tool. This technique has been used in the investigation of a mid air crash between two airplanes and for the investigation of a disaster with an exploding fireworks factory.

Another example of this technique is a case in which we modeled a crime scene with two people murdered. Several pictures of blood spatters from three different locations were added in the model. From DNA analysis it was known that for every location the blood came from a different person (the two victims and a third person). With bloodstain pattern analysis three volumes were reconstructed that indicated the origin of the blood for these three different locations. In combination with a model of the two victims and their wounding channels, and other evidence like the position of bullets found, different scenarios were tested.

By generating a sequence of images, or even making an animation, it is possible to visualize a scenario. However, precaution should be taken, because animations suggest a reality that might not leave options open for other ideas about what happened.

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3D Computer Modeling, Photogrammetry, Blood Spatter

C58 The Use of 3D Acquisition Techniques of Surfaces for Forensic Image Databases

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After attending this presentation, attendees will understand the possibilities of 3D scanning methods in forensic science

This presentation will impact the forensic community and/or humanity by demonstrating the use of 3D acquisition techniques of surfaces for forensic image databases. 3D techniques for scanning can result in higher recall rates when comparing to an 2D image database.

Techniques for three dimensional acquisition of surfaces are developing rapidly, and are becoming cheaper and faster to use. However, most forensic image databases are still based on two dimensional (digital) photographs. Known examples are databases for tool marks, bullets and cartridge cases. For this reason, a research project has been started on the feasibility of using the third dimension in forensic image databases.

It is important that the surfaces are not damaged by the techniques. For this reason, we have limited our research to techniques that work contactless. Many products have been developed in the manufacturing industry for contactless scanning of 3D surfaces. These products are based on:

- Stereo Photogrammetry
- Laser Scanning Triangulation
- Moiré Fringe Contouring
- Structured light

Stereo Photogrammetry is combining two (or more) images from cameras with a different viewpoint. This is also similar in the way that we see depth with two eyes. A computer can exploit this offset to perform the same operation. If presented with two photographs of an object taken from cameras set slightly apart, it can use the differences between the two pictures to retrieve 3D information from the image. The trick is to let the software firstly identify the correlation between the image pair.

The technique of laser scanning triangulation involves projecting a stripe of laser light onto the object of interest and viewing it from a camera. Deformations in the image of the light stripe correspond to the topography of the object under the stripe and are measured. The stripe is then scanned across (or around) the scene to produce 3D data for the rest of the object.

The essence of the Moiré fringe contouring is that a grating is projected onto an object and an image is formed in the plane of some reference grating. The image then interferes with the reference grating to

form Moiré fringe contour patterns which appear as dark and light stripes. Then, analysis of the patterns gives accurate descriptions of changes in depth and shape.

In the structured light approach, patterns of light (grids, stripes, elliptical patterns, etc.) are projected onto an object. Surface shapes are then deduced from the distortions of the patterns that are produced on surface of the object. With knowledge of relevant camera and projector geometry, depth can be calculated by triangulation.

In the literature approaches are known in forensic science with laser triangulation and structured light. Approaches for using laser triangulation are known for crossing ink lines, cartridge cases and faces. The advantage of structured light is that it captures images very fast (less than ten second per scan), the technique is not expensive and it is possible to work with small objects.

We have used structured light for toolmarks and logo's of a drug tablet. With this technique, heights of 5 micron can be measured. One disadvantage of this technique is that, depending on the depth and on the surface that is scanned, occlusions are possible. By measuring the surface under different angles, and averaging the result, it is possible to avoid occlusions. The matching of the different positions is committed with the Fourier Mellin algorithm. The system could be improved by using a stepping motor when turning the tablet. From this research it is recommended to develop a 3D image database in which pattern recognition method are based on the 3D structure instead of the 2D side light image.

Three-dimensional techniques for scanning surfaces are now in the research and development stage in forensic science. As soon as the techniques will become faster, more sensitive, less expensive and more experience with the techniques is obtained, it is expected that they will be introduced routinely in forensic science.

3D, Structured Light, Image Databases

C59 Assessment of Roper and Howard's 2:1 Expectancy Rule in Nighttime Motor Vehicle Accident Reconstruction

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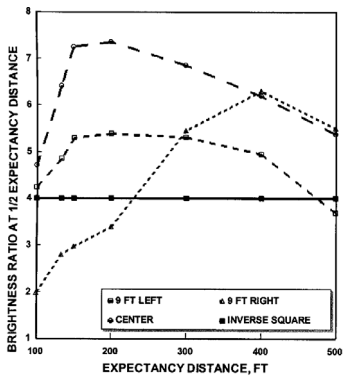
The objective of this study is to evaluate the rationale commonly applied by accident reconstructionists to correct for the distance at which a non-expectant driver will see an obstacle in the path of his vehicle under nighttime headlight illumination based on the 1938 findings of Roper & Howard, who reported that a typical driver who expects to encounter an obstacle will first see it at twice the distance as one who is totally unaware of the obstacle's presence [1]. Attendees will learn to differentiate between motor vehicle accident scenarios to which the 2:1 expectancy rule is applicable and those to which it is not.

This presentation will impact the forensic community and/or humanity by differentiating between motor vehicle accident scenarios to which the 2:1 expectancy rule is applicable and those to which it is not.

The objective of this study is to evaluate the rationale commonly applied by accident reconstructionists to correct for the distance at which a non-expectant driver will see an obstacle in the path of his vehicle under nighttime headlight illumination based on the 1938 findings of Roper & Howard, who reported that a typical driver who expects to encounter an obstacle will first see it at twice the distance as one who is totally unaware of the obstacle's presence [1]. Attendees will learn to differentiate between motor vehicle accident scenarios to which the 2:1 expectancy rule is applicable and those to which it is not.

The forty six test drivers who participated in a study conducted by Roper & Howard were unaware that they were involved in a visibility experiment and would be encountering a mannequin standing in the road directly ahead of them as they test drove a vehicle down a rural roadway at night. Their reactions to this unexpected confrontation with a human-like obstacle were recorded by a strip chart recorder monitoring the drivers' foot pressures on the accelerator peddle. These measurements were then used as a basis for determining the driver's distance to the mannequin at the instant of detection. The test was then repeated with the same 46 drivers, who were now in an expectant state similar to that of test drivers in most structured visibility experiments. The analysis of these data revealed that the ratio of mannequin detection distances for 46 drivers in the non-expectant vs. expectant states was 0.50±18% (18 is ± one standard deviation expressed as a percent of 0.50). The reciprocal of 0.50 is the basis of Roper & Howard's 2:1 expectancy rule.



The headlights used by Roper & Howard were not intended to produce a distribution representative of any existing headlamp beam pattern, but were uniquely designed for the purposes of this study to produce uniform illumination throughout the area where the mannequin was standing [1]. Under this condition, mannequin brightness would have varied inversely with its distance squared, which would have resulted in a brightness ratio for non-expectant vs. expectant drivers of 4:1. Since object size, brightness and distance are all factors in object visibility, the application of Roper & Howard's 2:1 expectancy rule is strictly valid only under the conditions that the brightnesses of uniformly-illuminated humans or human-like objects in the vehicle's path increase by a ratio of 4:1 when distances are halved. These same limitations apply to the application of the "Hyzer Shortcut Method", described by Olson & Sivak as a procedure for making first-approximation estimates of a driver's visibility limitations from an expert's field observations [2]. Following are some objects and lighting conditions that are either incompatible with Roper & Howard's 2:1 expectancy rule or need to be subjected to more critical analysis before applying it to them.

1) Retro-reflecting small signs, license plates and warning devices. Reflected brightnesses of retro-reflecting devices under uniform headlight illumination are inversely proportional to the 4^{th} power of their distances. By reducing distances to one half, brightnesses increase by a factor of 16:1.

2) Wires, cables, ropes or chains stretched across the roadway. Reflected brightnesses of uni-dimensional objects under uniform headlight illumination are inversely proportional to the 3^{rd} power of their distances. By reducing distances to one half, brightnesses increase by a factor of 9:1.

3) Objects illuminated by low-beam headlights: Low-beam headlights do not uniformly illuminate large objects such as pedestrians.

4) Objects located above or below headlight level or to the left or right side of the roadway: Headlight illumination is angle dependent so that the brightnesses of objects located above or below headlight level or off to the left or right side of the roadway rarely meet the required 4:1 brightness ratio when their distances are halved, as illustrated in the above graph for the specific case of low-beam-headlight illumination of objects located to the left, center and right side of the road at ground level. Brightness ratios are shown to range from a low of 2:1 to a high of over 7:1 when distances to the objects are reduced by half, depending upon the location of the objects within the pattern of the headlight beams.

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Expectancy, Accident Reconstruction, Visibility

C60 A Luminance-Based Analysis of Olson and Sivak's 1984 Research on Visibility Response Distance to Dark-Clad Pedestrians Under Headlamp-Only Illumination

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The objective of this paper is to present a scientifically-valid method for interpolating and extrapolating Olson and Sivak's [1] experimentally derived visibility response distance distributions to dark-clad pedestrians under US low beam headlamps.

This presentation will impact the forensic community and/or humanity by demonstrating that the visibility identification luminance distribution of dark-clad pedestrians, derived from Olson and Sivak's response distance distributions, for both the left and right side of the road, fit a single normal distribution when plotted together. Therefore, it can be used to determine identification distances to pedestrians for many common nighttime vehicle/pedestrian collisions.

One of the most relied-upon studies of pedestrian visibility is a 1983 report by Olson and Sivak [1], also described in reference 2. In part of this study on low-beam headlamps, twenty-three young passenger and/or driver observers were asked to identify and respond to a target on either the right or left side of the road under headlamp illumination. One of the four potential targets was a dark-clad pedestrian wearing blue denim clothing measured at 6% reflectance. Data collected in this study were plotted as response distances on normal probability paper and resulted in mean response distances of 145 and 75 feet for pedestrians on the right and left side of the road, respectively. Figure 1 was derived by digitizing figures 3.16 and 3.17 in reference 1.

Figure 1

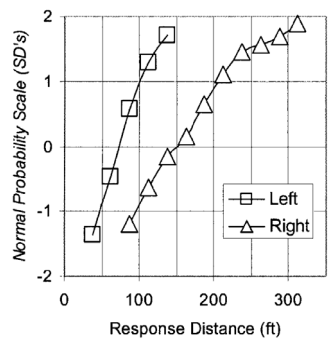
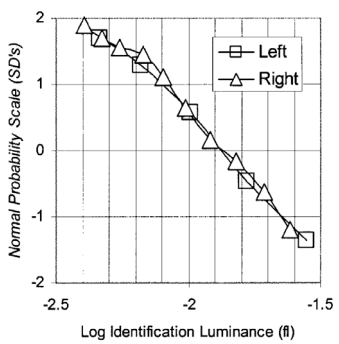


Figure 2



For relevant vehicle/pedestrian collision reconstruction, where the struck pedestrian may be standing or moving somewhere other than 9.5 feet on the left or 9.5 feet on the right of the path of the approaching vehicle, and may be wearing something other than 6% reflective clothing, it is necessary to extrapolate and/or interpolate the data contained in Figure 1. With this in mind, each point in Figure 2 was created from a point in Figure 1 as follows; 1) each response distance was converted into an identification distance; 2) identification luminance at headlamp height was calculated for each identification distance; and 3) identification luminance was plotted logarithmically to the same normal probability scale as Figure 1. The data points for the identification luminance to pedestrians standing to the left and right side of the road merge into a straight line when plotted logarithmically in figure 2, indicating a single normally distributed population of observers with a mean identification luminance of 0.014 fl at headlamp height, and a mean plus and minus one standard deviation of 0.023 fl and 0.008 fl, respectively.

Log identification luminance distributions similar to figure 2 were also determined at each distance at foot/ground level and at 4 feet up on the pedestrian. Though the curves for left and right standing pedestrians also coincide at ground level with a mean identification luminance of 0.039 fl, the better coincidence was found to be at headlamp height. The curves did not coincide at the 4 foot level. Two advantages of using luminance at headlamp height for visibility distance calculations are 1) headlamp height allows the use of the inverse square law for pedestrians located in the center of the road, and 2) illumination at headlamp height is not affected by contrast with the illuminated road surface in the same manner as illumination at ground level.

The results of this analysis allow the reconstructionist to determine visibility distance from luminance measurements or calculations for many common collisions involving vehicles operating with low beam headlamps and dark-clad pedestrians. A luminance-based analysis permits interpolation and extrapolation to be made for different pedestrian positions in the roadway and different clothing reflectances. Additionally, with a luminance-based analysis driver/observer statistics and expectancy considerations can be more easily quantified.

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Olson, P.L. and Sivak, M. (1983) Improved Low–Beam photometrics, University of Michigan Transportation Research Institute, Ann Arbor, Michigan, Report No. UMTRI-83-9.

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Accident Reconstruction, Visibility, Illumination

C61 Photogrammetry and 3D Laser Scanning Used for Facial Recognition

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The goal of this presentation is to present to the forensic community how photogrammetry can help in facial recognition. It shows the results of photogrammetric calculations to indicate how accurate facial comparisons can be done.

This presentation will impact the forensic community and/or humanity by demonstrating to the forensic society a mathematical tool for facial recognition, in order to avoid subjective comparisons.

Comparisons between two different faces are best performed when both are looking in the same direction. However, photographs of a perpetrator and the suspect are often taken from a different point of view. In case the suspect is willing to co-operate with the police, a photograph can be made using the three-point method, described in [Aarts, 2001]. However, the procedure is time consuming and estimations about the accuracy cannot be given. It's easier to make a 3D laser scan of a suspect's head, taking about 10 seconds, and use this model to reconstruct the position of the perpetrator's face using photogrammetry. This reconstruction can be done, with certain accuracy, and error estimates can be calculated. The most important advantage of this method is that the accuracy may give information about whether the suspect is the same person as the perpetrator, in order to avoid subjective comparisons. This research will present the results of this method.

To view the 3D-model of the suspect from the same position as the face of the perpetrator on the photo, the parameters of the camera used need to be known. Since this information is never available, these parameters have to be approximated by using the information given: the photo and the 3D-model. Photogrammetry provides the mathematical equations needed to calculate camera parameters using a photo and the dimensions of the object seen on this photo. A camera match algorithm is derived that needs a minimum of four identical points present in the photo and 3D model, the so-called match points. To calculate the camera parameters an iterative process is used based on least-squares adjustment. The accuracy for parameter calculation is presented for different situations.

For the first experiment, a photo and 3D model of a cube was used. The photo was taken with a camera with known parameters. From the eight corners of the cube the co-ordinates in 3D were given and the corresponding photo co-ordinates were read from the photo. With this information, the camera parameters were derived and compared with the known parameters. Statistical information about the remaining errors in the mathematical model was calculated as well. In the second experiment a photo and 3D model of the same face were used. The points on the 3D model used as match points were also unequivocally visible on the photo, so no mistakes were made in the identification of points. In the case of the cube, the cube-corners were also unequivocally identified. In the third experiment the same photo and 3D model were used as in the second experiment, only the match points used in the 3D model were not unequivocally given in the photo. This simulates the real situation in which the suspect is the same person as the perpetrator. The fourth experiment used the same photo as in the former experiments but the 3D model was of a different face. This is the case when the suspect and the perpetrator are not the same.

The results for these four experiments are given for the camera match algorithm. It shows the differences in estimation of the camera parameters in the mathematical model depending on experimental setting. Further research is necessary to study the flexibility of this algorithm for the application of facial recognition in the future. Furthermore, some other aspects that have to be taken into account, e.g., resolution of the photo and the size of the face in the photo, will be discussed.

Aarts, Prof Dr J.M., *Mathematical Analysis of Forensic Photo Identification*. Faculty ITS, TUDelft. November 2001.

Photogrammetry, Facial Recognition, 2D-3D Registration

D1 Medico-Legal Implications for Osteogenesis Imperfecta in Cases Involving Possible Child Abuse

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The goal of this poster presentation is to present to the forensic science community a review of the available literature concerning the identification of child physical abuse and the medico-legal implications concerning the brittle bone syndrome known as osteogenesis imperfecta.

An intricate aspect of forensic osteological investigations is the ability to differentiate skeletal trauma resulting from accidental and non-accidental injuries. This ability becomes more important when confronted with cases involving potential child physical abuse. The failure to recognize skeletal trauma caused by child abuse and skeletal trauma resulting from accidents or congenital conditions can result in the compromise or obstruction of child protection. Erroneous interpretations as to the manner in which skeletal trauma occur could inhibit full assessment by non-medical advisers while reinforcing parental denial, thereby putting a child at risk of physical harm or even death (Lynch 1995). Conversely, skeletal trauma resulting from congenital conditions such as osteogenesis imperfecta, a brittle bone condition that primarily affects infants and young children, can and has been confused with non-accidental injuries. Due to inaccurate diagnoses, the lives of both parent and child have been severely affected when confronting such situations (Paterson 1997).

The present poster presentation seeks to provide a comprehensive review of the available literature concerning past and current research involving the medico-legal implications of osteogenesis imperfecta when diagnosing children exhibiting unexplained fractures. In doing so, this poster presentation provides a brief historical account of the recognition and diagnosis of osteogenesis imperfecta and child physical abuse. Following is a description of the etiology of the disease and an account of the various fractures prevalent in young children and infants. Specifically, an overview of fracture patterns resulting from abuse, accidents, and osteogenesis imperfecta is presented. Four child abuse related cases (Interest of J.V., Lamberton v. State, Awkerman v. Tri-County Orthopedic Group, and Matter of Mathew D.) are also discussed in this poster presentation to examine the validity of arguments that suggest osteogenesis imperfecta can be confused with physical abuse.

The medico-legal implications of osteogenesis imperfecta, as argued in this presentation, relate to the attempt by abusers to avoid prosecution by using the osteogenesis imperfecta defense. It also relates to inadequate medical examination by physicians leading to misdiagnosis. A proper medical examination will always differentiate osteogenesis imperfecta from physical abuse. This researcher contends that there is no excuse for misdiagnosis of osteogenesis imperfecta in favor of child physical abuse. Moreover, this presentation serves as a starting point for future investigations providing research guidelines whereby better and more accurate diagnostic techniques for the osteological identification of osteogenesis imperfecta within a medico-legal context are possible.

In addition, this poster presentation seeks to make forensic anthropologists aware of the need for more involvement in cases where child physical abuse is suspected. According to Walker et al. (1997), this is an area that has received little attention from anthropologists. Yet, a forensic anthropologist can make a tremendous contribution. For specialists with little or no experience in human skeletal remains analysis, cases involving potential child physical abuse can prove to be challenging. The diagnosis of the battered child syndrome is very different when looking at radiographs or directly at bone. Radiographically invisible lesions are in many cases apparent when carefully conducting gross examination of bone (Walker et al. 1997). Furthermore, to the inexperienced eye, congenital conditions such as osteogenesis imperfecta can provide a source of confusion in determining whether skeletal lesions resulted from non-accidental injuries or from some other reason (Ojima et al. 1994; Gahagan and Rimsza 1991). In general, the goals of this poster presentation are to encourage continuous research and interest in this subject.

Osteogenesis Imperfecta, Brittle Bone, Child Abuse

D2 DNA Analysis of Submerged Pine Logs

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After attending this presentation, attendees will understand methods of extracting and analyzing DNA from woody tissue for the purposes of historic or genetic reconstruction of forests.

This presentation will impact the forensic community and/or humanity by demonstrating more reliable protocols for wood DNA extraction are needed for timber certification, forensics and criminal prosecution, nautical archaeology, paleobotany and especially for reconstructing colonial history. We demonstrate here the use of DNA extraction and analysis from submerged logs as a reliable tool in reconstructing North American forest genetic composition and diversity. Submerged logs constitute an "accidental museum" for reconstructing pre-settlement forests along the Atlantic seaboard and the Gulf of Mexico. This method also holds promise in archaeology for DNA analysis of early wooden buildings, wooden ships, wooden forts and wooden tools of early European colonists.

DNA analysis of submerged logs is a novel approach to historic and genetic reconstruction of North American forests. Along the Atlantic seaboard, Gulf of Mexico, Great Lakes and Puget Sound, logs were rafted along flat rivers and estuaries in the 19th century as a means of transport. During rafting, many logs sunk and were preserved from degradation in deep anaerobic silt 7 to 15 m below the water's surface. The value of these submerged logs for historic purposes depends on reliable methods for extracting high molecular weight DNA. DNA analysis of submerged logs has value for identifying species and for measuring polymorphism for population genetics studies. Criteria for a reliable protocol include 1) high-molecular weight DNA extraction, 2) amplification of rbcL, a chloroplast gene indicating DNA origin from a photosynthetic plant, 3) a close homology between ribosomal DNA sequences and those of putative forest tree species and 4) assaying for DNA polymorphism. A DNA protocol was developed for submerged pine logs dredged in the Cape Fear River near Wilmington, NC. DNA extraction was based on a CTAB protocol modified with proteinase K, RNAase and polyvinyl pyrrolidone (PVP) steps. Crude extraction of DNA from five submerged log samples was followed by stringent DNA purification. Chloroplast gene rbcL (ribulose-1,5- bisphosphate carboxylase) could be amplified in all samples. Intergenic transcribed spacer (ITS) sequences from ribosomal DNA were 98 to 94% homologous to sequences from two indigenous pine species, Pinus taeda and P. palustris. Assaying nuclear polymorphism required a variant of the DNA protocol purification step to improve amplification of single- and low-copy DNA sequences. A nuclear microsatellite was assayed; its polymorphism matched 3 of the 14 known P. taeda alleles. This is a

robust DNA protocol for wood, which will have broad research applications for reconstructing genetic patterns in pre-settlement forests as well as wood certification, forensics, paleobotany and nautical archaeology.

Gymnosperms, Forest History, Forensics

D3 Intergration of Molecular Pathology to Modern Forensic Medicine and Forensic Autopsy

Marrah E. Lachowicz, BA, MFS, 1300 East Orange Street, Tempe, AZ 85281*

After viewing this poster presentation, Forensic personnel will learn the implementation of Molecular Pathology to facets of Forensic Medicine is beneficial to both autopsy and research procedures. The presentation notes, in a formal content analysis, many current research plans and procedures that one may adopt to autopsy practices. In addition, a formal Normative Survey of Forensic personnel indicates that the Forensic Science community welcomes implementation procedures. This research study also indicates a symbiotic relationship between the fields of Molecular Pathology and Forensic Medicine is beneficial to scientific growth in these respective fields.

This presentation will impact the forensic community and/or humanity by demonstrating for persons wishing to conduct laboratory research in the fields of Forensic Medicine and Molecular Pathology, this study provides support to indicate that this research is welcome by the scientific community providing grounds for grant funding for research in these areas. Researching actual Molecular Autopsy methods in an academic research setting could provide the necessary information for the integration into current autopsy processes occurring in Medical Examiner's office across the United States.

The field of Forensic Medicine provides a new, under-developed outlet for testing in Molecular Pathology. The current methods in Molecular Pathology, as stated earlier, are in Clinical Medicine and Research on tissues from living subjects. However, sampling from the deceased provides a large source of pathologic samples that can be analyzed. These samples can provide additional insight to end-stage disease processes, indicating more information about the pathological processes that lead to death. Also, by studying postmortem samples, Forensic Pathologist and researchers in this field can provide statistical information about causes and manners of death as well as statistical information regarding terminal illness and genetic conditions. Sampling from the deceased is recommended to provide a continual source of samples for Molecular Pathology and Molecular Autopsy procedures.

The application of Molecular Pathology to Forensic Medicine during autopsies can also advance the field of Forensic Pathology. By applying the Molecular Autopsy to Forensic cases, Forensic Pathologist can analyze samples for specific mechanisms of death. Sampling of wounds at the histological (molecular and cellular level), as in the case presented earlier, will provide another method to analyze wound types present in Forensic cases rather then just examining wounds by the naked-eye. By using microscopic laboratory methods, Forensic Pathologist will have additional methods to diagnosis the cause and manner of death. Although integrating these methods into current autopsies would be costly, integrating these procedures to Forensic cases is recommended in order to provide a more in depth autopsy analysis in these cases. The necessary equipment and Molecular Pathologist professionals could be integrated into the larger Medical Examiner's offices with appropriate funding.

Molecular Pathology is the clinical application of biotechnology to cellular autopsies. Procedures in Molecular Pathology are both descriptive and predictive in nature. The application of the "molecular autopsy," has been limited in the field of Forensic Medicine. Main outlets for research in "molecular autopsy," procedures have been limited to Clinical Medicine and research. Molecular Pathology procedures could be beneficial to Forensic Medicine and modernize the autopsy process. By utilizing current molecular autopsy methods and researching new testing procedures, Forensic Pathologist may be able diagnosis the cause of death using these tests. Utilizing these procedures may also provide preventative information regarding disease. This research study will review current integration procedures in peer-reviewed scientific studies utilizing the integration Molecular Pathology and Forensic Medicine to access the success trend of the integration of these two fields. This research study will also poll professionals and students obtaining higher-education degrees within these prospective fields to determine if integration would be accepted and promoted within these two fields.

Forensic Medicine, Forensic Pathology, Molecular Pathology

D4 Homicidal Deaths in Delhi (1992-1996)

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After attending this presentation, attendees will understand the trends of homicidal crimes in developing nations like India.

A meticulous postmortem review was under taken in the department of FORENSIC MEDICINE MAMC to find out about trends in homicides during the period 1992-1996. Standard procedure for autopsy and review of inquest papers was conducted. Out of 3,886 medicolegal autopsies performed in the department during the said period, only 232 cases (5.9%) were homicidal deaths. The most common age group of victims was 21 - 30 years (38%). Males were victimized three times more than females. Incidence of crime was slightly more in the nighttime than daytime though evenly distributed during winter and summer seasons. In our series, sharp weapon injuries were the most common type (34.9%) followed by blunt force injuries (15.9%). Defensive wounds were present in 35 cases (15%). Violent rage/ quarrel was the motive in 61 cases (29%).

Homicides, Weapon of Assault, Victim

D5 Highly Informative Y-Chromosomal Haplotypes of Four Y-Specific STR Loci, DYS385, DYS446, DYS449, and DYS464

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This presentation will provide a good opportunity to discuss the possibility of a new set of small but efficient Y-STRs to substitute the established minimal haplotype.

This presentation will impact the forensic community and/or humanity by providing a good chance to discuss the possiblity of new set of small but efficient Y-STRs to substitute the established minimal haplotype.

Y-chromosome-specific STR typing has become very useful in evolutionary studies and forensic casework, namely in deficiency paternity testing and in rape cases involving one or more semen donors. So far, numerous Y-STRs have been discovered and some have been used for forensic purposes and population studies to evaluate diversity of the haplotypes. However, forensic researchers have been looking for small and

efficient subsets of STRs that might distinguish more individuals. Therefore, the combination or addition of new Y-STR markers with extremely high gene diversity has been attempted in many groups. More recently, new highly informative Y-specific STRs (DYS446, DYS449, and DYS464) have been identified and expected to be useful for the establishment of small but efficient subset of STRs. In this work, we applied single multiplex PCR system to analyze 4 Y-STRs (DYS385, DYS446, DYS449, and DYS464) in 300 Koreans. We calculated the haplotype and allele frequencies, and the usefulness of these four highly informative Y-STRs was discussed by comparing its haplotype diversity with that of minimal haplotype.

Four Highly Informative Y-STRs, Haplotype Diversity, Minimal Haplotype

D6 Case Study – Consensual Sex, Genital Injuries, and Sexual Assault of a Fifteen-Year-Old Female

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The goal of this presentation is to discuss the concept that rape is a legal issue and the medical findings, or lack of findings, are based on the victim's history.

A 15-year-old female was seen at a SART (Sexual Assault Response Team) facility in San Diego County. An evidentiary examination was authorized by law enforcement. The 15-year-old disclosed:

- Consensual sex 2 - 12 hours before
- She passed out and woke up with a male putting his penis into her vagina
- Reported to law enforcement 12 hours later
- She stated "sex" hurt with all of them

FINDINGS: Multiple lacerations and abrasions 4-7 o'clock on the posterior fourchette going up to the fossa navicularis. Positive Toluidine Blue dye uptake

Positive examination consistent with the history as stated

CONCLUSION: Photo documentation of all the injuries allows the nurse to use photographs for peer review. Photo documentation also serves to document the injuries for other experts to review.

Sexual Assault, Photo Documentation, Colposcopy

D7 Postmortem Quantitation of Insulin and C-peptide in Cases of Suspected Exogenous Insulin Administration

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After attending this presentation, attendees will be presented with convenient methods for insulin and C-peptide determinations in postmortem blood samples for the purpose of identifying exogenous insulin administration

This presentation will impact the forensic community and/or humanity by providing a validation and application of commercially available RIA kits for the quantitation of insulin and C-peptide in postmortem hemolyzed blood specimens. The kits provide technically easy to perform and economically cost effective methods to obtain reliable results in helping to establish the role of exogenous insulin in determining cause of death.

Homicide reports by exogenous insulin injection are rare. However, since insulin, and syringes to inject it, are readily available, and it is a potentially lethal drug, insulin should be given consideration in suspicious homicides. The ratio of insulin to C-peptide (insulin/C-peptide) may be used to make a forensic diagnosis of exogenous insulin overdosage. Endogenous insulin is secreted in equal proportion with C-peptide. Because C-peptide is more slowly cleared than insulin, the physiological insulin/C-peptide is less than one. Exogenous insulin will result in a ratio greater than one. Quantitation of insulin and C-peptide in a postmortem specimen can be cumbersome, and require large quantities to be present. Described below are simple and economical radioimmunoassays (RIAs) for quantitative determination of insulin and C-peptide in postmortem blood specimens.

Commercially available radioimmunoassay (RIA) kits were obtained from Diagnostic Systems Laboratories, Inc. (Webster, TX). Both kits have received FDA clearance, and have been used in preclinical toxicological, clinical and diagnostic applications. The standard curve covers a range of insulin concentration from 1 to 300 uIU/mL, and 0.1 to 20 ng/mL for C-peptide. Both RIAs require only 100 uL of specimen for a single determination. Blood specimens were collected from three deceased individuals who had a medical history, which included diabetes and insulin therapy at the time of death. The specimens were grossly hemolyzed, even after centrifugation at 1000g. Duplicate aliquots of each specimen were stored frozen at –20 and 4 degrees C for three days. Because both RIAs were designed for determinations in non-hemolyzed serum and plasma, validation was required for a grossly hemolyzed postmortem blood specimen. Validation included adding known amounts of insulin and C-peptide standards to the hemolyzed specimens and performing assays for recovery and linearity studies.

Insulin standards ranging from 1 to 150 uIU/mL were added to the specimens and when assayed gave recoveries of 94 to 103%. Serial dilutions of 1:2, 1:4 and 1:8 of one specimen gave linearity from 75 to 120%. Only one specimen contained enough insulin to allow for linearity by dilution studies. All specimens were assayed in duplicate with results within 10% CVs. Using these procedures, the specimens were quantitatively assayed for insulin. Specimens stored at -20 degrees C had insulin levels of 88.5, 4.3 and undetectable (less than 1.5) uIU/mL. Specimens stored at 4 degrees C had lower insulin levels of 70.3, and less than 1uIU/mL in the remaining two specimens. Thus, freezing would be the preferred storage condition.

Recovery assays for C-peptide included additions ranging from 0.1 to 10 ng/mL, and gave recoveries of 52 to 98%. Linearity by dilution studies were not possible at this time because all three the specimen contained too little C-peptide. The CVs of duplicates were less than 10%. C-peptide concentrations in the specimens from the three deceased cases were undetectable (less than 0.1), 0.25 and 0.1 ng/mL respectively. Specimens stored at 4 degrees C had undetectable C-peptide concentrations (less than 0.1 ng/mL). Again, freezing provided the best storage conditions.

In conclusion, the specimen with 88.5uIU/mL of insulin could be of exogenous source since the C-peptide was less than 0.1 ng/mL. In addition, the commercial assays have reliable performance for use with grossly hemolyzed postmortem specimens.

Insulin, C-Peptide, Postmortem

D8 Homicide or Suicide? An Equivocal Death Investigation

Vernon J. Geberth, MS, MPS, Lt. Commander (Retired), New York Police Department, PO Box 197, Garnerville, NY 10923*

The goal of this presentation is to present to the members of the forensic community the complications involved in an equivocal death investigation, specifically, those equivocal deaths involving a "Staged Crime Scene."

This presentation will impact the forensic community and/or humanity by indicating the importance of crime scene reconstruction coupled with the evaluation of victimology in determining the factors in an Equivocal Death Investigations. I show examples of suicides involving long barrel firearms and make reference to wound structures due to high velocity rifles. I also illustrate how it this case was forensically impossible. The impact of my presentation occurs as the audience actually sees how the original investigation was unprofessional and resulted in an erroneous finding. The audience is then presented with an alternative finding based upon the forensic evidence and the victimology.

"Equivocal death investigations are those inquiries that are open to interpretation. There may be two or more meanings and the case may present as homicide, suicide or accidental death. The facts may be purposefully vague or misleading as in the case of the "Staged Crime scene."[1]

In this case, the deceased was a single, 25-year-old male. His body was discovered lying on his back with his feet on floor as if he had fallen back onto the bed. A Winchester semi-automatic .308 Model 742 was between his legs. The victim owned the weapon, which came from the premises. There were various amounts of blood, skull and brain matter found in the bedroom. The velocity blood spatter traveled in a South direction going into the bedroom closet. The victim's brain was found in the front hallway, which was in the opposite direction of the velocity blood. This would be North and East from the bedroom. The entire upper half of the skull was absent due to the gunshot wound. There were two bullet holes in the roof above where the victim was discovered. However, there wasn't any blood, brain matter or tissue on the ceiling. The police investigators concluded that the deceased had shot himself twice in the head with the high-powered rifle. There were two empty shell casings found by his feet and three live rounds were recovered from the gun, which belonged to the deceased. An open box of Remington .308 ammunition was found in an adjoining room. According to the police report, "There was no evidence of a break-in and the rest of the trailer was observed and there were no signs of a struggle." The police and coroner assumed that the death was a suicide. A local hospital pathologist conducted an autopsy and determined that the cause of death was a gunshot wound to the head and ruled the death a suicide.

The consultant determined that the scene had been "staged" to make the death appear to be a suicide and concluded that the police investigation was both perfunctory and inadequate according to recognized standards of death investigation. There were numerous investigative errors and serious omissions. A crime scene reconstruction would have revealed that is was forensically impossible for the deceased to have committed suicide as presented in the scene. A detailed examination of the crime scene including the process of the crime scene and weapon for fingerprints was not undertaken. The police did not attempt to recover the fired rounds. The gun was never tested nor did the police conduct any ballistic examinations or perform any GSR testing. The police did not reconstruct the event nor take into consideration the operation of the alleged suicide rifle.

Reconstruction Considerations

The hospital pathologist concluded that the death was a suicide. However, he could not define nor determine the exact location of the entrance wound. In his report he stated, "The entire upper half of the skull completely absent secondary to gunshot wound of skull. Examination of mouth discloses upper and lower natural teeth in excellent dental care. From the outline of the remainder of the skull cavity, the entrance wound appears to be from left to right and upward."

A forensic pathologist would have insisted that the authorities provide the pieces of shattered skull and then glued them together to determine the outline and entrance of the bullet. A forensic pathologist would also have been able to determine if one or two shots had been fired into the brain.

In suicides involving long barrel firearms, such as rifles or shotguns the victim usually selects the forehead, followed by the temple, the mouth or under the chin. The temple shots are usually consistent with the handedness of the victim. In other words, if the victim was right handed the wound will be found in the right temple. In this particular case the victim was right handed. The wound, according to the hospital pathologist was to the left temple.

Placing the barrel of the Remington .308 Model 742 to his left temple would have been extremely awkward if not impossible. The Remington .308 Model 742, which is a semi-automatic rifle, ejects the rounds to the right of the stock anywhere from 8 to 12 feet. In this particular case the police reported finding two spent .308 cartridges by the victim's feet at the base of the bed. It is also important to consider the effects of such a high-powered rifle on the victim. For instance, wounds of the brain from high velocity rifles such as the Remington .308 Model 742 are extremely devastating and produce a bursting rupture of the head. It would have been physiologically and neurologically impossible for the deceased to have fired two rounds into his head with this type weapon. In addition, the discharge of a .308 would have pulled the gun out of the deceased's hands and sent the rifle flying in the opposite direction. The gun would not be conveniently sitting between the deceased's legs with the barrel pointed toward the head.

Remington .308 Model 742 has a tremendous kick-back. The ammunition found at the scene was .308 Win ammo. This translates into 150 to 180 grains providing a velocity of 2200 to 2960 feet per second. In my expert opinion, it would have been virtually impossible to fire this weapon twice into the head in an upward direction toward where the two holes were observed by the police and not leave blood, hair, or brain matter on the ceiling.The insurance company's expert witnesses had concluded that the death of the victim was suicide and was caused by a self-inflicted gunshot wound to the mouth. The consultant dismissed these findings as erroneous and inconsistent based on the hospital pathologist's report.

Furthermore, the insurance company's inquiry conveniently disregarded the most important issue in this particular case. What was the intention of the deceased to take his life?

Victimology

Many suicide deaths are preceded by verbal threats of self-destruction and other indications of despondency. In some instances these threats are made to people whom the deceased respects or thinks highly about.

In other instances the sudden change in behavior is shown by subtle actions, such as increasing life insurance, giving away prized possessions, speaking of life in the past tense or abuse of alcohol or drugs. These behaviors are termed "Warning Signs" and present the investigator with a base of inquiry, which can support a hypothesis of possible suicide.

The victim in this particular case was a twenty-five-year-old single male, who was socially active. He was last seen at work on Monday when he paid his union dues three months in advance. He did not report to work on Tuesday and his body was discovered on Wednesday.

He was expecting a visit from his fiancé, who was going to stay with him at the trailer. In fact, he was in process of renovating the trailer for his fiancé. He had had purchased paint and wallpaper and had borrowed tools from his neighbor to re-do the kitchen cabinets and had just built a new deck on the trailer. He had recently made a loan application for a trip to Alabama because he owned property in Alabama and planned on relocating there in the Fall with the fiancé after clearing the property. He also attended a local Community college at night and maintained a 90% G.P.A. My opinion of these factors was that they certainly didn't fit the profile of a suicide victim.

The police disregarded the following facts:

- The victim kept at least $1000.00 in cash in his trailer, but the police recovered only $2.50. Victim's car found unlocked - keys in ignition.

- The victim's empty wallet was found on floor of the car.
- The victim's tools and radar detector were missing from his car.
- The victim had purchased a Birthday card for sister. A $50 bill was missing from card.
- The victim purchased $70 worth of groceries on Monday afternoon.
- There were cigarette butts in ashtray. The victim did not smoke.
- A Gold calculator was missing from the scene. It was later found in town Pawnshop.

Conclusion

It was quite apparent that the victim's death was in fact a murder and not a suicide.

I believe that the authorities made the mistake of assuming that the death of the victim was a suicide. Their assumption was based on the fact that this event was a "Staged" crime scene.

The preliminary observations of the crime scene by the authorities were erroneous as they failed to take each factor to its ultimate conclusion. It is apparent that a detailed examination of the crime scene, including the process of the crime scene and weapon for fingerprints was not undertaken. The background information of the deceased regarding his motivation apparently was not taken into consideration in determining whether or not the facts of the case were consistent with their theory of suicide.

The consultant determined that there were numerous investigative errors and serious omissions in this investigation as well as an obvious failure to forensically support the classification of suicide with evidential facts. The authorities failed to pursue and evaluate the crucial information supplied by the reporting witnesses and next of kin regarding the missing money as well as property taken from the trailer and victim's car. This Wrongful Death consultation revealed the death to be a homicide and exposed the police investigation as perfunctory and inadequate and not in accordance with recognized standards of professional death investigation.

[1] Geberth, V.J. *Practical Homicide Investigation: Tactics, Procedures, and Forensic Techniques*. Third Edition, Florida: CRC Press, LLC, 1996, p. 20.

Equivocal Death, Staged Crime Scene, Crime Scene Reconstruction

D9 SNP Based Ancestry Informative Markers for the Inference of Biogeographical Ancestry (i.e., "Race") and the Estimation of Admixture: Application for the Louisiana Serial Killer Case

Tony Frudakis, PhD, Matthew J. Thomas, PhD*, and Zach Gaskin, BS*, DNAPrint Genomics, Inc., 900 Cocoanut Avenue, Sarasota, FL 34236*

After attending this presentation, attendees should retain that SNP based DNA tests for forensics exist and have been used in a high profile case.

The impact of this work became evident in the recent Louisiana Serial Killer case where we determined by a SNP based DNA test that the suspect was 85% Sub-Saharan African & 15% Native American. The Louisiana task force, following eyewitness accounts and an FBI profile that the suspect was a caucasian, had run out of leads. We performed our DNA Witness 2.0 test and two months later the task force had the man linked to 6 homicides through STR typing in custody. The alleged murderer was, in fact, African American. This test could aid in any case where there is a biological sample left at the crime scene and you have no suspect or conflicting eye witness accounts of what ancestry your suspect is. The true impact to society comes when this investigative tool is utilized to expidite the investigation thus getting criminals off the streets before they have time to strike again.

Biogeographical Ancestry is the heritable component of "race," but to date, no method has been described to accurately measure genetic structure within individuals. Socio-cultural and geo-political metrics for measuring human "race" are human and not natural constructs, therefore eye-witness accounts and the investigative interpretation of these accounts are notoriously unreliable .In this presentation, we present novel markers and methods by which to do this. We mined the human genome sequence for candidate Ancestry Informative Markers, validated them on an ultra-high throughput genotyping platform and established parental population allele frequencies. Using 71 of the most informative AIMs, covering most of the chromosomes, and coalescing the human population to four main continental population groups (sub-Saharan African, East Asian, Indo-European and Native American), we use a maximum likelihood method to determine individual BGA admixture proportions and their associated confidence intervals. We observed that self-reported population affiliations correlated almost perfectly with the majority BGA population affiliation determined for a sample of 3,300 international samples. BGA admixture results were surprisingly frequent, and when observed, were generally not inconsistent with anthropological and geopolitical history. The admixture proportions produced tracked in family pedigrees in a manner consistent with the law of independent assortment, and simulation revealed that the markers relevant for resolving the group affiliations functioned independently within the confines of our algorithm. Because a large number of high □ value markers were used, the test was surprisingly robust; reasonable levels of simulated allele frequency errors that could be caused by biased parental sampling had no significant impact on the BGA proportions determined. Combined, these results show that BGA admixture can be reliably read from the DNA. In March of 2003, we applied this technology to assist with the Louisiana Multi-Agency Homicide Task Force Serial Killer Case, which had been bogged for the prior year. Prior to testing, and based on two separate eye-witness accounts, the killer was believed to be a Caucasian, or European American individual. The results of the test suggested that this profile was not accurate and that the killer was of 85% sub-Saharan and 15% Native American BGA. Based on these results, DNAPrint advised the Louisiana Serial Killer Task Force to abandon dragnets of Caucasians and focus exclusively on African Americans of average African American skin tone. The Task Force embraced this result, and within two months, their shift in focus towards leads consistent with the BGA profile resulted in the swabbing of an African-American individual that was eventually matched with the crime scenes through STR profiling. The case represents the first successful application of a multi-factorial post-human genome test for forensic sciences that the Company is aware of. We will also present progress made for other genome-based methods of physical profiling, such as the inference of human iris and hair color within individuals of mainly Indo-European descent.

Biogeographical Ancestry (BGA), Ancestry Informative Markers (AIM), Louisiana Serial Killer

D10 Power Tool Injury Biomechanics

Gary S. Deegear, MD, Biodynamic Research Corporation, 9901 IH 10 West, Suite 1000, San Antonio, TX 78230*

After attending this presentation, attendees will gain the ability to recognize and interpret the patterns in injuries involving power tools and how to apply this and other information to reconstruct the injurious event.

This presentation will impact the forensic community and/or humanity by adding to the body of knowledge regarding injury pattern recognition and the integration of applicable information to injurious event reconstruction. By the reconstruction of events, such as power tool injuries, alternatives to safety and guarding can be recognized.

Power tool injuries represent an interesting subset of traumatic injuries that may be difficult to interpret accurately. It is possible, with specific knowledge of the tools involved, the circumstances of the incident and patterns of injury to bone and soft tissues, to reconstruct power tool injuries.

Although tool mark forensics are well known within the forensic community, this work differs dramatically by using the integration in forensics of medical knowledge, kinesiology, anthropometrics, blood-stain pattern analysis, and alternate light sources. This integrative approach is combined with knowledge of power tool operation and uses, available force, and configuration to arrive at a reconstruction.

The injuries are generally divided into soft tissue and boney injury. Soft tissue injuries are then subdivided by traditional types in forensic medicine. Each type of soft tissue injury can then be related to its particular mechanism for causative information.

Boney injuries, when examined, are typically interpreted by fracture type. However, in power tool injuries these can be placed more appropriately along a spectrum of cut versus crushed bone. Research in the response of boney tissues (and soft tissues) to power tool implements has been done over the past 8 years and the results of these studies support the accurate determination of the amount of tool force, the direction of force, the order of the injuries, and the orientation of the tool to the injured part.

Examination of the involved tool and any available work piece or work area can yield pertinent information regarding the injurious interaction. General consideration during the examination should be taken of any damage, tool marks, tool condition and operation, and existing tool configuration. Blood stain and tissue spatter patterns should be sought using visible and alternate light sources. This particular set of collected data must be interpreted with knowledge of power tool interactions with living tissues. Research in this area has been done as well. This information, combined with case studies, has yielded important interpretive clues for power tool injury reconstruction.

Knowledge of how a particular tool is used and misused, the force (power and direction) of the tool operation, available tool configurations, and tool dimensions (including weight) is combined with the above typical forensic analysis to arrive at the final reconstruction. Occasionally, static and\or powered testing of a tool is required to fully understand the operation and forces involved for that particular tool.

Extraneous factors should be included in the analysis. The medical history of the injured individual often produces critical pertinent information, such as seizure disorders, previous injuries, vision or other sensory problems, medications, substance abuse, psychiatric problems, and congenital disorders. The individual's state of health at the moment of the injurious event is often reflected in the medical records. Although these should be previously scanned for injury information, other helpful information, such as toxicology screens, should be sought.

Any reconstruction must entertain alternative scenarios that can be excluded or used to modify the existing hypothesis. The integration of kinesiology and anthropometrics into the reconstruction assists in this end of the analysis. Matching the injured individual to the injurious tool directly or through the use of surrogates and exemplars often clarifies the reconstruction. Even simple testing using easily available surrogate tissues can assist in the reconstruction by examining injury outcomes in the patterns produced by the tool and tissue interactions in varying configurations.

The approach used here is broadly applicable due to its foundation in forensics. The specifics of the analysis are based upon appropriate knowledge and pattern recognition. It is hoped that this work will bolster the sparse information available in the area of power tool injuries.

Power Tool Injury, Injury Pattern, Accident Reconstruction

D11 Digital Crime Scene Reconstruction

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The goal of this presentation is to show the high-level theory and procedures that have been developed for physical crime scene reconstruction can be applied to digital crime investigations. This allows the field of digital forensics to utilize theories that have been tested and proven in the courts.

This presentation will impact the forensic community and/or humanity by demonstrating the observation that digital forensics is more similar to a crime scene investigation than it is to other forensic areas. The physical computer is just the housing for many pieces of evidence, each of which can be used to reconstruct the events that occurred prior to a crime. This presentation shows how to categorize digital evidence so that it can be used in a digital crime scene reconstruction. This will make solving investigations more efficient and give more credibility to the result of digital investigations.

This paper applies the high-level theory and procedures of physical scene crime investigations to digital crimes. Using the physical crime scene investigation phases, including preservation, survey, documentation, search, and reconstruction, this paper describes how a digital device can be investigated using the same high-level procedures that have been developed over many years in the physical world. Digital devices and computers are now involved with the investigation of many crimes, including the use of a computer to attack a high profile Internet site, distributing child pornography over the Internet, or two criminals communicating via email. In each case, one or more computers must be analyzed to find traces of digital evidence. This process has been called digital or computer forensics and applies to laptops, servers, mainframes, cell phones, and PDAs.

The area of digital forensics is relatively young and is in the process of developing the theories and methodologies that are needed to make it more science than art. Digital evidence has not been seriously challenged in the courts, but it is expected to be in the future. By correlating the phases of digital investigations with those of physical investigations, credibility can be achieved for the digital investigation process.

This paper approaches the computer as a crime scene and applies the theory of physical crime scene investigation. A digital crime scene is the virtual world that is created by an operating system, software, and hardware. Data is constantly entering and exiting the system and traces of system activity are left behind. Temporary files are created when documents are opened and the Internet activity of a user can be traced days later. The classical crime scene investigation phases of securing the scene, surveying the scene for obvious evidence, documenting the scene, searching the scene for additional evidence, and performing a crime scene reconstruction all directly apply to the phases of a computer investigation. This paper provides an overview of how a computer investigation uses the same high-level phases as a physical crime scene investigation, but with different procedures. The process model considers the digital crime scene to be a secondary crime scene to the physical location where the computer is located. This is important because the end goal of any digital investigation is to identify the person responsible.

The primary focus of this paper is on the crime scene reconstruction phase for a digital crime scene, where evidence is classified and the scientific method is used to reconstruct the events that occurred during the incident. This research uses the published literature to show that digital crime scene reconstruction is similar to physical crime scene reconstruction and that digital evidence can be classified in the same categories as physical evidence, although with different criteria. For example, the existence of and contents of a given file can be functional evidence that an application was executed on the system. Similarly, the existence of deleted data that was created when an application was executed can be functional evidence. Many applications and operating

systems save a history of user activity and it can be used as relational evidence because it shows what actions the user performed and in what location they were performed. Relational evidence can also be found in the existence of a temporary file that shows that an application was executed in that directory.

The paper will show how digital evidence can be sorted into each of these categories to efficiently solve digital investigations and discusses how much the evidence can be trusted. Digital investigations are becoming more common and generally accepted process models and approaches must be defined. The physical investigation procedures are generally accepted and should be applied to digital investigations whenever possible. This paper shows the first attempt at defining the process and classification definitions for digital crime scene reconstruction.

Digital Forensics, Digital Evidence, Crime Scene Reconstruction

D12 Empirical Elimination of a Digital Enhancement

Joerg Hess and H. Dale Nute, PhD, Florida State University, 4750 Collegiate Drive, Panama City, Florida 32405*

After attending this presentation, attendees will understand the necessity to empirically validate photography enhancement algorithms.

This presentation will impact the forensic community and/or humanity by serving to caution those working with photography enhancement that subjective observations coupled with enhancement may present an erroneous implication.

The importance of empirical validation of photo enhancement algorithms was demonstrated by a case in which a photograph was enhanced, appeared to show an object in a particular location and, upon investigation, was demonstrated not to be present.

The case involved a boating accident in which two individuals overturned a small rowboat at night in extremely cold water. One victim was found floating next to the shore the next morning but the second was never found. Extensive searches were immediately conducted including an air search, shore search, and cadaver dogs, and an underwater search with divers. Although the victims were thought to be relatively close to the shore, the bottom of the lake dropped precipitously. Subsequent underwater searches over the next two years were conducted using side-scan sonar, and drop cameras. On the last day of one of the searches, an interesting photograph was acquired on the video recording of a drop camera but the battery was almost discharged and the photograph quality was extremely poor. The photo appeared to show a boot and a portion of a leg. The "rest of the body" would have been outside the frame of the photograph. The location of the camera at the time of the picture was initially calculated to be around 200 feet but later measurement of the cable determined it to be closer to 170 feet.

Standard contrast enhancement by Adobe Photoshop was performed and the features of a boot and trousers leg seemed to be even more apparent. Based on the photograph, another search was set up. This search was jointly conducted by four agencies and employed a newer model of side-scan sonar, two models of remotely operated vehicles (ROV) with video, another drop camera, and divers. The GPS coordinates of the photograph were extrapolated from the data supplied by the operators of the drop camera on the previous search.

The search protocol was to conduct a side-scan sweep of the area surrounding the GPS coordinates, download the data, identify potential targets, determine their precise GPS coordinates from the software, then deploy the ROVs and drop camera to verify or exclude the target. Using this strategy all targets in the primary search area were excluded. The search protocol was then repeated on the areas immediately next to the primary area. All targets in the secondary area were also excluded. Due to the persuasive nature of the photograph, it was decided to perform a redundant exclusion in the primary area. Two divers used a circle search to clear the area and eliminated all targets.

Because the enhanced photograph had generated such high expectations by everyone involved, especially the family of the missing victim, it was decided to demonstrate the source of the photograph. The target closest to the GPS coordinates was an uprooted tree trunk with roots attached. There were several in the primary area searched but this one was the closest to the expected target. One of the roots on this tree contained a bend in it similar to that seen in the "boot & leg" photo. A frame of the video of the root was selected and then dis-enhanced, i.e., made more fuzzy, so that it looked similar to the original photograph. Although it did not appear to be a portion of a victim as closely as the original photograph, it demonstrated enough similar features to explain the features seen in the original photograph and thus, not finding the victim in the area.

Digital Evidence, Photography Enhancement, Underwater

D13 Digital Evidence Case Report: Data Conversion on Digital Audio.wav Files

Kenneth W. Marr, BSEE, MS, MSIS, David J. Snyder III, BSET and Jeffrey L. Edwards, BSME, MSCE, Federal Bureau of Investigation, Engineering Research Facility, Building 27958A, Quantico, VA 22135*

After attending this presentation, attendees will recognize and use methods to decipher corrupted .wav files and restore the files to be used as forensic evidence.

This presentation will impact the forensic community and/or humanity by demonstrating techniques for recovery and conversion of digital audio files are essential for examiners who work with digital audio evidence. Additional awareness of these safeguards helps to improve the quality of forensic exams of all examiners who use digital evidence.

Digital Evidence has been recognized as a forensic discipline by the American Society of Crime Laboratory Directors, Laboratory Accreditation Board (ASCLD/LAB). Since many forensic disciplines already use digital techniques for specific procedures unique to those disciplines, this designation of digital evidence as a separate discipline highlights the importance of safeguards needed when using digital evidence techniques. This case study reviews methods and procedures used to recover digital audio .wav files which were corrupted and unreadable. This type of audio file is prevalent in the industry and has started to frequently appear in case submissions.

Digital audio .wav files were received and were not readable using standard desktop computer applications. The digital files of this case were generated by a 911 communications logging system but were garbled and required audio enhancement, although the files could be played back on the originating 911 system. However, all attempts to playback the files in the FBI Audio Lab caused computer default errors. The techniques used to successfully recover the audio files and convert them to readable .wav files are reviewed.

With the pervasive nature of forensic digital evidence, there are general procedures and safeguards which may be taken to ensure that the evidence is handled properly. Several industry groups (for example, the Scientific Working Group on Digital Evidence) have published documents which are valuable resources for forensic examiners involved with digital evidence. This case report will also review techniques to recover, preserve and store digital audio evidence.

Data Conversion, Audio .wav Files, Digital Evidence

D14 SWGIT Presents: Part 1 - Does Your Forensic Imaging Unit Need Accreditation as a "Digital Evidence Unit"?

Richard W. Vorder Bruegge, PhD, Federal Bureau of Investigation, ITD, Forensic Audio, Video, and Image Analysis Unit, Building 27958A, Quantico, VA 22135*

The goal of this presentation is to provide guidance to the forensic community regarding issues relating to imaging technologies and laboratory accreditation. Attendees will better understand whether their imaging units - whether forensic photographic units, forensic image analysis units, or forensic video analysis units - should seek accreditation under the Digital Evidence discipline.

This presentation will impact the forensic community and/or humanity by guiding the forensic community relating to issues of forensic imaging, digital evidence, and accreditation from the Scientific Working Group on Imaging Technologies (SWGIT). Lab managers, quality assurance personnel, and imaging scientists will learn the SWGIT position on how digital imaging and image analysis relates to other disciplines such as computer forensics and forensic photography.

The Scientific Working Group on Imaging Technologies (SWGIT) was created in 1997 by the Federal Bureau of Investigation to provide guidance to the law enforcement community by developing recommendations for good practices in the use of imaging technologies within the criminal justice system. It consists of more than forty imaging professionals drawn from federal, state, and municipal law enforcement organizations, as well as academic institutions. SWGIT work products are not intended to represent the formal policy of any one agency, but, instead, represent a consensus opinion developed by individual experts from a broad sampling of agencies and experiences.

Laboratory accreditation is an issue of great importance to the forensic science community. In the United States, some forensic laboratories are required, by law, to have formal accreditation. In such cases, a failure to achieve accreditation may result in the closure of the facility. Many laboratories are not required by law to achieve accreditation, but choose to pursue this status as one means of establishing their credentials within the field.

Recently, a major accreditation organization - the American Society of Crime Laboratory Directors, Laboratory Accreditation Board (ASCLD/LAB) - recognized "Digital Evidence" as a forensic science discipline in which laboratories could seek accreditation. Included within this discipline, ASCLD/LAB identified three subdisciplines: (1) computer forensics; (2) audio; and (3) video and imaging. This was done with the recognition that the fundamental education, knowledge, training, and experience required to perform forensic examinations in the three subdisciplines of "Digital Evidence" are distinctly different. However, a number of laboratories remain uncertain over how to handle their photographic and video units within this context.

Some of the questions being asked within the imaging and digital evidence communities include the following: Should forensic photographic units seek accreditation under the Digital Evidence discipline? Would it be appropriate to do so? Does the inclusion of "Video and Imaging" under the same discipline as "Computer Forensics" mean that computer forensics examiners are automatically qualified to conduct examinations on video and imaging evidence? Do evidentiary images and videos need to be processed by computer forensics examiners? Do forensic photographers, or individuals engaged in forensic image or video analysis, need to be qualified in the field of computer forensics? Since "Video and Imaging" is identified as a sub-discipline of "Digital Evidence", are examinations of analog videotapes or film negatives not considered a part of this discipline?

The SWGIT has developed a number of positions regarding these issues. Specifically:

1. The fundamental education, knowledge, training, and experience required to perform forensic examinations in the three sub-disciplines of Digital Evidence (computer forensics, audio, and video and imaging) are distinctly different. For example, individuals conducting computer forensic examinations require competency in such areas as computer systems architecture, operating systems, and storage devices. Individuals conducting image and video examinations require competency in such areas as photography, optics, image capture, and image processing. Therefore, individuals qualified to conduct examinations in one of the sub-disciplines must not be assumed capable of conducting examinations in another.

2. Units engaged in forensic image analysis and/or forensic video analysis seeking accreditation through ASCLD/LAB should do so in the sub-discipline of video and imaging, which is currently included in the discipline of Digital Evidence. This holds true whether original evidentiary items under examination are in digital or analog form.

3. It is not appropriate for forensic photographic units to seek accreditation within the discipline of Digital Evidence unless they perform forensic image or video analysis.

4. Accreditation issues relating to imaging functions performed in accredited disciplines (such as latent prints, questioned documents, DNA analysis, etc.) should be addressed within the accredited discipline, and not within the Digital Evidence discipline. For example, an image enhancement used to improve the visibility of ridge detail in a latent print exam is an intrinsic component of the latent print exam, regardless of whether it is performed on a computer or in a wet chemistry darkroom. The same holds true for image enhancements used in the discipline of questioned documents to improve the visibility of a faded signature.

Note that the means by which a particular laboratory handles the issue of accreditation will depend upon the type of work performed by the unit under consideration. Most photographic units will not need to seek accreditation under the discipline of digital evidence. Other units may find that digital evidence is the only appropriate discipline for accreditation. The purpose of this presentation will be to provide SWGIT guidance on this and related issues, as well as to solicit feedback from the community regarding the issues raised in this presentation.

Digital Evidence, Laboratory Accreditation, Forensic Image and Video Analysis

D15 SWGIT Presents: Part 2 - Forensic Image Processing, Repeatability, and the Myth of Bit-for-Bit Duplicates

Richard W. Vorder Bruegge, PhD, Federal Bureau of Investigation, ITD, Forensic Audio, Video, and Image Analysis Unit, Building 27958A, Quantico, VA 22135*

After attending this presentation, attendees will provide guidance to the forensic community regarding issues relating to image processing activities and to provide examples regarding how multiple techniques may be used to generate the same result.

This presentation will impact the forensic community and/or humanity by demonstrating to forensic community digital image processing need not be replicated on a bit-for-bit level for purposes of repeatability. Since different techniques may be applied to images to extract the same information, and since differences in display techniques (i.e., prints versus video monitors) do not alter the information content of an image, quality assurance guidelines need not be set to require bit-for-bit duplication of processing steps.

The Scientific Working Group on Imaging Technologies (SWGIT) was created in 1997 by the Federal Bureau of Investigation to provide guidance to the law enforcement community by developing recommendations for good practices in the use of imaging technologies within the criminal justice system. It consists of more than forty imaging professionals drawn from federal, state, and municipal law enforcement organizations, as well as academic institutions. SWGIT work products are

not intended to represent the formal policy of any one agency, but, instead, represent a consensus opinion developed by individual experts from a broad sampling of agencies and experiences.

The American Society of Crime Laboratory Directors/Laboratory Accreditation Board (ASCLD/LAB) recently voted to recognize "Digital Evidence" as a discipline under which forensic laboratories may be accredited. Included within this discipline was a subdiscipline identified as "Video and Imaging." This fact, along with the ubiquity of digital cameras in general, has led some to assume (wrongly) that all imaging functions can and should be performed using computers. What is worse, this has led some in the forensic community (including some laboratory quality assurance personnel) to assume that, because a computer is used, one should be capable of duplicating every image produced in a bit-for-bit fashion. The purpose of this paper is to demonstrate the fallacy of such an argument and to provide guidance regarding the meaning of "repeatability" in an image processing environment.

During a recent murder case in Broward County, Florida, a latent palm impression on a piece of duct tape that had been photographed in 1996 was at issue. When originally examined, the latent impression could not be identified. In 2001, however, after processing of the original film negative using commercially available digital image processing software, the palm impression was identified as belonging to a suspect who was subsequently charged with the murder. In hearings before and during the trial, the defense challenged the use of digital image processing in this case as "junk science" because the technique utilized did not lend itself to an exact, bit-for-bit, pixel-for-pixel duplication. Fortunately for the forensic science community at large, and the forensic imaging community in particular, the judge in this case denied the defense motion to exclude the palm print evidence and upheld the use of the technology and the technique in this case.

The specific technique utilized in this case was a digital version of the "dodge and burn" technique that has been utilized in traditional photographic darkrooms (including crime laboratory photographic darkrooms) since the creation of negative films over a century ago. The technique relies upon the selective underexposure ("dodging") or overexposure ("burning") of areas that would otherwise be too bright or dark on the final print. There are actually numerous techniques that can be applied to produce adjustments to the relative brightness and contrast within an image. For example, most traditional photographic darkrooms have the ability to adjust the contrast of an image simply by using specially sensitized photographic papers and different filters. Likewise, most digital image processing software packages offer several different tools or operations which can be used to adjust the brightness and contrast of an image. In fact, in the Broward County case above, the FBI Laboratory utilized a straightforward brightness adjustment to raise the latent impression, after which an examiner made an independent identification of the suspect's palm.

The key factor in this situation is that despite the different approaches used to process the latent impression, the same result was achieved - an identification of the suspect. In other words, the result of the processing - the ability to perceive features necessary to identify the suspect - was repeatable, even though different procedures were utilized. This is a critical issue for photographers, imaging scientists, and laboratory quality assurance personnel to recognize when implementing procedures within their own laboratories.

In general, forensic image processing activities are undertaken to permit the viewer of the image to extract information from the scene that was less apparent prior to the enhancement. For example, a dark image depicting the back of an automobile may be lightened to permit one to read the license plate number. Likewise, an overly bright image of a bank robber's shirt may be darkened to allow one to read the writing on his T-shirt. If it is possible to process such images to reveal details not immediately observable in the original image (as in the Broward County case above), then there are probably multiple ways in which one can do so. In such cases, the specific techniques selected by the imaging expert to process the image will most likely depend upon the expert's knowledge, training, and experience. Furthermore, the resulting images will not be precise bit-for-bit duplicates of one another, but will differ from one another in easily measurable ways. This paper will provide multiple examples to demonstrate this.

Other factors, such as fundamental differences between display monitors and printers, should also be considered when addressing the issue of repeatability in image processing activities. One can recognize that a digital image displayed on a monitor contains the same information as a printed version of that image. This is despite that fact that, from a physical sciences standpoint, the two images are completely different. It is not insignificant to note that many court rooms in the United States today are equipped with devices that permit the jury to view projected versions of printed photographs rather than look at the image directly. Furthermore, the Federal Rules of Evidence has long accepted the position that a photographic print made from a film negative is to be considered an original - identical to the negative. Given these observations, laboratory mangers should take care when preparing quality assurance requirements lest they unnecessarily restrict the flexibility of their individual experts to perform image processing operations and related functions.

Forensic Photography, Image Processing, Forensic Image Analysis

D16 Detection and Identification of Rhinoceros Species by Specific Primers

Kuo-Chuan Wu, MS, Ministry Justice Investigation Bureau, PO Box 3562, Taipei, Hsin-Tien, 231, Taiwan*

After attending this presentation, attendees will understand the use of the primers quote from the paper to identify the parts and products of Rhino.

The community may be encouraged to design species specific primers to detect parts and products of wildlife.

Rhinoceros are the first animals listed in the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), which prohibits the hunting, trading and use of endangered species. In Chinese traditional medicine, powder of Rhinoceros has long been acclaimed by herbalists as a cure for fever and used as an ingredient in a range of products, most often in the form of tablets and herbal teas, although blocks or raw horn have also been found. Owing to the over exaggerating curing effects and huge profit, it was smuggled continuously, although there is also a strict wildlife conservation law here in Taiwan to prohibit the trading of the parts or products of Rhinoceros.

There are currently a series of tests that can indicate the possible presence of Rhinoceros horn powder, including immunology test of keratin, electrophoresis of horn protein extraction and microscopic observation of horn surface structures. More definitive tests include FINS system with cytochrome-b sequencing and the comparison to the national database.

But these kinds of identification methods were not going to work if the specimens were a mixture of more than two different species or there were more than two species of Rhinoceros horn powder put together, the peaks of ATGC spelling would be mixed up, resulting in much more difficulty for sequencing the species differentiating segments of cytochrom-b DNA. A more efficient and confirmative method should be developed to resolve the problem and enhance the law enforcement.

There are five endangered species of Rhinoceros, Ceratotherium simum, Diceros bicornis, Rhinoceros unicornis, Rhinoceros sondaicus and Rhinoceros sumatrenis. A pair of primers for amplifying consensus DNA sequence of 12S rRNA of mtDNA was designed to confirm the existence of Rhinoceros DNA. The primers have been tested on a range of different animal parts and products. DNA extracts only give a PCR product in the presence of Rhinoceros horn powder.

For the purposes of determining how many species are in a powder, Rhinoceros species specific primers were also selected and then compare the sequence to the DNA database using the FastA method. After electrophoresis of the multiplex PCR products by using ABI 310, peaks of different dyes for each specific species of Rhinoceros could be detected without ambiguity, for example for Ceratotherium simum blue dye peak 351bp long would be found, for Diceros bicornis yellow dye peak 351bp long would be found, for Rhinoceros unicornis green dye peak 376 bp long would be found, etc.

The Rhino-specific and Rhinoceros species specific primers could be an efficient method for detecting parts and products of Rhinoceros.

Rhinoceros, Products of Wildlife, DNA Detection

D17 Alcestis: Bridging the Gap Between Morbidity Research and Health Surveillance

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The goal of this presentation is to present an overview of Alcestis and its use in enhancing communication with other governmental agencies in with regards to instances of death.

This presentation will impact the forensic community and/or humanity by providing an overview of Alcestis; the benefits that can be obtained by medical examiners, coroners, and death scene investigators; and preliminary findings of analyses conducted from data collected by Alcestis in Michigan. The system could serve as a comprehensive source of information that can be accessed anywhere by appropriate individuals to research and track a case. Information in the database is accessed in a hierarchical fashion. In other words, login and password allow users to be privy to as much or to as little information as is necessary. Consequently, local health departments and police can be provided with the information they require without violating HIPAA compliancy.

This presentation will provide an overview of Alcestis; the benefits that can be obtained by medical examiners, coroners, and death scene investigators; and preliminary findings of analyses conducted from data collected by Alcestis in Michigan.

Medical examiner and coroner investigations produce valuable information useful to health officials, the criminal justice system, and families of the deceased. Alcestis provides uniform standards for data collection and reporting procedures for medical examiners and coroners at the state or county level.

Alcestis bridges the gap between surveillance and research with the creation of an electronic system storing in-depth data on the circumstances and social factors surrounding fatal injuries and unexpected deaths. Hosted on the Internet, the database provides health professionals with a valuable tool for community health assessments, injury prevention efforts, and other statewide efforts.

Alcestis provides medical examiner/coroner offices a fully supported package that includes: secure Internet access to the on-line database, paper data collection forms and data analysis tools. Training, technical support, and quality improvements are on-going. Medical examiners and coroners benefit from Alcestis through quick and easy access to their mortality data, instant reports and the ability to share data among offices and with other colleagues.

The system consists of three components: a death scene investigation report, an Internet-based database container for medical examiner data entry, and county profile pages connected to the database that automatically aggregate and chart the data for reporting.

Additionally, Alcestis serves as an alerting mechanism for local public health departments when instances of infectious disease or bioterrorism occur. The alert can be either a simple faxable form with the proper contact information clearly presented on the top, or an e-mail containing necessary information generated to **the proper** authority. The alert feature increases the frequency and ease of communication between medical examiner offices and local and state health departments. Enhanced communication allows for a strengthened relationship between these parties and ideally gives way to increased contact on many levels: emergency preparation, disease outbreaks, and scene investigation to name a few. Today's forensic science requires the full participation of agencies and departments on all levels and Alcestis assists parties in communication and case management.

A future direction for the system includes the possibility of collaboration with other statewide systems, including the state police database. The system could serve as a comprehensive source of information that can be accessed anywhere by appropriate individuals to research and track a case. Information in the database is accessed in a hierarchical fashion. In other words, login and password allow users to be privy to as much or to as little information as is necessary. Consequently, local health departments and police can be provided with the information they require without violating HIPAA compliancy.

This new technology is an enhanced tool for forensic scientists that can be used during the course of medical examiner or coroner investigations as well as serve as a communication tool for other governmental agencies including, but not limited to, local public health departments.

Interagency Communication, Injury Surveillance, Mortality Research

D18 Management of Volatile Scenarios Within the Hospital Emergency Department

Barbara Spence-O'Donnell, BSN, RN and Mary K. Sullivan, MSN, RN, Carl T. Hayden VA Medical Center, 650 East Indian School Road, Phoenix, AZ 85012*

The goal of this presentation is to outline the elements of a Code Green Response Program and to demonstrate its value in the management and control of behavioral crises and interpersonal violence within the Emergency Department (ED).

This presentation will impact the forensic community and/or humanity by identifying potentially unstable situations that might escalate to acts of violence and prompt initiation of a definitive Code Green action plan can combine to eliminate ignition factors, thus deescalating or defusing potentially dangerous situations.

The Emergency Department is the most likely hospital area to become the scene for workplace violence. Individuals experiencing a mental health crisis and those who are unable to control verbal and physical aggression are thrust into a confining space with many other ill and injured patients. Psycho-social problems, mental illness, alcohol and drug abuse, frustrations associated with access to medical care and physical illness often combine and eventually reach an ignition point within the hectic environs of the ED.

During busy times, workloads are heavy, patient waiting times may be excessively long and human stress tolerances reach the limit. Furthermore, the trend to treat larger numbers of mental health patients on an out-patient basis results in their migration to Emergency Departments when they become overly anxious, seriously depressed or perceive a loss of control. Many medications for patients with conditions such as hypertension, thyroid problems, neurological disorders and pain can also aggravate certain adverse behavioral phenomena. With the right combination of precipitating events, ignition factors and loss of self-control, violence will erupt and anyone within the area can be seriously injured or killed. The abilities of staff members to anticipate potentially unstable patients at triage, and to take definitive steps to defuse anger and aggression are vital in preventing catastrophic consequences for patients and caregivers.

Unique knowledge and skills possessed by forensic nurses make them ideal candidates for workplace violence task forces and response teams. They are acutely attuned to detection of suspicious circumstances and promptly recognize a dangerous scenario. In addition, forensic nurses are accustomed to working collaboratively with other disciplines. Perhaps most important however, is that from their clinical acumen, they know that violence can quickly escalate from verbal abuse to homicide. Unlike most other healthcare personnel, forensic nurses actually believe that workplace violence is a real threat to their safety and life.

This poster will present the criteria for initiation of the Code Green Response and illustrate the specific roles and responsibilities of medical and nursing personnel, hospital police and others who combine to control patient behavior, limit the zone of danger and protect patients, personnel and others from acts of violence, hostage scenarios, and emotional terrorism. The provisions of regulatory guidance (Joint Commission for Accreditation of Healthcare Organizations, Occupational Safety and Health Act), federal statutes, and other applicable laws will also be addressed.

The Code Green Response Program as well as specific staff education and training have resulted in successful management of impending and actual volatile scenarios at the Carl T. Hayden Veterans Affairs Medical Center. Exemplary case studies will be illustrated. An environmental assessment tool, including the hospital environs and community social pattern, will be suggested as a significant component of an initial planning strategy for developing a response to workplace violence.

Code Green Response, Workplace Violence, Forensic Nurses

D19 Emasculation: Auto-Inflicted Wound or Aggression

Florent Trape, MD, Service of Forensic Science, Chu Rangueil TSA 50032, Toulouse, 31059, France; Philippe Birmes, PhD, MD, Department of Psychiatry, CHU Purpan Casserladit Place du Dr. Baylac, Toulouse, 31059, France; Norbert Telmon, MD, and Daniel Rouge, MD, Service of Forensic Science, CHU Rangueil TSA 50032, Toulouse, 31059, France*

After attending this presentation, attendees will learn that specific injuries need assessment of auto aggressive behavior.

Around 21 hours 30, the firemen bring to the University Hospital of Toulouse a forty-year-old man to take care of a hemorrhage due to a complete emasculation. The surgical operation consists on a cleaning of the wound and a joining of the cutaneous plan. The following day, the services of gendarmerie intervene to question the victim. He describes an attack by two unknown individuals when he was changing the tires of his car following a puncture on the roadside. The individuals threw him in a ditch and attached him to a tree. They placed an opaque bag on his face. The victim thought that they used a cutter like weapon for the emasculation. He would then have lost consciousness for a few minutes. Then he would have gone to the roadside where he would have been taken in charge by some passers by who took him to the hospital.

This type of wound is rare most of the time in the context of gangland killing.

The medical examiner established a descriptive certificate of the wounds the following day at the request of the legal authorities, where he noted the absence of wounds on the level of the wrists and the ankles. The examination of the skin highlights the presence of two separated testicles, associated the scrotal skin, the rod would not have been found on the spot.

The victim, with his request, profits from a psychiatric consultation two days after his aggression. He is married, the father of three children, follows the occupation of house painter, does not have particular toxic practices, and will initially evoke the absence of conflict concern with a third person.

The contact is of good quality, without thymic collapse, without productive symptomatology of the psychotic line, without structured depressive symptom. The study of the antecedent does not reveal anything notable on the psychopathological level other than one month imprisonment for voluntary violence in his youth. No psychiatric care was initiated, thus, he would never have recourse to the psychotropic treatments.

During initial questioning, regarding the action to be taken with his children, of the image which his close relations of him will have when they know the nature of his wound, we didn't notice any emotion. Four days after the aggression, he is again heard by the legal authorities, after a long interrogation, he ends up acknowledging that he auto-inflicted his wound. He is the subject then of a new psychiatric evaluation where he appeared relieved and reassured to have evoked these facts with the policemen.

The successive talks will make it possible to update a conjugopathy evoluating for many months, the scenario of an amputation of a body lying dormant already for 4 months.

With the question of the choice of the emasculation, a very particular amputation, the answer will remain pragmatic and concrete, the interested party arguing that the amputation of another member would have bothered him in his professional life.

Such a passage to the auto-aggressive act apart from any delirious and depressive structured symptomatology appears to us to have to be studied within the framework of hospitalization, hospitalization in psychiatric medium which the interested party accepts.

Let us note that the day after his hospitalization, in front of the psychiatrists of the service of reception, he revealed that it was the pressure of the gendarmes which had obliged him to acknowledge an auto-castration but that he was in fact the victim of an aggression as he had initially evoked.

The interest of this case is to share the medico-legal data and the psychiatric talks data in order to conclude on the origin of the castrating gesture, while respecting the professional secrecy.

Emasculation, Self-Injury, Mental Disorder

D20 Utilizing Forensic Nurses in the Postmortem Sexual Assault Examination: One Medical Examiner's Perspective

Stacey A. Lasseter, MSN, RN and Karen Kelly, MD, Harris County Medical Examiner's Office, 1885 Old Spanish Trail, Houston, TX 77054*

The goal of this presentation is to demonstrate advantages of using Forensic Nurses to conduct the post mortem sexual assault examination

This presentation will impact the forensic community and/or humanity by demonstrating the impact forensic nurses can have in the post mortem sexual assault examination. The forensic nurse brings to the post mortem examination a myriad of knowledge and techniques that will enhance the documentation of findings. Medical examiner/coroner offices should consider incorporating forensic nursing services into the post mortem sexual assault examination.

Sexual assault is a crime broadly characterized as any unwanted sexual contact, including rape, incest, molestation, fondling or grabbing and viewing or participating in pornography. Each state defines rape somewhat differently, but most include the following 3 criteria: 1. any vaginal, oral or anal penetration by a penis, object or other body part; 2. lack of consent, communicated by verbal or physical signs of resistance or if the victim is unable to consent by means of incapacitation because of age, disability or drug or alcohol intoxication; 3. threat of or actual use of force. For several reasons, an accurate number of sexual assaults in the United States is difficult to determine. Recent studies have shown that approximately 1 out of every 6 women in the US (18%) has been the victim of an attempted or completed rape in her lifetime.

In order to standardize for prosecution collection of appropriate forensic evidence in cases of rape, emergency departments have begun to routinely utilize forensic nurses and their specific training and materials. In many large centers a sexual assault examination conducted by a forensic nurse has become the standard of care. Training of forensic nurses includes evidence collection and preservation, injury identification and documentation and expert witness testimony. In addition to kit collection and a routine pelvic inspection, Toluidine Blue Dye, colposcopy photography and alternate light source use are but a few of the specialized techniques used in these cases by the forensic nurse.

In medical examiner/ coroner offices, the examination process in suspected cases of sexual assault normally involve kit collection and pelvic inspection without special attention, tools or documentation techniques. To our knowledge, the use of forensic nurses to document sexual assault in post mortem cases is a rarity. Beginning in 2002, the Harris County Medical Examiner's Office in Houston, Texas began using forensic nursing services. The major component of the forensic nurse's role is to conduct post mortem sexual assault examinations. To date, approximately thirty post mortem cases have been evaluated in our office. We will present data, including control cases, showing the types of injuries documented, laboratory results from the collection of kits and the improved identification of the subtle exam findings using Toluidine Blue Dye.

Forensic nurses, trained in a clinical environment, have extensive experience in gynecologic evaluations and examinations. They bring this background knowledge with them to the post mortem sexual assault examination and can provide a spectrum of techniques to enhance demonstration of assault-related findings. Their use augments the medical examiner/ coroner's ability to determine the role sexual assault may have played in the cause and manner of death. As expert witnesses, their testimony lends significant weight to the outcome of criminal prosecution of sexual assault/ rape homicides.

Sexual Assault, Forensic Nurses, Toluidine Blue Dye

D21 The Forensic Science Program at Baylor University: A Successful Experiment

Erin Slinkman, Baylor University, PO Box 97370, Waco, TX 76798*

After attending this presentation, attendees will have knowledge of an undergraduate forensic science major and what it entails.

This presentation describes the opportunities afforded to me as a Baylor student majoring in forensic science. The Baylor forensic science major became a reality in October of 1999. The program was originally designed to give premed students hands-on experience in a multidisciplinary approach. The day the program began 35 biology and chemistry majors declared forensic science as their major.

The university hesitated to establish this program and gave it four years to graduate fifteen majors. One immediate question from the administration was "Is this a fad?" attributed to the emergence of many forensic-related television programs showing at the time. As the president of the Forensic Society, I have found that 80% of our students do not watch these shows. Although many initial majors applied to medical school, there are now a significant number of students solely interested in a career in forensic science as a result of exposure to this program. There are currently 350 majors, and we have graduated over 200. Yes, the program is a success! To manage the growing number of forensic science majors, Baylor has created the classification of 'Pre-Forensic Science.' A student must complete 30 hours with a grade point average of 2.75 in order to declare forensic science as a major. Then, the student may start enrolling in the core forensic science classes, such as Crime Scene Investigation, Human Osteology, and Forensic Anthropology.

The Baylor Forensic Science program provides experience beyond the usual classroom lecture and encourages students to get into the field for forensic experience. After taking classes such as Human Osteology and Forensic Anthropology, a Baylor forensic science student may become a part of the Baylor Forensic Team (B.F.T). When law enforcement agencies call upon Dr. Susan Wallace, the program director, for assistance, the Baylor Forensic Team often accompanies her.

We consider ourselves as highly trained individuals able to distinguish human and nonhuman skeletal material. Since 1999, team members have spent many hours searching for human remains in tall grass fields, canyons, 30 feet deep wells, and steep hillsides. We see these team activities not only as opportunities to fulfill a commitment to service but also to gain forensic experience should we choose not to attend medical school but continue on specialized subdisciplines in forensic science. In addition, majors must complete twelve hours of internships. The internships are extremely varied and tailored to each individual's special interest.

Since enrolling in Baylor in the fall of 2000, I have had numerous opportunities for specialized internship training through the Baylor Forensic Science Society. I have taken an introductory Hostage Negotiation class taught by retired Detective Dominick J. Misino from the New York City Police Department. Through this class, I had the opportunity to listen to actual negotiation tapes, as well as practice role-playing negotiation with modern equipment. I also participated in a Blood Spatter Interpretation seminar, taught by Rex Plant of the Washington, D.C. Police Department. In this weeklong seminar, I used human blood for experiments. I learned about spatter patterns, such as cast off, droplets, and impressions and how different angles and heights of attack affected blood droplet patterns. I enrolled in a Blunt Force Trauma workshop given by Dr. Steve Symes from Mercy Hurst College in Pennsylvania in which I viewed examples of trauma to human bones and skulls. Actually getting to see real examples of trauma helped bring forensic cases and pictures into reality. The last internship I completed was a Forensic DNA Analysis class taught by Dr. Lori Baker at Baylor University. I learned the basics of forensic DNA analysis including how to extract and amplify mtDNA from buccal swabs, run electrophoresis gels, purify gel and complete a yield gel to quantify the actual amount of DNA. I received instruction for performing an ETOH precipitation, which prepared the DNA for analysis using a base sequencer. I learned how to read a sequencing sheet of the coded DNA base pairs. Through this class and my other internships, I have been exposed to different subdisciplines of forensic science and have gained invaluable knowledge to apply in future endeavors. In addition to these internships, Psychological Profiling, Forensic Photography, Medicolegal Death Investigation, and Forensic Entomology are also offered to forensic science majors at Baylor.

Some of the most memorable and valuable experiences I have received as a student in the Baylor Forensic Science program centered on the forensic cases in which I have been actively involved. I have learned different techniques for the searching for human remains in different physical settings. My first case concentrated on the recovery of human remains located in large mounds of dirt and gravel. I have descended into wells to search for human remains, walked areas of landfills in 110º heat searching for a missing woman, and walked miles along an interstate highway searching for a human cranium. My peers before me recovered a serial killer's first victim. The case that has meant the most to me is the recent search for one of our Baylor University basketball players who was the victim of a possible homicide. Although this event saddened me I felt I was helping to bring closure to a grieving family.

Choosing forensic science as a major has provided me special skills and knowledge that I could not have received in my regular premedical classes. As an undergraduate I have been able to apply classroom knowledge at actual field situations. From what I have learned and observed as a direct result from my participation in this program I believe I have gained a level of maturity and experience that will serve me well as a future professional. I recommend this program for anyone planning a medical career or a graduate program in forensic science.

Forensic Science, Forensic Science Undergraduate Major, Forensic Science Education

D22 Survey of the Adopt Situation of Polygraph Identification by the Court of Appeal During the Period of 2002 in Taiwan

Lee Chen, MS, Fuh-Kuo Lee, BA, and Fuh-Kuo Lee, BA, Scientific & Technical Research Center, Investigation Bureau, Taiwan, ROC, 74, Chung-Hwa Road, Hsing-Dien City, 100, Taiwan, ROC*

After attending this presentation, attendees will understand the application of lie-detection on the court system in Taiwan.

For the forensic community in Taiwan, this gave a foundation on the future research work of the cooperation relationship between court and the forensic lab (the new litigation law with a overall cross examination process is applying from October this year). For the other country, it is a good presentation to explain one of the reason why the polygraph test can be used in trial in Taiwan.

After the Survey of 100 appeal court cases related to polygraph identification, we have evaluated the adopt rate about the variables of detection theory, legal category, overrule reason, questioned rate & the power level of co-evidences, and through the analysis, we found some trends are good for future reference on the use of polygraph identification in the court system of Taiwan.

All the cases are randomly sampled from the case report of Taiwan High Court, and the periods covered the entire year of 2002. Through this survey and the analysis on all variables, we found there is a high rate of adoption on the polygraph identification by the court in Taiwan. About the different of detection theory, more court prefers the memory and response impact theory than the interrogation theory. For the overrule reason, most rejections are reasoned by lack of other co-evidences, the reason of against the logical speculation is the second. The questioned and contended rates are not as high as our original prediction, we think it is because most of the examinants are examined voluntarily, that means the screen processes for the qualify of examinants are in highly validity.

This is the first attempting to make understanding on the application of the polygraph test in this country. Because the litigation process is going to change on all trial court from September of this year, the cross-examination will be applied on the new process. This is a revolutionary change and no doubt for the strong impact on forensic evidence identification, the lie-detection identification also include. On this crucial time, the result of this research is good to open a new door for the future research work on the application of the polygraph identification in this country.

Polygraph, Litigation Process, Taiwan

D23 Nicole Brown Simpson: From Threat Assessment to Lethal Domestic Violence - What Can We Learn From Her and Other Victims of Abuse?

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After attending this presentation, attendees will gain a greater understanding of the threat assessment process, the analysis of domestic violence crime scenes and the prediction and possible intervention in domestic abuse cases.

This presentation will impact the forensic community and/or humanity by providing a greater understanding of the analysis of domestic violence scenes, the assessment of the various types of threats and an assessment of the type of individuals who are likely to abuse or be abused.

On June 12, 1994, Nicole Brown Simpson attended her daughter's dance recital at Paul Revere Middle School with her family. The event was followed by a family dinner at Mezzaluna Trattoria, and ice cream at Ben and Jerry's. OJ Simpson was not included in the celebration. He made it perfectly clear that he was furious! He was a man who was not used to rejection!

Following the festivities, Nicole and her children returned to their home at 875 S. Bundy Street. A short time later, it was discovered that Nicole's mother had left her prescription glasses at the restaurant. Ronald Lyle Goldman, their waiter at Mezzaluna, found the glasses and offered to drop them off at Nicole's residence, since Bundy Street was on his way to his after work date. Nicole sent 9-year-old Sydney and 6-year-old Justin to bed, drew her bath and waited for Goldman to drop off the glasses before she slipped into her tub. Sometime around 10:00 p.m. neighbors heard Nicole's Akita barking. Nicole sustained stab wounds to her neck and head and her throat had been slashed. Ronald Goldman sustained approximately twenty-five stab and incised wounds. A left glove and a stocking cap were discovered at the scene. Bloody Bruno Magli shoe prints were noted, walking away from the bodies toward the alley behind Nicole's residence. Blood drops were discovered on the left side of the shoe prints. A limousine driver was waiting in front of OJ's house on Rockingham Avenue to drive him to the airport at eleven p.m. for a late flight to Chicago. Kato Kaelin heard a thud against the air conditioner in his room. The bloody right glove was later discovered at this location. OJ Simpson's white Ford Bronco was impounded while he was still in Chicago. Blood that matched OJ, Nicole and Ronald was discovered on the driver's door, front seats, the steering wheel and the console.Thirty-nine drops of projected blood were discovered on one of the socks OJ wore on the night of the murders and nineteen drops were discovered on the other. Cuts were documented on a finger on OJ's left hand. Simpson was later arrested following a 60-mile slow speed chase on 405 with his friend Al Cowlings in Cowling's white Bronco. The media recorded this drive from the air and each overpass of the highway, as OJ sat in the passenger seat, holding a gun to his own head. A jury found O J Simpson not guilty of the criminal charges. A civil jury later heard the same testimony and found him liable for the murders, awarding the Brown and Goldman families 33.5 million dollars.

Could this tragic crime have been prevented? Why did Nicole remain married to OJ Simpson from 1985 to 1992 in spite of her claims that OJ had abused her for most of their marriage? What could she or other victims of domestic abuse do to participate in their own safety and survival? What can authorities do when a victim reports abuse and violence on numerous occasions but repeatedly returns to the abuser and refuses to prosecute? Why do victims of domestic violence remain with their abuser? How can authorities tell if the threat is real and the victim is truly in danger? What is the obligation of the psychiatric community to report patients who confide victimization or violent intentions and what information regarding their patients must they reveal? And finally, are individuals who have celebrity status treated differently by law enforcement and the legal system? These are a few of the many questions that will be addressed by the three presenters in this joint session. The murder of Nicole and Ronald will be used as an example of the worst case scenario possible, along with numerous other case examples from the case files of the presenters.

Threat Assessment, Domestic Violence, Intervention

D24 "Viking Funeral" — Ritual Murder or Suicide?

Robert J. Morton, MS, FBI - National Center for the Analysis of Violent Crime, FBI Academy, Quantico, VA 22135*

This presentation is designed to highlight the many components of equivocal death investigations, through the presentation of an unusual case.

The question of homicide versus suicide is the central issue involved in equivocal death investigations. These inquiries are approached as homicide investigations for obvious reasons. Equivocal death investigations are, by their very nature, complicated, and emotionally intense because of pressure from the surviving family members, and the community. Investigators, and medico-legal professionals face many challenges because of the lack of clear and convincing evidence.

The FBI's National Center for the Analysis of Violent Crime (NCAVC) is routinely consulted by federal, state and local authorities in a variety of cases of violent crimes, especially bizarre or repetitive homicides. NCAVC assistance was requested by local authorities in regards to a case involving the possible suicide of a 22-year-old male victim.

The victim was discovered by his girlfriend in a utility shed behind her parent's residence where the victim and girlfriend were residing. The victim suffered from a single gunshot to the forehead. The crime scene appeared very bizarre to the investigators and the victim's family. The contents of the shed, including a lawnmower, and other garden implements, had been removed. The interior of the shed had a number of objects placed in it, including rugs, religious figurines, and candles. The scene was arranged very carefully, with the rugs placed in the middle of the floor, surrounded by the various religious figurines and candles. The victim was found lying on the rugs, dressed only a pair of shorts, and had a cross with a circle scratched onto his chest. The door to the shed was closed, and his shoes placed neatly outside the door.

The gunshot wound was caused by a .38 caliber bullet, fired from a Smith and Wesson handgun which was found next to the victim's body. The entrance wound had a circumferential marginal singled abrasion with an accompanying 1/4 inch soot ring encompassing the wound. There was also a second soot ring surrounding the first soot ring. It appeared to be a contact shot. A deformed lead bullet was recovered in the left cerebellar hemisphere. The bullet path was front to back, and slightly left of midline. A toxicological drug screen was negative for any commonly used or abused substances.

The corner ruled the cause of death was a penetrating contact gunshot wound of the head, with the manner of death undetermined.

Investigation revealed the handgun belonged to the victim's girlfriend's father and was kept in the residence. There was no suicide note found.

There was conflicting background information on the victim regarding suicidal tendencies. The victim was normally "emotionally" upset several times a week, but was not on any medications, nor was he participating in any therapy or counseling. The victim had not previously attempted suicide. The victim did not have any life insurance policies. The victim was unemployed, and did not have a criminal record. The victim's sketch book was located after the incident, and contained several drawings with bizarre themes.

The victim's family did not think the victim would commit suicide. They were aware of future plans he had for marriage, and returning to college the following fall. The victim had also offered to perform a number of household chores for his parents later that week. The victim's parents were concerned the victim may have been killed in a "ritual" murder.

The issues in this case highlight the difficulties faced by law enforcement and medico-legal death investigators in dealing with equivocal death investigation, including determining despondency, locating indicators of suicide, and eliminating the possibility of a staged homicide.

Equivocal Death Investigation, Suicide, Despondency

D25 Identifying the Unknown — The Role of the Forensic Odontologist

Barry E. Lipton, DDS, 11200 Seminole Boulevard, Suite 108, Largo, FL 33778*

After attending this presentation, attendees will understand 1. the statistics involving missing persons and unknown remains and the role of the Forensic Odontologist, 2. how information is placed into the NCIC System and the problems associated with inaccurate information from untrained resources, and 3. Case Studies: a. A cold case involving a missing teenager and a Jane Doe buried for almost 19 years; b. 17-year-old antemortem dental records of a 14-year-old missing female and a 31-year-old Jane Doe.

This presentation will impact the forensic community and/or humanity by increasing the awareness of problems associated with inaccurate dental evidence in dealing with Missing and Unidentified persons.

How important is the timely identification of unknown remains? In cases involving a death, little progress will be made without first establishing the true identity of the deceased.

In this country, there are approximately 100,000 missing persons on record in the National Crime Information Center database and only 5% of these missing persons have supplemental dental records included in their files. Nationally, there are approximately 5,000 people listed as unidentified in the NCIC database, of which 90% are adults. Of the close to 5,000 unidentified, only 68% have supplemental dental information.

Case Study #1/A Statistic: On Monday May 7th. 2001, Detectives from the Pasco County Sheriff's Office contacted me, asking if I would assist in reviewing dental information related to a teenager who had been missing for almost 19 years. They had reason to believe that the remains of a Jane Doe, buried in a neighboring County in 1983, may be those of their missing teenager. A review of the 1979 dental x-rays, chart and NCIC form for the missing teenager, showed inaccurate entries on the submitted NCIC form. Dental x-rays, the postmortem dental report and NCIC information for the unknown were not available for review, as they were lost. Although some similarities were noted when comparing the dental records of the missing teenager and the charted postmortem (1982) remains of the unknown, several inconsistencies were noted in the initial comparison. However the Sheriff's Department elected to proceed with an exhumation.

The unknown from Manatee County was exhumed on June 13, 2001. The skull and dental structures were separated from the remains, re-examined, re-charted and x-rayed. A significant finding during the re autopsy was that teeth originally reported as not present during the 1982 autopsy, were found among the remains. One of which, the Maxillary Left Central Incisor, had a unique pin retained porcelain restoration, previously uncharted.

This presentation will review the results of the dental comparison of the postmortem records with the dental evidence of two cases involving missing teenagers: the problems associated with inaccurate dental charting; NCIC submissions; lack of proper dental records and radiographs; and problems when duplicate copies of the original dental findings and reports are not maintained.

Missing/Unidentified, Dental Records, NCIC

D26 Underwater Crime Scene Investigation: A New Frontier in Forensic Science

H. Dale Nute, PhD, Florida State University, 4750 Collegiate Drive, Panama City, FL 32405*

After attending this presentation, attendees will become familiar with the capabilities and limitations of underwater crime scene investigations and the legalities concerning their conduct.

This presentation will impact the forensic community and/or humanity by demonstrating considerable ignorance, misinformation, and confusion which currently exists about the capabilities and limitations of crime scene examinations and the proper protocol for conducting them. Some of these misconceptions will be corrected.

The necessity for recovering evidence from underwater sites is unquestioned. Everything from plane crashes and boating accidents to the disposal of bodies, cars and weapons involved in crimes requires some sort of crime/accident scene processing. There are, however, several questions about how to recover it. These questions involve pragmatic, scientific, safety, and legal issues.

Pragmatically, can evidence of value be recovered after having been exposed to water? Not only can many types of evidence be recovered and valuable information inferred, some types of materials may actually be better preserved than if left in the open on land for the same length of time. In many cases, however, much of the evidential information is lost or destroyed by marine organisms or the water itself. Proper recovery techniques are as important for underwater evidence as for land evidence, if not more so.

Scientifically, is there any requirement for examination beyond just collecting the items of evidence? In many cases no, but in many other cases yes. Like all other potential items of evidence, an object's evidential value depends on the questions or issues in the case. In most cases, documenting the scene underwater provides the same type of information for the case investigators and the jury as does documenting a case with measurements and photographs on land. In other cases, the process of recovering an object will severely compromise its evidential value and an underwater examination is imperative before collecting it.

Safety-wise, how safe is the recovery of evidence? Again, that depends on the nature of the scene. Some are simple for investigators trained to work underwater. Others absolutely cannot be processed by a diver and if the scene is to be processed, some form of technology will be required. A variety of technology is currently being developed to aid the underwater investigator even in routine investigations.

Legally, what is required to conduct an investigation underwater? Underwater operations are sufficiently hazardous that OSHA imposes rather severe regulations to assure the safety of commercial divers. For reasons of exigency, an exemption to the regulations is provided for Public Safety Divers to conduct search and rescue operations or to locate and stabilize the scene of a crime or accident. To process the scene, including the recovery of evidence, however, requires either a commercial diver or a scientific diver. Scientific diving also has an exemption that allows for prolonged investigations and the collection of data and specimens. Additional training and administrative requirements are required to meet the criteria of this exemption. The purpose for the task, not the task itself, establishes whether it falls under the regulations for scientific diving or commercial diving. A scientific diver with proper training and equipment performs many of the same tasks in marine biology and nautical archaeology as commercial divers do in other types of work. These are essentially the same tasks required of underwater crime scene investigators, the specimens just happen to be human and the sunken ships just happen to be recently sunk.

If crime scene investigation is a science, then a crime scene investigation conducted underwater should meet the requirements of scientific diving. This means that the underwater crime scene investigator must also be a qualified forensic scientist as well as a competent diver. The emphasis, however, is on investigator and scientist, not diver. Diving is merely a means of getting to the job site.

Underwater Crime, Scientific Diving, Underwater Investigation

D27 Use of 3D Computer Animation to Evaluate Complex Shooting Events

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The goal of this presentation is to present to the forensic community a method for visualizing complex shooting events using 3D animation software.

This presentation will impact the forensic community and/or humanity by demonstrating how 3D computer animation was used successfully to better understand a complex and high-profile shooting event. In the future, they may use this tool to aid in their own analyses.

This presentation will examine how 3D computer animation was used to evaluate a complex and controversial shooting event. A man was killed when he was shot multiple times in the back by a police officer. A reconstruction of the event using 3D computer animation demonstrated how the event occurred.

A police officer investigating a noise complaint at a large Halloween party observed what he believed was a narcotics transaction. Standing in the backyard of a Hollywood Hills home, he looked into a bedroom window. Inside the darkened bedroom he saw three men making an exchange. When he illuminated the individuals with his flashlight, one of the men pulled a large handgun from his waistband and turned and pointed it at him. The officer reacted by drawing his gun and firing it nine times at the man through the glass panes of a French door.

The man fell to the ground and subsequently died from his injuries. The autopsy showed the man had been hit by four rounds. Three were in his back, and the other was to the back of his head. It was discovered that the man, an aspiring actor, had been holding a fake gun. The gun was a movie prop. The event immediately became controversial and received considerable attention in the media.

This particular incident would be difficult for the average person to conceptualize due to its complexity. Multiple shots were fired at various angles in a short period of time, and both the officer and the man were moving at the time. Computer animation allows one to visualize the complex interaction of objects with regard to time and space. Thus, it is an excellent tool for analyzing this kind of event.

Three important factors had to be considered in reconstructing the shooting: the paths of the bullets, the motion of the man who was shot, and the timing of the firing sequence.

To determine the bullet paths, a shooting reconstruction was conducted at the scene. The five shots that missed, hit the bedroom wall and a closet door. These bullet holes had been subsequently repaired, however repairs were clearly visible so the location of the holes could still be determined. The original French door had been preserved and was reinstalled with bullet holes in the glass still intact. By correlating the bullet holes in the glass with those in the bedroom walls, the paths of the bullets could be generally defined. Three-dimensional measurements were then taken of the scene and bullet hole locations using a surveyor's total station.

Next, a shooting exercise was conducted at a firing range. The same officer was told to draw his weapon and fire nine rounds in response to a visual cue. He was told to assume the same posture and step backward while firing, as he did the night of the incident. Several tests were recorded using high-speed video at 500 and 1000 frames per second. The tests showed that the officer was able to fire all nine shots in less than two seconds.

The officer and an eyewitness both stated that the man turned toward the officer and pointed the prop gun at him. However, in order for the shots to have hit man's back, he must have turned away during the event. A videotape was made of an individual pointing a gun as described and then suddenly turning away. The tape was used to determine a reasonable rotation speed for someone turning away from a threat.

Using this data, a computer animation was created. The shooting scene was modeled on the computer using a 3D animation program. This type of program allows the user to accurately define and visualize objects in 3D space. Once a scene is created, bullet paths through space can be defined.

Human-like computer models, called mannequins, were scaled to match the dimensions of the officer and the man. They were then placed in the scene according to witness statements. Bullet paths matching the descriptions in the autopsy report were plotted through the body of the mannequin representing man. (It should be noted that such mannequins are idealized representations of humans. Some torso and extremity dimensions may differ from those of the actual people involved, just as dimensions vary between individuals of the same height. Also, the mannequin's torso does not bend the same as a human's since it is made up of articulated polygons. However, a good approximation of human body positions is possible.)

By correlating the bullet paths through the body with the officer's line of fire, it was determined that the man had to bend at the waist and rotate to his left, presenting his back to the officer. The variation in the angles of shots laterally indicated that the man was in motion when he was shot. The vertical angle of each shot to the torso indicated that he was bending over as he rotated. His body position at the time of the head shot could not be determined because of the head's ability to rotate independently of the body. The timing of the shots was based on the data recorded at the firing range. The rotation speed for the mannequin representing the man was based on the videotaped reenactment.

The resulting 3D computer animation was a real-time visualization of how this event likely occurred.

Computer Animation, Shooting, Firearms

D28 Polygraph Testing and the Effect and Detection of Deliberate Manipulation of Physiological Data: An Assessment of the State of the Art in Polygraphy and in the Practice of the Forensic Sciences

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After attending this presentation, attendees will learn what the available research reveals about the effect of physiological and psychological manipulations on polygraphic data when the Control Question Technique (CQT) is administered. The CQT is the most common approach to instrumental credibility assessment ("lie detection") in the U.S. The emphasis in this session will be on presentation of polygraphic data showing how deliberate manipulations influence recorded signals and how readily available technologies enhance manipulation detection.

This presentation will impact the forensic community and/or humanity by demonstrating a better understanding of how polygraphy and practices in that field fit within general practices in the forensic sciences.

When polygraph testing is carried out using the CQT a subject's physiological responses to a set of "control" questions and a set of relevant (crime/event related) questions are compared in order to determine the subject's truthfulness. Simply stated, more consistent and pronounced responses to control questions than to relevant questions, leads to a decision of truthfulness whereas consistently greater responses to relevant than to control questions produces a decision of deception. Persons who are lying about relevant questions, however, may employ "manipulations" during a CQT to try to "beat the testing." This can be done in one of two ways. First, physiological responses to relevant questions may be suppressed, relative to control question responses. Second, physiological responses to control questions may be "artificially" enhanced. In either instance, the result is intended to show greater responses to the control than to the relevant questions in order to change the outcome from "deception indicated" to a "no deception" indicated result. This produces what is termed a false negative outcome, an actually deceptive person being reported as truthful.

The effectiveness of deliberate manipulations on CQT outcomes is not well established. Laboratory, "scripted event," studies reported to date have examined the effect of mental and physical manipulations. In one study, it was reported that 37% of the "guilty" subjects who were trained to use either pain or another physical activity, or both, were able to defeat the CQT. In addition, 25% of the guilty subjects in this study, who were specifically trained in the use of a specific cognitive activity were also able to defeat the CQT. In an earlier study, however, it was found that guilty subjects who were trained in the use of a "method acting" procedure were unable to alter the outcome of their CQT examination. In this study all "guilty" subjects were correctly detected.

Considered together, the available laboratory studies suggest that "guilty" subjects may avoid detection with the CQT if they have specific prior knowledge of the testing conditions and, importantly, if they are given intensive practice in applying specific manipulations. This is and has been, of course, a concern in the polygraph examiner community. And, it is seemingly even more important today. There are now sites on the World Wide Web, accessible to anyone with a computer, which post reasonably accurate information about polygraph testing and about methods that might be used to defeat specific applications of such "tests." Moreover, a recent report on Polygraphy by the National Research Council of the National Academy of Sciences highlighted the need for scientific scrutiny of the likelihood that polygraph testing outcomes may be affected by deliberate manipulations of examinees.

If examinees' efforts to manipulate polygraphic data can be readily detected it would be assumed that their effect would be minimized, perhaps even nullified. However, laboratory-based research suggests that attempts to detect deliberate manipulations of polygraphic data may be only moderately successful. This finding is in direct conflict with many anecdotal observations and some systematic, field-based reports of practicing polygraphists. Based on the data offered in this paper the weight of the evidence favors the position of field examiners.

In this presentation the research findings on the use and effects of manipulations of polygraphic data will be presented and discussed from two perspectives. The first of these is how such manipulations relate directly to the practice of polygraphy. The second, and the emphasized view, will be on how such research should be interpreted within the general context of the forensic sciences and the need for more rigorous assessment of forensic practices.

Polygraphy, Lie Detection, Credibility Assessment

D29 Do Come Over, Someone Has Killed Father

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After attending this presentation, attendees will understand the method in which suspects respond to questioning often times provides interrogators with insights into the suspect's culpability. Investigators who are trained in interrogative techniques present challenges to the guilty, in that offenders are unaware of these strategies. The objective of this paper is demonstrate the guilt of Lizzie Andrew Borden based upon her manner of responses to subsequent questioning following the murder of her father and step-mother.

This presentation will impact the forensic community and/or humanity by demonstrating criminal interrogation which is a forensic discipline in which interrogators discover acts of deception. This pre-

sentation will demonstrate that Lizzie Borden, acquitted of murder, was in fact lying when answering relevant questions. This demonstrates the reliability of the three-step interrogation technique.

On August 4, 1892, two murders occurred in the small town of Fall River, MA. As history has recorded, Andrew Borden and Abby Borden were both bludgeoned to death with an unidentified weapon. Abby Borden died first, after suffering 19 injuries to the side and rear of her head. Approximately 90 minutes later, Andrew Borden was bludgeoned to death in the same manner, and died from 10 injuries to the left side of his face. The only known persons present during the time frame of the murders was Lizzie Borden and the housemaid, Bridget "Maggie" Sullivan.Lizzie Borden was quickly developed as the most likely suspect of the murders. The police investigation, which was cursory at best, failed to answer two important questions that supported the eventual acquittal. No murder weapon was ever definitively identified, and the lack of blood spatter on Lizzie or her clothing could not be explained.

Police and court officials questioned Lizzie Borden on four occasions. Her manner of responding is typically found in instances where interrogators use a technique known as the "three-step interview." This particular technique demonstrates that a suspect is practicing deception when answering specific questions. This technique requires that the suspect provide an initial free and uninterrupted statement surrounding the circumstances of the incident under investigation. The second step consists of randomly chosen facts for clarification. Step three requires the suspect to reiterate the circumstances of the incident. It has been seen that deceptive suspects fail to maintain consistency and accuracy during the third step of this technique.

To support the theory that Lizzie Borden was guilty of double murder, the scene was compared to Lizzie Borden's inquest testimony. Analysis of the testimony, as compared to the trial testimony of other witnesses, revealed that Lizzie Borden reacted in the same manner as other suspects when confronted with interviews similar to the three-step interview process. In the end, Lizzie Borden's statements concerning the murders began as her initial version of the murders, to mixed and questionable, to a different version. Truthful witnesses rarely have problems reporting the same information three times. In addition to the weapon and blood questions, Lizzie Borden's inquest testimony, which was the proof of her deception, was not permitted into her criminal trial.

Lizzie, Borden, Murders

D30 Medical Evidence in Sexual Offense Trials: A Two Year Audit of Data Relating to Expert Witness Testimony of Forensic Physicians in Sexual Offense Trials

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The goal of this presentation is to present information about medical evidence in sexual offence trials to facilitate an understanding of the forensic role of the doctor providing services to patients who allege sexual assault.

This presentation will impact the forensic community and/or humanity by demonstrating how information about medical evidence in sexual offence trials provides a valuable insight into the forensic role of the doctor in this setting and has the potential to inform both the medical and legal professions for the ultimate benefit of the courts and in the interest of justice.

Patients who allege recent sexual assault in metropolitan Perth, WA, are seen by a group of 10 doctors who are trained in aspects of clinical forensic medicine and who provide 24 hour medical and forensic services to approximately 400 alleged victims of sexual assault per year. Sixty per cent of these patients have reported the incident to the police at the time of examination and a further fifteen per cent are considering involvement of the criminal justice system. The forensic role of the doctor in this setting involves documentation of injury on the body and in the genito-anal area, the collection of physical evidence, the preparation of a medical report detailing examination findings and their significance, and expert witness testimony in court.

This paper will present data relating to over 160 subpoenas and 80 court appearances by doctors over the two year period from July 2001, to June 2003. Three quarters of these subpoenas were for the District Court, and the remainder for preliminary hearings and the Children's Court. Data collected include duration of time from examination to trial, opportunity for pre-trial discussion between lawyers and doctors, time spent by doctor in the witness box and specific issues the doctor was questioned upon.

The average time between examination and the doctor's appearance as a witness was 21 months. All trials involved pre-trial discussion between the doctor witness and lawyer (prosecution +/- defense). The average length of time the doctors spent in the witness box was 40 minutes, with the length of evidence varying from 10 minutes to 2 hours. Doctors were questioned about genito-anal injury in forty five per cent of trials, general injury to the body in thirty per cent of trials and history given to them by patient and the patient's demeanor in ten per cent of trials. This paper will present details on these and other medical issues which the court sought information about.

Sexual Assault, Medical Evidence, Forensic Physician

D31 Quantitative Characterization of Tool Marks for Comparative Identification

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The goal of this research project is to measure surface roughness as a means of identifying features such as toolmarks.

This presentation will impact the forensic community and/or humanity by demonstrating If successful, this process should yield a forensic technique that is rapid, easy to perform, applicable to any shaped surface, and has the potential to be automated for automatic matching. By providing quantitative data the method answers the challenges created by the Daubert decision. The instrumentation needed for the method, while somewhat expensive, should still be affordable to many state and regional laboratories.

This paper will present initial results of an effort to provide the forensic community with quantitative, scientific, statistical data that supports the current comparative identification of bullet striations and toolmarks. This study is designed not to replace the current method, challenged in courts as being "unscientific" (see 1993 *Daubert v. Merrell Dow*), but to supplement the method with scientific data. The overall goal is to provide local, state, and federal law enforcement officials with statistically valid data that supports examiner testimony and is suitable for courtroom presentation.

Current examination relies upon qualitative examination of a surface and optical matching of a pattern across a region that essentially is two-dimensional in nature. This project extends the characterization of tool marks from a two-dimensional qualitative examination to a three-dimensional quantitative one.

In the proposed method the surface is examined optically and regions of interest identified using conventional comparative examination techniques.Replicas are then made of the 'evidence' and 'standard' surfaces, the regions of interest identified and the resulting replicas are characterized using a three-dimensional profilometer. This instrument uses a finely balanced stylus to measure the topography of the surface over a user-defined area. The resulting data from the 'evidence' scan is then matched to the 'standard' scan and statistically eval-

uated to determine a probability of fit using a computer program.

In order to be useful it must first be shown that replicas produced using commercial materials and resins do accurately replicate the intended surface, and that these replicas can be accurately and consistently measured using a profilometer. Initial experiments have shown that, to within the specifications of the instrument, replicas are an accurate reflection of the surface and that multiple scans produce only slight changes in the surface. Current efforts are now aimed at developing the computer match routine that will take the quantitative data, automatically align the 'evidence' and 'standard' scans, then compare them statistically to determine an order of fit.

Tool Markings, Quantitative Characterization, Automatic Identification

D32 Multiple Fatality Planning: Managing Mass Fatalities From a Variety of Causes, Including a Potential Bioterrorism Threat

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After attending this presentation, attendees will understand a model for effectively dealing with a mass fatality incident at a provincial or state level, and to review the recent Toronto SARS experience as a model for a potential bioterrorism threat.

This presentation will impact the forensic community and/or humanity by assisting coroners and medical examiners who may be faced with the task of coordinating a mass fatality recovery operation. The Ontario model is based on an Incident Command structure and focuses on many of the critical areas that must be managed effectively in such an event. The development of this model has been assisted by field experience gained by our members in a variety of different settings: SwissAir Flight 111 crash, Eastern Ontarion Ice Storm (2000), World Trade Centre, Bali Nightclub Bombing, Toronto SARS outbreak (2003). The SARS outbreak in Toronto serves as an excellent model for how an evolving bioterrorism incident, such as smallpox outbreak, would be effectively dealt with.

Because the scope of emergencies vary, and most are managed at the local community or municipal level, there is the potential for a catastrophic event to overwhelm the capacity of local authorities to carry out the extensive operations necessary to respond in a timely and appropriate manner. A multiple fatality incident could be such an overwhelming event, and hence the Ontario Provincial Multiple Fatality Plan has been developed to provide a structural framework for a systematic, coordinated and effective response in those circumstances.

Aimed at establishing mutual cooperation and assistance between agencies and organizations of varying jurisdictions, the plan allows for the investigation, reporting, recovery, identification, examination and disposition of human remains. Under the *Coroners Act*, coroners in the Province of Ontario investigate all unnatural deaths such as those where accident, suicide, foul play or suspicious circumstances may exist. Most mass fatality incidents would likely fall within the coroner's jurisdiction.

The authority for implementation of the Plan rests with the Chief Coroner for the Province of Ontario. Once initiated, a control group of senior administrators will be quickly convened to oversee operations in a number of different areas, including incident site investigation, morgue and forensic pathology operations, antemortem and postmortem records management, family liaison and assistance, liaison with other governmental disaster management agencies, and international liaison (where required), and media relations.

Although the traditional focus of mass fatality plans in the past has been on reacting to incidents such as plane crashes, explosions, or natural disasters, recent history has taught us that chemical, biological, radiological and nuclear events are also likely possibilities. These threats pose interesting and unique challenges to the safety and well-being of emergency responders, recovery personnel, and death investigators, including coroners, medical examiners, pathologists, and morgue assistants.

Careful consideration must be given to dealing with potentially contaminated remains, including those that may pose a threat of infection. Temporary morgue facilities or, as a minimum, a secure containment area may need to be established. In the early stages of an incident, autopsies may be necessary to establish the medical cause of death (MCD) or to help in understanding the etiology, or they may be able to assist Public Health officials in planning strategies for containment or quarantine. Once the MCD has been clarified, further autopsies may be necessary only to establish identities of the decedents, or to gather sufficient forensic documentation for future court proceedings.

The recent outbreak of SARS in Toronto, Ontario, has provided very useful incite into the types of problems that will likely arise for death investigators in the event of a bioterrorism event, such as anthrax, or smallpox inoculation of the population. Facilities must be in place for safely carrying out postmortem examinations with minimal risk to personnel in the early stages of an incident, including appropriate negative pressure ventilation systems, protective clothing, etc.

Once the correct diagnosis has been established that would likely apply to the majority of the deaths occurring in a multi-fatality incident, which may be an instantaneous event, or may be slowly evolving, criteria may need to be established to limit the ongoing risk exposure of pathologists, morgue attendants and the like. Screening tools which can be applied by knowledgeable and experienced personnel can be useful in determining who requires a postmortem examination and who does not. Protocols must be flexible and allow for limited autopsies and sampling of only those specimens that are essential.

Communication with other agencies, families of decedents, and with the public through the media from the earliest possible moment is instrumental in maintaining confidence in government officials and allaying irrational fears and even unnecessary panic. Daily media news conferences proved very successful in the Toronto SARS experience to both inform the general public about progress in the evolution and containment of the epidemic, and to educate them about the nature of the disease and its methods of spread. This was particularly critical in a slowly evolving and ongoing crisis with this infectious disease, and would apply equally to a bioterrorism event in order to keep the public on-side and cooperative with Public Health containment initiatives.

In conclusion, Mass Fatality Planning must be flexible and take into consideration the variety and potential scope of threats that exist in our post-9/11 world. Coroners and medical examiners must be prepared to efficiently process large numbers of human remains that may be contaminated and therefore may place them at risk, and must be cognizant of the need to keep other agencies and the public fully informed during the event.

Mass Fatality Planning, Bioterrorism, SARS

D33 A Tale of Two Toxicities: Death by Poisoning of Two Married Health Care Professionals

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After attending this presentation, attendees will understand the importance of coordination of the efforts of, and consultation among, the varied disciplines involved in the investigation of a suspicious death with ambiguous findings, and in which intimate femicide is a possibility.

This presentation will impact the forensic community and/or humanity by demonstrating an appreciation of the value of well-coordinated multidisciplinary expertise into an ambiguous death.

This case vignette will present the results of an investigation into the sudden deaths of two married health care professionals, in which extensive consultation and teamwork were required in order to determine the cause and manner of the deaths.

This young, apparently happy couple had met at university. He was a physician who had recently completed his post-graduate training, and had taken up a teaching position in a tertiary center. She was a nurse, who had put her career on hold while she raised their young children. All members of the household were previously well.

One evening in early fall, emergency services were called by the physician, who reported that his wife had become unresponsive following an apparent seizure. She was transferred to hospital via ambulance, where she was pronounced dead after resuscitative efforts were unsuccessful. The coroner was notified of the case, and, because of certain findings, police became involved, and a forensic autopsy and laboratory tests were performed. Based on initial findings and an urgent investigative case conference, all manners of death (natural, accident, suicide and homicide) were plausible, and all possibilities required careful evaluation.

Two weeks after the death of his wife, the physician died suddenly at his office. There was considerable local media attention. His death was investigated by the same team, augmented by a consultation from Behavioral Sciences, and underwent further review within the Office of the Chief Coroner.

Drawing sound conclusions about the cause and manner of these two deaths required integration of the careful collection and scrutiny of physical evidence in tandem with the professional analysis of the subtleties of human behavior. The presentation will provide an overview of the contributions of each of the investigative disciplines, the manner in which the expert work was coordinated, and the final investigative conclusions about the circumstances surrounding these two deaths.

Toxicity, Domestic, Multidisciplinary

D34 Comparative Analysis of Computer Forensics Software on IBM Compatible and Macintosh Media

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The goal of this presentation is to provide the forensic community with a sampling of the Computer Forensics software tools available for imaging and analyzing computer hard drives and storage media. The given information in this presentation will help Computer Forensic Examiners and others working in this field to gain knowledge of applications, advantage and disadvantage of three specific software programs researched during this study and help them determine which program may work best for their needs in searching for evidence of a crime.

This presentation will impact the forensic community and/or humanity by aiding the forensic community in understanding the different forensic software available and will help them choose the best software for their cases.

This study attempts to answers three important questions when choosing software tools: 1) Can the program recognize and therefore image a particular type of storage media? 2) Can the examiner view or execute the specified test files and documents either from within the program or with an external program? 3) Can the program recognize and therefore image a Macintosh formatted storage media? The programs evaluated, scored and then subsequently rated on the aforementioned criteria.

The results shown in the Tables 1 and 2 indicate the total number of test documents and files each program was able to open, view, or execute either from within the program or with an external program.

In conclusion the present study will provide a very useful guide for the suitable program choice and proper application of the forensics software.

Table 1

RATING	PC ZIP DISK SOFTWARE TESTED	NUMBER OF OPENED FILES
1	Forensic Toolkit (FTK)	26 out of 26
2	ProDiscover	23 out of 26
3	EnCase	20 out of 26

Table 2

RATING	MACINTOSH ZIP DISK SOFTWARE TESTED	NUMBER OF OPENED FILES
1	EnCase	7 out of 26
2	Forensic Toolkit (FTK)	5 out of 26
3	ProDiscover	0 out of 26

Computer Forensics, Software Tools, Comparative Analysis

D35 Odor Analysis of Decomposition

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The goal of this presentation is to present research on the identification of molecular odorants (volatile compounds) released during decomposition of buried human remains. Attendees will become aware that human decomposition is significantly more complex than previously thought, which has implications in the training of cadaver dogs and in the detection of human remains

This presentation will impact the forensic community and/or humanity by demonstrating research which furthers our understanding of human decomposition and has profound ramifications in cadaver dog training procedures and in the development of field portable analytical instruments which can be used to locate buried human remains.

The detection of buried human remains is often aided through the use of ground-penetrating radar (GPR), manual probing techniques or trained 'cadaver dogs.' Of these methods, the means by which cadaver dogs locate human remains is least understood as the compounds the dogs are actually alerting to are unknown.

Because of the success of canines, the science of odorology expanded to deal with the forensic applications of scent discriminating dogs. These dogs have proved invaluable in such vital areas as explosive and accelerant detection, narcotics detection, cadaver location and searching for criminals as well as lost or missing persons. Canines have the ability to find historic human remains and the ability to discriminate human remains from those of other mammals. Additionally, dog trainers have recognized from observation of canine behavior that odor emitted by a live person differs from a cadaver and the odor from a recently deceased individual differs from one in advanced decomposition. As such, the smell associated with the stages of decomposition consists of multiple signatures. While dogs are trained to locate bodies and differentiate between human and animal remains there are limits to their abilities, in part due to environmental factors.

The current study seeks to find the basis for the canine's scent acuity by identifying the volatile compounds released from soft tissue decomposition in a burial environment and was conducted at the University of Tennessee's Anthropological Research Facility. Air samples were collected from directly below and above buried subjects (at a depth of 2.5 ft.) and also at the surface of the graves using triple

sorbent traps which concentrated the volatile compounds released from the decompositional process. These samples were then thermally desorbed and analyzed using gas chromatography – mass spectrometry (GC-MS).

A total of four individuals, ranging from freshly buried to having been buried for over a decade, were monitored twice monthly for over a year. Results show that volatile compound releases from buried subjects are more complex than previously realized, with over 300 specific compounds identified to date. Additionally, the compounds released are dependent upon the stage of decomposition and the length of interment. Below-ground video capture imagery shows decomposition under conditions of shallow burial in a temperate climate to be roughly eight times slower than surface decomposition and dependant upon the season of burial. Temperature measurements of burials using below- and above-ground thermocouples showed seasonal fluctuations in temperature and indicate an approximate 12 hour lag between equilibration of grave temperature with the surface air. In addition, a 35ºF disparity between summer and winter grave temperature extremes was observed.

Odor Analysis, Cadaver Dog, Burials

D36 What's That Smell? Odor Composition of Human and Animal Bone Using Gas Chromatography-Mass Spectrometry

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After attending this presentation, attendees will be presented with a comparative analysis of molecular odorants emitted by human and animal bone for potential use in the identification of indistinguishable bone fragments.

This presentation will impact the forensic community and/or humanity by demonstrating research which will further our knowledge of molecular odorants released during bone degradation and provide a database for further research on the volatile(s) used in canine discrimination of bone. The introduction of a new method of odorant sampling has applications in identification of volatiles from a variety of trace evidence sources in addition to classifying fragmentary skeletal remains as human or animal in origin.

It is recognized that well-trained cadaver dogs can distinguish the scent of human remains from those of animals. Cadaver dogs are trained to detect generic air scents common to all human remains; however, whether they respond to an individual, or combination of compounds is unknown. Because cadaver dog can, in some instances, detect skeletonized remains, bone must release volatile compounds forming the basis for this study.

The wet-weight composition of bone is 20-25% organic, 60-65% inorganic, and 10-15% water. Protein hydrosis in the organic matrix liberates amino acids. Further breakdown of these amino acids results in the release of organic compounds detectable by cadaver dogs enabling them to identify the location of human remains. In nature, most odors are comprised of a mixture of volatile compounds which elicit sensory properties, i.e., molecular odorants. Identification of odorants released by human and animal bone will establish a database useful for compound selection necessary for enhanced cadaver dog training.

Preliminary sampling of bone odor released by human and animal remains indicated spectral differences in composition. Subsequently, eight adult human femora (two of each: male, female, African American, European American) and a tibia or femur from 14 animals—pig, gray fox, raccoon, two dogs, bear, pig, rabbit, two cows, two deer, rabbit, and sheep—were selected from the William M. Bass Forensic Skeletal Collection for further comparison. The bones were placed in Tedlar® sampler bags and filled with compressed air where they remained sealed four to five days. Two liters of air were drawn from the bag through triple sorbent traps (TSTs), concentrating bone-released odorants. The compounds were then thermal desorbed and analyzed using gas chromatography – mass spectroscopy. It is predicted a unique odor signature specific to human skeletal remains will be found for segregation of human from animal bone.

Odor Analysis, Skeletal Remains, Cadaver Dogs

D37 A Comparison Between the Modified Griess Test and Use of Sodium Hypochlorite for Enhancement of Gun Shot Residue Patterns on Fabric

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After attending this presentation, attendees will understand: (1) the comparison of the modified Griess test results compared to an application of a sodium hypochlorite solution as an agent for enhancing gun shot residue (GSR) powder patterns, (2) the results of the test on 12 samples of dark or multi-colored fabric, and (3) the advantages and disadvantages of using the modified Griess test and the sodium hypochlorite solution to enhance visualization of powder patterns. The purpose of this presentation is to present the results of an experiment that evaluated the modified Griess and a sodium hypochlorite solution used as a bleaching agent for the enhancement of GSR powder patterns at specific distances on dark or colored fabric targets.

Humanity demands that forensic scientists and jurists search for truth in the administration of justice. Without truth, the innocent may be punished and the guilty may be set free. This presentation will impact the forensic community and/or humanity by adding to the search for finding truth. The purpose of this research was to develop a more practical and economical method for enhancing gunshot residue patterns.

An essential element in reconstructing some crime scenes is to determine a weapon's muzzle to target distance. The determination of this distance can be estimated based on the size and intensity of the powder pattern if the type of ammunition and weapon are known. Dark or multi-colored fabrics interfere with the investigator's interpretation of powder pattern size and intensity. Tests were conducted to enhance visualization of powder patterns on dark or multi-colored fabrics.

GSR patterns have been classified as contact, near contact, intermediate-range, and long distance based on the size and intensity of the patterns. Even though the investigator may have a known type of weapon and ammunition to test, the test firings cannot be used to establish a precise muzzle to target distance. However, in some cases the investigator may eliminate certain ranges of distances based on the GSR pattern characteristics. The GSR mainly consists of nitrates and nitrites from burned and partially burned propellant, carbon and metals such as barium, lead and antimony from chemicals used to manufacture primers. Also, there may be other trace element present in the residue depending on the type of ammunition. When a weapon is fired the propellant gases exit and materials contained in the gases are deposited on the target depending on the distance.

A model 686 .357 S&W revolver, with a 4-in barrel was used to produce GSR patterns by firing .38 caliber Winchester Western ammunition with lead round nose bullets into samples of dark or multi-colored fabric with a muzzle-to-target distance of 7.62 cm (3 in) for two groups of 12 samples. Group one of the samples was tested with the modified Griess test and group two was treated with sodium hypochlorite to compare the visualization enhancement of each method on the GSR pattern.

The materials prepared for the modified Griess test were 12 sheets of 203 x 254 mm (8 x 10 in) Kodak polycontrast RC (resin coated), type F photographic paper fixed with Kodak fixer for 10 minutes at 20°C (68°F). After fixing, it was washed in 20°C (68°F) water for 10 minutes and dried in an RC dryer. The desensitized photographic paper was then immersed in a 5% solution of sulfanilic acid for 1 minute, dried at 20°C (68°F) then immersed in a 0.5% solution of Alpha-naphthol in methyl alcohol for 1 minute and dried at 20°C (68°F). Twelve pieces of 203 x 254 mm (8 x 10 in) cotton cheesecloth were soaked in 20% acetic acid for 1 minute. Each sample of fabric was then covered with a piece of treated photographic paper with the surface of the GSR pattern adjacent to the paper's emulsion. The piece of cheesecloth was placed on the back of the fabric sample and ironed on medium heat for 1 minute. And orange color developed on the photographic paper in the presence of nitrites. The photographic paper was then washed in 26°C (80°F) water for 1 minute and then washed with methyl alcohol.

A 5.25% solution of sodium hypochlorite was sprayed onto 12 samples of dark or multi-colored fabric to determine if bleaching the fabric would enhance visualization of GSR patterns. The solution was sprayed in a mist on each piece of fabric until saturated. In 2 to 3 minutes, the fabric colors began fading and losing color due to application of the sodium hypochlorite solution. A significant amount of the color was removed with the first application, and there was an observable difference in the visualization of the GSR patterns after sodium hypochlorite was applied. After 30 minutes, the fabric was sprayed with a second application. However, after the second application, there was minimal observable change in the visualization of the GSR pattern.

The 12 types and colors of fabric tested included: red, green, and beige plaid cloth with 100% cotton, striped navy and red with 100% cotton, striped navy, white, green and red with 100% cotton, burgundy with 100% cotton, black with red floral pattern with 100% rayon, beige, black, and purple floral design with 100% rayon, black with light colored floral design with 100% rayon, navy with 100% acetate, navy with 100% wool, black with 70% triacetate and 30% polyester, black and white with 50% polyester and 50% rayon, and black with 50% polyester and 50% rayon.

The GSR patterns on all samples were difficult to differentiate and measure on the untreated fabric. All 12 patterns developed with the modified Griess were orange in color and were measured and photographed for comparison to the patterns treated with sodium hypochlorite. Ten of the 12 samples treated by applying a 5.25% solution of sodium hypochlorite to bleach the dye from the fabric, produced enhanced GSR patterns. The 2 samples failing to yield improved visualization of the GSR patterns were the black 100% wool and the fabric containing 70% triacetate and 30% polyester. The bleach had no effect on the wool and the fabric with triacetate and polyester turned olive green but with no visual GSR pattern. The GSR patterns from the treatment of sodium hypochorlite were also measured and photographed.

The GSR maximum pattern diameters ranged from 5.5 cm (2.16 in) to 8 cm (3.14 in) for the twelve samples that were fired at a distance of 7.62 cm (3 in) with and average pattern diameter of 6.62 cm (2.60 in) for the modified Griess patterns. The GSR maximum pattern diameters for the twelve samples treated with sodium hypochlorite ranged from 1 cm (0.39 in) to 7 cm (2.75 in) fired at a distance of 7.62 cm (3 in) with and average diameter of 6.62 cm (2.60 in).

In conclusion, the use of sodium hypochlorite for enhancing GSR patterns is equivalent to the modified Griess test if the dark or multi-colored fabric can be bleached. If the dye in the fabric cannot be bleached, the modified Griess test should be considered for enhancement of the GSR pattern. One advantage of using sodium hypochlorite is that the fabric can be treated in a few minutes and the pattern is enhanced. Also, after treatment, there is an increased contrast in GSR patterns that allows routine photography of the fabric. The disadvantage of the modified Griess test is the time it takes to prepare the reagents for testing. Also noted were differences in color intensity for the Griess test possibly due to the composition of the fabrics used in the testing.

Gun Shot Residue, Modified Griess Test, Powder Patterns

D38 A New Development of the Process of Polygraph Test by the Principles of Science and Identification

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The new process we present is expected to be challenged, as long as it can pass the examination of the principle of science, we believe it is a chance to be examined by the court or academy.

This presentation will impact the forensic community and/or humanity by demonstrating the challenge of junk science on the work of polygraph testing. We believe there is enough space to modify the testing process of this technique, to meet the scientific criteria, even by court debate. This presentation may offer some new concepts on the process of the testing and we hope it will open a new direction to reconsider the scientific character of lie-detection.

Based on the basic principles of scientific identification, we have tried to modify and enhance the quality control of the process of common lie-detection (polygraph identification) work. The principles applied include; the checking and screening criteria of physical and psychological abnormality, the practice of reproducibility, the development of a new technique to understand memory more efficiently, the level divided for curve shape on GSR, and the time interval between every two questions.

Through this modified process, we found there are some good ways to change and to meet the requirements of basic scientific principle. First, a very discreet screen process is applied to screen any of the abnormal physical or psychological situation of the examinant to get rid of all suspected countermeasure interferences. Second, through the pre-examination interview, a new method was developed to label the memory of the special event which is targeted by the detection. Then, to concentrate on the test process to avoid the decay of the contrast of the relevant and the control answers. This is a way to reach the criterion of reproducibility. For the quality control, a smooth GSR curve without any unexplainable notch are strongly demanded. And a quality control SOP was designed to regular the examination process to reach the consistency by the different examiners. On this point, our minimum requirement is the getting of GSR result has to be unified. There are also some techniques developed to reach this demand.

Since we applied this modified lie-detecting process on our identification work years ago, there are more than thousands cases have been detected for the trial court of Taiwan. The recent statistics on the high court of Taiwan showed more than 30% of the identifications were not questioned or contended by either of the two parties on the trial process. And the adopt rate by the court even higher than 60%.

Polygraph, Memory, Quality Control

D39 Establishing a Protocol Between Clinical and Forensic Institutions to Treat and Solve Violence Against Women Cases

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Most of the aggressions against women are not treated correctly because they are unknown, although it doesn't mean that their symptoms are not visible. Only 10% of the cases are reported, but 100% of the victims go to a medical institution asking for assistance for symptoms directly or indirectly related to violence. This study demonstrates this situation and the necessity to coordinate and collaborate through a protocol between Forensic and Clinical Institutions to solve medical and forensic issues and to avoid victimization.

We must break with the technical conception of Domestic Violence and to try to avoid taking a part (forensic implications) for the whole (health, social, familiar, juridical, economical, labor implications). Although we can not solve all of them, we shouldn't contribute to make more difficult the recovering of victims. It means that we should get a global approach and try to use all the resources to contribute to change the social and cultural elements that make it possible for these cases to happen. The protocol we present can help to close the gap between forensic and clinical assistance, and to increase (we would evaluate more women) and improve (we would intervene sooner) the information given by institutions.

1. Introduction

Violence against women is a crime, but not only a crime. It is a social behavior rooted on cultural values given by a patriarchal conception of society and couple relationships. It means that when a case happens, any of these cultural values arise to explain and justify the aggression. Only a small percentage of cases (no more of 10%) are reported and it means that only these victims can receive help through its institutions. However, all these women go to clinical institutions with symptoms related directly or indirectly to domestic violence.

2. Material and Methods

The study was performed in Medical institutions (Emergency service and General Practitioner Service) using different questionnaires about domestic violence (physical and psychological) and recorded social and demographic features of the patients. The sample consisted of all of the women that went to the institutions in a two-month period of time and the tests were administered by a physician during a regular consult.

3. Results and Discussion

There is not significant difference among the social and demographic features. 17.9% of this group of women (patients) reported suffering domestic violence, but paradoxically 51.8% consider their relationships as "good" or "very good." In response to the question of whether they would like doctors to ask regularly about family and couple matters, they answered "yes" in 88.5% of the cases; and they would like doctors to ask if they suffered violence and aggression, they answered "yes" in 88.6% of the cases. But at the same time, 35% of women wouldn't report domestic violence if a doctor reported the case.

We not only need additional tests, we need to reflect about legal regulations on this subject to try to help women and solve the cases. In this sense we have to introduce a global approach considering not only the legal and forensic implications, but also the clinical ones and the health issues behind this violence. A protocol under this global perspective would; help protect women, help them to avoid victimization, solve the forensic questions, and encourage the institutions to proceed judicially for the victim and the aggressor.

Domestic Violence, Health and Clinical Implications, Protocol Between Forensic and Clinical Issues

D40 Use of Clinical Laboratory Assays in a Forensic Setting: A Review

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After attending this presentation, attendees will be better aware of laboratory methods typically used in clinical differential diagnosis that can be applied to forensic setting. A literature review will be provided at the poster.

This presentation will impact the forensic community and/or humanity by making forensic scientists more aware of laboratory options to assist in determination of cause of death. The methods discussed are typically used for differential diagnosis in the living. They may be applied to forensic investigations providing additional information to forensic investigations.

Quantitative determinations of biochemical components, such as electrolytes, glucose or serum proteins, have been used in postmortem blood specimens to aid in determination of cause of death. In a variety of forensic studies, determination of esoteric biochemical markers has been useful in establishing postmortem diagnosis of the underlying cause of death. These are the tests typically used in an emergency room setting or tests used for differential clinical diagnosis. Following is a review of some of these tests.

Procalcitonin (PCT) is a propeptide of calcitonin, with a half-life of 25 hours, and is deprived of hormonal activity. In the living, PCT has been shown to have a good correlation in the differential diagnosis of bacterial and non-bacterial inflammation. Moreover, PCT has been able to differentiate between sepsis and systemic inflammatory response syndrome of non-infectious origin. For example, in postmortem specimens, PCT levels with severe sepsis have been shown to be as high as 90 ng/ml. Non-sepsis specimens had PCT levels less than 1ng/ml. And measurement of PCT seems reliable until 140 hrs postmortem. Because of its stability and the ease of measurement by immunoluminometric assay, PCT may be a more specific postmortem marker for sepsis than C-reactive protein (CRP). Rather, CRP is more related to systemic inflammation in general, and has recently shown application as a predictor of cardiovascular disease risk. Interleukin-6 was also found to be elevated in postmortem specimens of sepsis, and can be assayed by convenient manual immunoassays. Diagnosis of sepsis is a problem that continues to challenge forensic pathologists.

Troponin is clinically routine cardiac marker. The troponin complex consists of three myofibrillary proteins (TnC, TnI, TnT) and after myocardial injury TnI and TnT are extensively released into the blood. Automated immunochemical methods, as well as point-of-care tests, are used to measure these proteins in blood. In the living, TnI is non-detectable and has proven to be a sensitive marker for diagnosis and management of myocardial infarction. TnI measurement in postmortem specimens can provide evidence of death due to myocardial infarction (MI) and estimation of postmortem interval. Immuno-histochemical expression of TnI and TnT of postmortem cardiac tissue and their gradual decline would assist in making a firm diagnosis of MI. A rapid assay method (Roche CardiacT) designed for use in an emergency room setting, has been used to measure TnT in postmortem blood. In a study of 20 cases with final autopsy report of death due to MI, 85% were positive; and out of the 30 control cases studied only 30% were false positive. While these methods may provide quick supplemental information they are no substitutes for autopsy since they can not rule out other underlying reasons for the cause of death.

Glycosylated hemoglobin (HbA1C) is used as a marker for glycemic control in patients with diabetes. HbA1C reflects the average blood glucose level over a period of six weeks. Studies indicate that postmortem HbA1C can be an accurate marker to predict diabetes mel-

litus and therapeutic compliance. HbA1C specimens are reliable if stored at 4 degrees C, and temperatures from 27-35 degrees C for 7 days caused only an increase of 4-7% above original values. Levels of HgA1C greater than 8.5% in postmortem specimens indicate chronic hyperglycemia. Chromatographic methods are commonly used for HbA1C determinations. High levels of fructosamine in vitreous humor were also found to be indicative of diabetes. Insulin/C-peptide ratio may be used to make a forensic diagnosis of exogenous insulin administration especially in suspected homicide cases. Because endogenous insulin is cleared slower than C-peptide, physiological insulin/C-pepide ratio is less than one. Exogenous insulin/C-peptide ratio will result in greater than one. Commercially available RIAs are available for all of these assays.

Prostate Specific Antigen (PSA) is used clinically to detect and manage prostate disease, and is found in large quantities in seminal fluid. Several sensitive PSA immunoassays have been developed and are commercially available. Newer membrane assays are relatively easy to perform and offer similar sensitivity as immunoassays. It was reported that seminal fluid from vaginal swabs collected from sexual assault cases, even stored at room temperature for three months, could be extracted and PSA detected by membrane assays. Saliva specimens were used as negative controls. Thus, the membrane assays could be used for forensic identification of seminal fluid.

These are but a few examples of tests that could be helpful to the forensic scientist; tests that are usually thought of as clinical tests. Commercially available assays are available and offer more options in the armamentarium for determining forensic cause of death and other investigations.

Procalcitonin, Troponin, Glycosylated Hemoglobin

D41 Evaluation of Parentage Cases in Turkey

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After attending this presentation the attend will learn the disputed parentage cases in Turkey analyzed in a socio-demographic approach.

The forensic community will learn the current situation about the paternity practice in Turkey and will be informed about various socio-demographic parameters related to the subject.

Disputed parentage and specifically paternity is one of the most frequent type of testing of biological relationship performed in the Institute of Forensic Sciences of the University of Istanbul. Cases such as identifying the parents of an adopted, and possible baby mix-ups can also be categorized within the same group. Controversial cases of both civil and criminal origin as well as private applications are being examined. Many aspects of parentage testing have changed in the past decade in our country. We see an increase in the demand for testing which may be explained in several ways. The most valid one is the tremendous amount of information about the DNA technology, its validity and reliability that passed through media to public and increased the awareness. The result of this continual publicity about DNA is that more and more testing is being requested directly by individuals without involvement of lawyers or the courts. Even the number of exhumations for this purpose has been increased seriously. In this study we performed a socio-demographic analysis of 356 paternity cases. The material used, consists mainly of information obtained by the individual consent forms of the subjects taken during the application for the analysis used in completely anonymous format and the final paternity reports. The cases have been evaluated as to the age of the mother, the child and the questioned father, the sex of the children the marital status of the couple, and the degree of the exclusion of the paternity. Additionally the civil, criminal and private applications were examined separately. The seasonal fluctuations of the applications and the applicant (the father or the mother) have also been analyzed. Some of the outcomes of the study are as follows. The 47.7% of the children to be examined found to be males. The most frequent months of applications seem to be November (19.9%), December (10.5%) and January (13.2%). The exclusion rate is 29%, which is comparable to results found in various European and North American populations. When we examined the question with which the application was done, the reason for the analysis can be classified as suspicion in first place followed by wealth problems and finally the desire to prove the legitimacy to the family, a characteristic that reflects the culture itself.

Parentage, Paternity, Turkey

D42 Vehicle Fires: Actualistic Investigations

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The aim of this presentation is to provide the forensic community with temperature data from automobile fires that can potentially be applied to investigations.

This presentation will impact the forensic community and/or humanity by providing and demonstrating data that can be utilized in vehicle investigations.

In 2001, approximately 400,000 residential fires were reported. Investigations of many of these fire scenes incorporated either computer fire modeling or actual fire testing. The foundation of these techniques is temperature data primarily derived through the use of thermocouples devices which record fire temperatures at specified time intervals. Such data can be interpreted and manipulated in order to generate situation specific information on the intensity and duration of a structure fire. Further, temperature data lies at the foundation of investigator interpretations of fire behavior and burn patterns. Undeniably, temperature data are crucial for fire scene reconstructions and for the calibration of fire model predictions, and of increasing importance is the role that such scientific and technical data play in the substantiation and presentation of fire scene investigations in the courtroom.

Although fires in single passenger vehicles are among the most common type of fire with greater than 300,000 reported in 2001, limited resources are available to aid in the investigation of automobile fires. Currently, thermocouple data is being collected on vehicles burned in conjunction with the National Forensic Academy, a ten week program designed to educate and expose the forensic technician to procedures for identifying, collecting and preserving evidence. Overseen by the Law Enforcement Innovation Center at The University of Tennessee, Knoxville, participants are exposed to units including blood spatter, fingerprint analysis, skeletal recovery and bombs. A four day module of the course teaches techniques for the investigation of arson scenes and fatal fires, a component of which involves the ignition of an automobile, where a thermocouple device is mounted in the interior of each vehicle prior to ignition. Temperatures are recorded until cessation of burning or sixty minutes elapses. Results demonstrate a maximum temperature in excess of 1800 degrees Fahrenheit (F) was attained in each burning scenario. Of further note, in all experimental burns, temperatures exceeded 1600 degrees F in less than two minutes. As expected, variation in duration and intensity of heating was noted, yet experimentation demonstrates it can be partially attributed to vehicle model, fuel load, and environmental conditions.

To provide experience in recognizing the impact of heat upon soft tissues, several deceased animals are placed in the vehicle before burning. Following incineration, students, under the supervision of an

anthropologist, recover the specimens. The partially skeletonized remains exhibit color change and fracture patterns consistent with thermal alteration. This component of the National Forensic Academy provides a unique opportunity for students while generating a growing collection of heat-altered skeletal material of known exposure, duration and temperature.

This ongoing research involving vehicle fires will ideally provide investigators, from numerous disciplines with a foundation in recognizing, detailing, and understanding the intensity and duration of automobile fires.

Vehicle Fire Investigation, National Forensic Academy, Cremated Remains

D43 Identification of *Canis Familiaris* Signature Odor Chemicals in Human Remains

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The purpose of this project is to determine the signature odor(s) of human decomposition. In addition, a comparative study will be conducted to distinguish the odor of decomposing human remains from that of the scent, which emanates from other deceased animals, including pigs. Finally, to test whether or not a human remains canine will alert solely to bone, as opposed to attached tissue or the soil in which it is surrounded.

This presentation will impact the forensic community and/or humanity by distinguishing the signature odor of human remains, as opposed to other animals, is an essential part in forensic investigation, when a detector canine is used. It is crucial that the canine is consistent in its alert and not distracted by the surrounding environment.

Distinguishing the signature odor of human remains from that of other animals is an essential part of investigation in both the law enforcement and forensic science communities. When canines are employed for search and recovery missions it is crucial that they consistently alert to human remains as opposed to being distracted by the surrounding environment. By identifying the signature odor(s), canine training aids and subsequently the reliability of both the canine and those aids could be better established.

The process of human decomposition is a dynamic one. As the body goes through its various stages of putrefaction, biological compounds are broken down and an array of scent is emitted. Other studies have tested and identified some compounds, which are believed to be sources of the odor. Some of those compounds include 3-methyl indole (skatole), 1,4-diaminobutane (putrescine), and butanoic (butyric) acid. These compounds and eleven others are currently the focus for the identification of the signature odor(s). The compounds have been separated into five categories (biological amines, alcohols/cresols, indoles, methyl sulfides and organic fatty acids).

Since most of the compounds of interest have a strong unpleasant odor, optimization methods have been developed to transfer, absorb and maintain the compounds. This process included testing different absorbent media, as well as storage containers and bags. The samples were subjected to varying conditions to best mimic circumstances encountered in the field.

Human remains canines, 'cadaver dogs,' are those that are specially trained to alert to the scent of human decomposition. The ones used in this study are actively employed and certified by the Miami-Dade Police Department. Weekly field tests with the suspected compounds, human samples and animal samples are being conducted. In an effort to avoid conditioning the canines to any confounding variables, the searching procedures have been established and are implemented by the handler. In addition, some experiments will be blind (where the handler is not aware of the presence or absence of a sample) and some will not. This will be done to help assess the amount of influence (and subsequent bias) the handlers impose on their canine partners. To date, preliminary trials have shown no indication that the canines alert to animal remains. Conversely, they have alerted to some of the suspected chemical compounds, including 1,5-diaminopentane (cadaverine), dimethyl-trisulfide, and butyric acid.

In an effort to identify and quantify chemical compositions, headspace analysis of all the samples will be analyzed by solid phase microextraction/gas chromatography/mass spectroscopy (SPME/GC/MS) and solid phase microextraction/high performance liquid chromatography (SPME/HPLC). These techniques have been used in other forensic applications including identifying and quantifying narcotics, fire debris and explosives. However, their usage with regards to identifying the components of human decomposition has not yet been comprehensively studied. SPME/GC/MS analysis has revealed significantly better peak resolution when the samples undergo derivitization prior to analysis. Additionally, SPME/HPLC methodology is being optimized.

Human Remains, Animal Remains, Canine Scent Identification

D44 Discrimination of Duct Tape Samples Using FTIR, SEM/EDS, and XRD Analysis

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The analytical approach taken when comparing two pieces of duct tape to ascertain whether they may share a common origin will be presented. Examples of the discrimination power of each step within the process will be discussed. The steps will include macroscopic and microscopic observations, physical measurements, and the following analytical instrumentation: FT-IR, SEM/EDS, and XRD. After attending this presentation, the attendees will understand the importance of the sequence and discrimination power of each of the examinations.

This presentation will impact the forensic community and/or humanity by educating the forensic community regarding the differences that can be measured between two seemingly consistent pieces of duct tape. The technique of X-ray diffractometry is not commonly used in the forensic community; a case will be highlighted that demonstrates the importance of using this technique to discriminate between two pieces. Without this technique, there is the potential to draw an incorrect conclusion regarding an association between two specimens of duct tape.

In the FBI Laboratory, comparative analyses of duct tape specimens begin with macroscopic and microscopic examination of the physical appearance of the submitted evidentiary items. The adhesive color and backing construction as well as the thickness of the film backing and the overall tape thickness are all discriminating physical features between specimens. Fabric scrim characteristics such as the number of yarns per square inch in the warp (machine) and fill (cross) directions, and the type of fabric weaves are also used to physically compare duct tape samples.

If these physical characteristics do not provide points of discrimination between items of evidence, particularly in cases where the evidence has become aged or degraded, instrumental methods of analysis can be extremely useful. In the FBI Laboratory, Fourier transform infrared spectroscopy (FTIR), scanning electron microscopy with energy dispersive X-ray analysis (SEM/EDS), and X-ray diffraction (XRD) analyses are routinely used to analytically compare duct tape specimens. Each technique requires minimal to no sample preparation and can be

performed on specimens no larger than a one-inch square. Information regarding the additives used in the formulation of both the adhesive and the backing can be obtained using all three techniques. When used in concert, the discriminating power between physically similar specimens becomes much greater.

FTIR may be used to analyze filler materials in the adhesive layer of duct tape samples. Common materials that may be identified using FTIR include: talc, clay, calcium carbonate, and titanium dioxide. The absence or presence of any of these components in only one of the specimens being compared will readily disassociate the two samples.

SEM/EDS can be used to further compare both the film backing and the adhesive layer of two or more specimens in order to determine if there are differences in the elemental composition of either component. SEM/EDS data can reveal the presence of titanium, calcium, magnesium, or aluminum, even when these materials are not apparent from the FTIR data of the adhesive. Analysis of the adhesive and backing layers separately provides the analyst with two independent points of comparison between specimens. Thus, comparable data in one layer between specimens may be countered by differences in the other layer, which would serve to disassociate specimens that might otherwise be reported out as being consistent with one another.

When a method that complements SEM/EDS, such as XRD, is added to a duct tape analysis protocol, even further discrimination can be achieved between seemingly consistent specimens. In the FBI Laboratory, XRD is used to document the mineralogical aspects of both duct tape layers, either together or separately. Common diffraction patterns that are encountered in duct tape specimens include titanium dioxide (anatase or rutile forms), kaolin clay, talc, polyethylene (film backing), calcium carbonate, and dolomite.

In the case that will be discussed, physical comparisons between a severely weathered specimen and a partial roll of duct tape in pristine condition were conducted. These examinations revealed that similar specifications were used in the formation of the blown film backing. The relative backing and overall thickness measurements of the duct tape specimens were also comparable. The fabric scrim count in the warp (machine) and fill (cross) directions indicated that both were readily available consumer grade products and the weave of the scrim depicted a weft insertion pattern. Analysis of the adhesive using FTIR indicated that calcium carbonate was present in both specimens. Neither talc nor clay were observed in either sample, and the typically prominent absorption bands for titanium dioxide were less than obvious. SEM/EDS data showed that the adhesive did contain titanium and oxygen in both samples, and a small amount of magnesium was present in the film backing of the partial roll of duct tape. However, XRD analysis proved to be essential in this examination for it provided two important discriminating features: the form of titanium dioxide that was present in the adhesives; and, that talc was found in the backing of the partial roll of tape, but not in the questioned sample. Thus, two seemingly physically and chemically consistent specimens were determined to be different in what is often assumed to be a less discriminating feature of duct tape.

Duct Tape, X-Ray Diffractometry, Discriminating Power

D45 The 2004 Advanced Forensic Science Educators Conference

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After attending this presentation, attendees will be encouraged to offer Forensic Science Educational conferences in their communities; informing high school science and mathematics teachers of the value of utilizing forensic science scenarios to teach basic science principles; and encouraging high school students to study science and mathematics by introducing forensic sciences into their lesson plans.

This presentation will impact the forensic community and/or humanity by encouraging Academy members to offer Forensic Science Educational conferences in their communities

To explain the 2004 Advanced conference for high school science and mathematics teachers. This five-day conference will expand their forensic science knowledge and provide them with 10-14 classroom lesson plans that can be immediately used to introduce the forensic sciences to their students.

In 2000, the Third International Math and Science Study (TIMSS) was released. It reported US student achievement in the area of science and mathematics knowledge at the conclusion of 4th, 8th and 12th grade. Forty-four countries participated in this study. US students in the 4th grade were in the top quartile of the study. Those students steadily fell behind their international peers. By the end of 12th grade, U.S. students ranked in the lowest quartile of the study group.

In 2001, the Academy partnered with several universities to introduce science teachers to the forensic sciences. The initiative's goal was to establish the Academy as teachers' primary source for high quality forensic science information and education and to increase US students' interests in math and science. Two Forensic Science Educators Conferences were conducted in St. Louis and New York City. A third is scheduled in October 2003, at the University of Texas-Arlington. The two conferences that were held in 2002 provided more than 200 teachers with introductory information about many of the forensic science disciplines. These three-day conferences included presentations and workshops that assisted the teachers to utilize forensic science disciplines to entice students to study math and science. Additional conferences are scheduled in 2004 for Hawaii and Louisiana.

Teacher evaluations revealed that the conferences were extremely helpful and that their classes were increasing in enrollment. Many teachers reported that they had required a pre-requisite science class. This strategy has led to increased enrollment in introductory science courses in their schools.

With scholarship-funding from the St. Louis-based Saigh Foundation, an Advanced Conference will be conducted at Saint Louis University School of Medicine July 19-23, 2004. This five-day conference will provide three stages of instruction to teachers. The first two days will provide introductory information to teachers who have no forensic science background. The next three days will provide experienced forensic science educators with new information taught by Academy members and nationally recognized, veteran high school forensic science teachers who have successfully pioneered this effort in their own classrooms. Details of this advanced conference will be provided during the presentation.

Science and Mathematics Teachers, Advanced Educators' Conference, Forensic Science

D46 Forensic Science in the Health Care Setting: Pitfalls and Promise

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The goal of this presentation is to present forensic scenarios that occur in health care settings which require the application of forensic principles in order for proper investigation to ensue and quality of care improvements instituted; and to discuss strategies for educating and training health care providers to recognize and respond to possible forensic situations in a health care setting.

Since it is the duty of every health care provider to ensure a high level of quality patient care and accurate delivery of such services, this presentation will impact the forensic community and/or humanity by demonstrating that health care providers should have some level of awareness of what constitutes medico-legal and forensic significance.

The Department of Veterans Affairs (VA) Office of Inspector General (OIG) has extensive experience with numerous problems relating to potential forensic scenarios — both civil and criminal — that occur in the health care setting. Clinical forensic events of a civil nature usually include basic quality and standard of care issues. Criminal forensic events that can occur in the clinic and hospital setting may include, but are not limited to, patient abuse; suicide; assault; homicide; medication-related concerns including medication or delivery system tampering, improper medication administration, and grossly negligent medication errors; medical equipment and device tampering; problems with restraints; and problems in search and rescue procedures for eloped patients. The authors present data from over 100 such cases reviews.

In order to successfully understand these events for quality assurance and patient safety purposes, and to gather necessary information for prosecutorial purposes, it is essential that the scene of a possible forensic event in the health care setting be properly preserved.

To do this, it is necessary that those involved in direct patient care have increased awareness of what constitutes a forensic situation, and that there be designated clinicians who have the forensic knowledge base to respond appropriately. Preserving forensic evidence never precludes life-saving patient care delivery; however the skilled clinician with appropriate forensic training will be able to accomplish both without compromising either responsibility.

Medical school curricula offer little or no training in these issues. In fact, sometimes, it is falsely believed that forensic sensibilities are developed at the expense of patient care. Likewise, consideration must be give to the registered nurse who is an integral part of every aspect of patient care delivery. The contributions of clinical forensic nursing to direct patient care delivery, to the case reviews conducted by Quality Management, and finally to external investigations conducted by law enforcement or other agencies should be examined. Additionally, hospital-based clinical social workers may have important contributions to make in this regard. Overall, VA OIG data suggests that is vital for every hospital have a core team of individuals who have been thoroughly indoctrinated in the discipline of forensic science, especially with specific applications to the health care environment.

Forensic Medicine/Nursing, Inspectors General, Patient Safety

D47 Improving Health Care Delivery Through Forensic Science

Mary K. Sullivan, MSN, RN, Department of Veterans Affairs, Carl T. Hayden VA Medical Center, 650 E Indian School Road, Phoenix, AZ 85012; Robert C. Byrd, DDS, Department of Veterans Affairs, Sheridan VA Medical Center, 1898 Fort Road, Sheridan, WY 82801*

The goal of this presentation is to demonstrate the value of forensic / medical evidence management within the hospital and patient care environments. This presentation will outline several cases of suspicious patient events / deaths within Veterans Affairs Medical Center (VAMC) settings.

This presentation will impact the forensic community and/or humanity by demonstrating that forensic education and training should be encouraged and emphasized at all levels within the hospital's chain-of-command, and position descriptions should be updated, listing specific forensic roles and responsibilities for the clinicians, supervisors and administrators.

Evidence identification, collection and preservation are becoming vitally important as forensic investigations increase within health care systems. One of the more pressing issues currently confronting the emergency departments and other patient care areas is the ability of health care workers to recognize possible forensic implications in routine patient care scenarios and the expertise to manage and secure the appropriate medical / forensic evidence.

Adverse patient events range from those causing minimal concern to extremely serious action, but the vast majority of these are not criminal in nature. Regardless, the precise identification, collection, and management of facts, data and medical evidence are critical, criminal or not. It is the duty of every health care provider to ensure a high level of quality patient care and accurate delivery of such services. This means all healthcare providers must have some level of awareness of what constitutes medico-legal significance. In addition, patients deserve a safe environment in which to receive healthcare, and healthcare providers deserve a safe place to practice. Failures to recognize and safeguard evidence in healthcare settings can result in medical errors, miscarriages of justice for victims or perpetrators, and result in lengthy, complex investigations.

Many healthcare facilities do not have adequate mechanisms in place to collect, package, and store evidentiary items. The Joint Commission on Accreditation of Healthcare Organizations (JCAHO) has the laid the groundwork for the roles of clinical forensic nurses and other health care providers within hospitals in its published scoring guidelines for patient care assessment. Additionally, the Joint Commission includes the review of organizations' activities in response to sentinel events in its accreditation process that opens the door for closer examination of what role forensic science can play in improving health care delivery.

The Veterans Health Administration (VHA) is a leader in recognizing forensic sciences as a tool to not only improve investigatory efforts, but as a Quality Management tool in process improvement plans. The goals set forth by VHA leadership include heightening the awareness of healthcare workers of potential forensic scenarios in everyday patient care; to establish teams of clinicians indoctrinated in forensic science who will be first responders to suspicious events; and to standardize protocols in them management of medical / forensic evidence in each patient care department.

It has been established that the vast majority of law enforcement and investigative personnel are not trained to navigate through a complicated medical or surgical area, nor do most comprehend the medical / nursing jargon commonly used within medical facilities. Clinicians who have enhanced their practice with the forensic sciences and who maintain current knowledge of the justice system requirements while exhibiting the ability to apply this expertise to health care, become the critical link between law enforcement and healthcare practice.

Medical/Forensic Evidence, Suspicious Patient Events , Quality Management

D48 The Role of the Forensic Nurse Death Investigator

Joyce P. Williams, BA, RN, 26 Grove Creek Circle, Smithsburg, MD 21783; Nancy B. Cabelus, MSN, RN*, Connecticut State Police, 294 Colony Street, Meriden, CT 06451*

After attending this presentation, attendees will understand the role of forensic nurse death investigators, their educational foundation, and training and why their employment is a natural development in medical examiner and coroner systems.

This presentation will impact the forensic community and/or humanity by demonstrating the totality of information forensic nurses provide to medical examiners and coroners in death investigations.

This presentation will outline the role of nurse death investigators, their educational foundation and training and why their employment is a natural development in medical examiner and coroner systems. Medical legal death investigation is comprised of four aspects: scene investi-

gation, medical history, social history and the autopsy. (Fowler—personal communication) Forensic nurses are essential personnel providing vital evaluations to medical examiners and coroners that will determine the manner of death in all types of cases. The legal responsibilities of the nurse death investigator includes knowledge of state statutes, autopsy regulations, tissue and organ procurement, court testimony and legal documentation.

The number of forensic nurses working as death investigators is increasing throughout medical examiner's offices and coroner's jurisdictions worldwide. In some states, medical examiner's offices are hiring nurses as part of the investigative team and in other jurisdictions nurses are being elected as coroners. Nurses aren't only practitioners with strong backgrounds in bioscience; they also possess advanced medical and scientific expertise. Knowledge and training in medical terminology, pharmacology and pathology and the law are necessary when investigating the scene of untimely death. This applied knowledge steers the investigation when the forensic nurse interfaces with professional counterparts representing the disciplines of forensic science and law enforcement. The nurse correlates clinical findings and interprets the body's response.

Quality frontline investigation techniques are critical to the death investigation system. Contemporary death investigation systems acknowledge the importance of a functional multidisciplinary structure to achieve decisive death investigations. The nurse is a notable professional having the ability to objectively assess the medical, social and scientific background of the deceased. Nurses apply effective assessment skills, recognition and documentation of injuries, and patterns of injury useful in determining the cause and manner of death.

The correlation of the history taking: medical, psychiatric, social and occupational facilitates the investigator in the development of the sequence of events leading to the death of the decedent. Correlating this basic information with the findings noted on the body aids in the determination for further investigative efforts.

Nurses retain the ability to decode the medical record, a valuable resource of critical historical information. They also project objectivity during the review of the medical record and are able to recognize inconsistencies.

An essential part of death investigation is the conduction of interviews with witnesses. Traditionally, nurses are good history takers because the general public trusts them. This assumed level of trust helps the nurse to gather information and facts in the course of an interview. Nurses project an image that is likely approachable, less intimidating and more calming than the image of typical law enforcement authorities. This helps build a rapport with witnesses that may be useful in follow-up interviews.

An experienced nurse with keen, clinical assessment skills may tune in to non-verbal cues during the course an interview. Such observations may help to facilitate or prompt further and necessary questioning. Forensic nurses are trained to apply a degree of suspicion when there are inconsistencies in statements made by witnesses and especially when those statements are inconsistent with findings at the scene. The application of critical thinking by the nurse is fundamental in the interpretation and communication of information in stressful situations when emotions frequently run high.

Nurses as forensic investigators obtain useful data to support interpretation of the scene. The combination of a thorough history and good crime scene processing guide the pathologist in the performance of the autopsy. This useful information will assist the medical examiner to focus on specific areas of interest. The medical examiner findings are disseminated to all members of the multidisciplinary team. The result is a comprehensive systematic and scientific death investigation.

Forensic Nurse, Death Investigators, Medical Examiners/Coroners

D49 Is Current Medicolegal Death Investigator Training Meeting the Profession's Needs?

Julie A. Howe, BS, MBA, Saint Louis University School of Medicine, Division of Forensic Pathology, 1402 South Grand Boulevard; R512, St. Louis, MO 63104-1028*

After attending this presentation, attendees will have an increased awareness of medicolegal death investigation training programs available throughout the country. The impact of this trend is discussed as well as the qualities that are necessary to provide good training.

This presentation will impact the forensic community and/or humanity by increasing awareness of medicolegal death investigation training programs available throughout the country. The impact of this trend is discussed as well as the qualities that are necessary to provide good training.

The past few years have brought about an increased interested in medicolegal death investigation due largely to media exposure and television programming. Many high school students inquire about baccalaureate programs in this field without realizing that education has traditionally been received on-the-job or through training courses. Until national requirements are mandated within the profession, which would allow for standardized curriculums, training courses continue to be the vehicle for knowledge. With the 1998 distribution of *Death Investigation: A Guide for the Scene Investigator*, published by the National Institutes of Justice, courses are now focusing on the 29 essential skills and standards of practice identified. Using these guidelines in place of agency specific protocols is the first step in promoting standardization across jurisdictional boundaries. Individuals who develop new training courses should always use the guidelines to structure their course content to ensure consistency.

Media attention has brought about a heightened awareness of the significant role that medicolegal death investigators play in the prosecutorial process. This awareness has helped bring about a proliferation of basic training courses offered throughout the country to teach basic medicolegal knowledge and skills, even though few states mandate any type of training for their investigative personnel. There are roughly ten basic medicolegal death investigation courses offered nationally on a regular basis. These few offerings are severely deficient to educate the thousands of medicolegal death investigators working for Medical Examiner or Coroner jurisdictions.

The lack of a central repository for educational offerings or training is unfortunate. Forensic publications, such as the AAFS Newsletter, list courses specific to medicolegal death investigation. You can also discover training opportunities by performing a simple search on the Internet. Others, however, are listed under the sponsoring university or agency and are not accessible to anyone unfamiliar with its existence because key words are not entered into a search engine. Most sponsoring agencies retain a mailing list. This is certainly acceptable but presents a problem for expanding the audience. Thus, word of mouth still seems to be the most popular method of promoting training opportunities.

There are several variations in instruction methods. The majority of training courses have a medical examiner listed as the director and are affiliated with a university. Some allow open enrollment while others are state or region specific. Class size is limited when hands-on instruction or workshops are involved, while other courses lecture in the traditional manner to hundreds. The majority of courses utilize local forensic scientists to teach basic death investigation information but some bring in guest speakers who are considered experts in their field. Costs vary from $75 for two days to $675 for five days.

With the evolution of technology, education is also being offered online. Community colleges and universities are beginning to incorporate medicolegal death investigation topics in their criminal justice

curriculums. Even though this is an accepted method of learning, it removes the ability for registrants to share their experiences among peers in a classroom setting. Most medicolegal death investigators claim these discussion are a valuable part of the training. Perhaps online education is better suited for continuing education.

New courses that are being implemented nationally to meet the rising need for training new employees may be too basic for veteran medicolegal death investigators. Therefore, specialized training within forensic disciplines is also desperately needed to enhance the investigators base knowledge. Specific courses in bloodstain analysis, bloodspatter interpretation, forensic photography, entomology collection, etc. are currently offered but are usually limited to a specific region within the country depending on where the instructors are located.

There are certain qualities that define good training. Training funds are often limited, requiring one to choose their training options wisely. An analysis of traits will be discussed to evaluate educational offerings and determine if they meet the desired needs of the profession.

Medicolegal Death Investigation, Training, Education

D50 The Role of a Coroner's System in an Infectious Pandemic: The Toronto SARS Experience

Barry A. McLellan, MD, Office of the Chief Coroner, 26 Grenville Street, Toronto, Ontario M7A 2G9, Canada; Jagdish Butany, MD, Toronto General Hospital, Department of Pathology, 200 Elizabeth Street, Toronto, Ontario M5G 2C4, Canada; James N. Edwards, MD, and David H Evans, MD, Office of the Chief Coroner, 26 Grenville Street, Toronto, Ontario M7A 2G9, Canada*

After attending this presentation, attendees will understand the evolving role of a medicolegal death investigation system during a pandemic caused by an initially unknown pathogen.

This presentation will impact the forensic community and/or humanity by increasing understanding of how a medicolegal death investigation system can advance public safety during an infectious pandemic by improving medical knowledge and assisting public health decision making.

Sudden Acute Respiratory Syndrome (SARS) was first publicly identified by the World Heath Organization (WHO) on March 12, 2003, but in retrospect this new infectious disease appears to have started in Asia in late 2002. At the time of submitting this abstract SARS has been identified in 31 countries worldwide. Significant outbreaks of SARS have occurred in China, Hong Kong, Singapore and Toronto. The political, economic and public health effects of this pandemic has been enormous.

The first death of a SARS victim in Toronto occurred on March 5, 2003, although its public health significance was not appreciated until just over one week later. At the time of abstract submission there have been 40 deaths (20 male/20 female; age range 39-99 years; median age 75 years) attributable to SARS in Toronto (with 13 active probable cases still in hospital).

The Toronto experience can be separated into two distinct epidemiological outbreaks (SARS I – March 5 to May 10, 2003, and SARS II – May 22 to June 12, 2003). At the time of the first deaths (SARS I) the pathogenesis and specific causative agent responsible were not known. 14 autopsies (out of 25 deaths) were performed during SARS I with the focus on medical cause of death, including testing to identify the etiological agent. All but one of the autopsies were conducted on cases with a probable (WHO criteria) diagnosis of SARS; all cases with probable diagnosis were positive for SARS based on microscopic and, when available later, PCR testing. As a result of these initial autopsies the *Coronavirus* genome was sequenced and PCR-based diagnostic testing developed. Autopsies were centralized at one site with the best ventilation and physical plant. All but 4 of the autopsies were performed by one pathologist. A protocol for a limited autopsy (including in situ organ sampling from liver, spleen, kidney, urinary bladder, heart, lung, pharynx, trachea, bone marrow and skeletal muscle) was developed during SARS I. The cranium was not opened in order to reduce aerosol formation.

The second outbreak (SARS II) resulted from transmission from an unrecognized acute care hospital inpatient; by the time of recognition 3 other health care facilities had SARS patients secondary to patient movement between facilities. By the time of SARS II *Coronavirus* had been identified as the causative agent and the focus at autopsy shifted, in large part, to using post mortem examination and test results to rule out potential (yet clinically low suspicion) cases. Autopsies were predominately performed on elderly inpatients with non-specific clinical pictures and evidence of infection, and provided important information for public health decision making (specifically identifying who required isolation). Based on experience from SARS I a new protocol was developed requiring that only the chest be opened; samples from lung, heart and skeletal muscle were examined by light and electron microscopy and PCR (reverse transcriptase PCR for SARS *Coronavirus* RNA) testing was performed within 24 hours of autopsy. Twenty autopsies were performed during SARS II (18 negative, 2 positive). Based on this new protocol it was possible to efficiently diagnose or rule out SARS cases within 24 hours of death, information that proved invaluable for public health decision making. There was one homicide case (stab wound to head) during SARS II where the decedent was febrile at the time of death and had been exposed to a SARS patient prior to death. This was the only case where a complete autopsy was performed. Test results available 20 hours after autopsy were negative for SARS.

Medicolegal death investigation systems do play an important role in an infectious pandemic, a role that may evolve during the course of the outbreak. Information gained as a result of autopsies can both advance medical knowledge and assist with public health decision making. In this instance of major public health concern the Coroners Office played a major role in diagnosis and disease containment.

Pandemic, Epidemic, Virus

D51 The Importance of Consistent and Reasoned Death Classification in the Proper Execution of a Death Investigator's Public Duty

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After attending this presentation, attendees will learn new strategies for death classification consideration.

This presentation will impact the forensic community and/or humanity highlighting to others in the public service of death investigation, for both forensic and medico-legal purposes, that cautious, informed and reasoned conclusions are essential to maintaining public confidence as we execute our authority as participants in administrative justice and public safety.

This presentation will demonstrate the forensic and medico-legal importance of consistent and rational classification of death by coroner and medical examiner systems. The process utilized by the Office of the Chief Coroner in Ontario, Canada to achieve this outcome will be described.

As persons provided with significant powers, often usurping the wishes of family, to investigate and determine cause and manner of death, coroners and medical examiners exercise an important public duty. The process utilized by the Office of the Chief Coroner to develop by what means guidelines that are transparent, reasoned and medically

and legally valid will be presented. The guidelines are based on the collective experience of senior coroners and consideration of definitions in other jurisdictions.

Death investigation in Ontario, Canada (perhaps the largest medico-legal jurisdiction in North America) is conducted by licensed physicians. Approximately 340 physicians (full time physician supervisors and managers and fee for service physician investigators) apply the principles to ensure consistent determinations in the 30,000 death investigations each year. These physicians are appointed coroners through an "Order in Council" of the provincial government following an application, interview and background screening. References are contacted to ensure good medical judgment and keen forensic and medico-legal interest.

The significance of "by what means" decisions by coroners in forensic and medico-legal death investigation will be discussed. The impact of death classification on legal matters for the deceased, the family, business associates and colleagues, the justice system and the public will be demonstrated. Utilizing the legal test of "balance of probability" in a medically based death investigation organization coroners in Ontario make these decisions cognizant of the legal, religious and societal (both private and public) impact of findings such as accident, suicide and homicide.

The definition of suicide in Ontario has been determined by a judicial decision and is stated to be death resulting from "the intentional act of a party knowing the probable consequences of what he is about" [*Beckon* v. *Young* (1992) 9 O.R. (3d) 256 (O.C.A)]. The court also directed that the application of this definition also requires a "high degree of probability".

Intense scrutiny of the circumstances of deaths as a result of police action, which are often the subject of a mandatory public inquiry in the form on an inquest, has initiated close examination of the " homicide" definition in a non-culpable context. Only five classifications are open to an inquest jury: natural, accident, suicide, homicide and undetermined. No other "creative" determinations or descriptions can be returned. This principle must be applied against a strong policing initiative to avoid the "homicide" term.

Ontario has an active inquest system in which a jury of five persons is tasked with the determination of cause and manner of death following sworn evidence about the circumstances leading to the death and the active participation of parties granted "standing" at the inquest. The definitions of natural, accidental, suicide, homicide and undetermined provided to the jury are identical to those utilized by investigating coroners. These definitions must be applied to the circumstances of the case, relying on clear and cogent evidence. No finding or implication of blame or legal responsibility can be returned by the jury in their verdict or their recommendations.

Sample investigation and inquest cases will be presented to demonstrate the application of the guidelines and discussion welcomed.

Death, Medico-Legal, Forensic Impact

D52 The Next Big Challenge for Quality Forensic Service

Chin-Chin Lim, MSc, MBA and Ming Kiong Michael Tay, PhD, MBA, Centre for Forensic Science, Health Sciences Authority, 11 Outram Road, Singapore 169078, Singapore*

After attending this presentation, attendees will obtain a wider understanding of quality and the organizational capabilities required to ensure a quality forensic service offering. Action plans are proposed to build these capabilities and to deal with the potential constraints encountered during implementation of a quality assurance program. Real-world illustrations will be given during the presentation

This presentation will impact the forensic community and/or humanity by demonstrating to forensic scientists whom too often adopt a narrow perspective of what constitutes a total quality assurance program. Quality management, however, entails more than focusing on technical aspects. People-related issues such as organizational culture, managerial preparation, generation and sharing of knowledge, talent management, communication and relationship management are equally - if not more important - to insure a quality program that continues to be relevant to the needs of the criminal justice system.

A forensic organization is a unique collection of highly differentiated resources, capabilities and expertise. Organizational capabilities are fundamental to performance and vital to the provision of a quality forensic service. Developing the relevant type and amount of capabilities valued by criminal justice system will help forensic organizations remain relevant and stay ahead in quality performance.

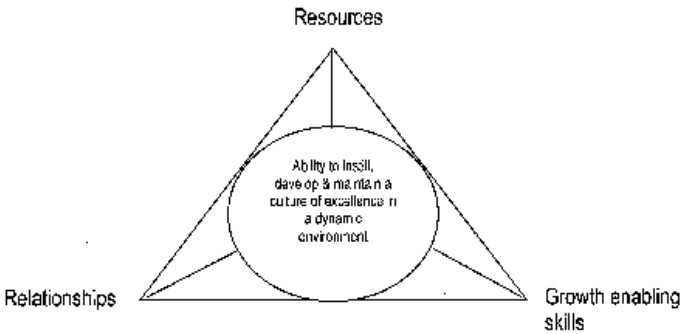
Our view and definition of quality is fundamental as it determines our priorities and allocation of resources to achieve the quality we desire. Quality has been variously defined as "innate excellence in terms of service specification," "free of errors and conform to design specification," "fit for its purpose," "meeting measurable characteristics required to satisfy a customer," and "value in relation to price." In the forensic fraternity, accreditation and certification have become buzzwords synonymous with quality. We submit that these are necessary but insufficient. There is little doubt that they impart a seal of quality to forensic organizations but a quality service delivery entails more than focusing on quality work processes and obtaining reliable scientific findings. Quality includes various other tangible and intangible assets likely to have significant impact on the service delivery process in the long run. In parallel with our restricted view of quality, there is presently, a lack of understanding of the capabilities required for delivering quality forensic services. Heavy emphasis is continually placed on technical capabilities (the integration of knowledge and skills of forensic scientists with equipment and technology) and stringent quality assurance to provide error-free services.

Objectives

The key issues of this paper are to identify:

1. organizational capabilities needed for delivering quality services and action plans required for building these capabilities
2. potential constraints for exploiting and leveraging these action plans

The bedrock of a quality service delivery process is the ability to instill, develop and maintain a culture of excellence in a dynamic environment. This bedrock is in turn based on three key factors: resources, growth-enabling skills and relationships, which in a balanced combination, constitutes a formidable tool for insuring a total quality program. Resources include the technical capabilities and expertise as well as an integrated team of committed professionals and a wide range of management skills. Growth-enabling skills encompasses knowledge generation and sharing, experimentation and learning, creativity and innovation. Lastly, special relationships refer to vital links and ties with colleagues, clients, suppliers, and international counterparts.



Culture of Excellence

Technology is a powerful driving force in the forensic field. New technologies usher in new possibilities, new expectations and new services. Benefits sought by the criminal justice system change in importance over time. Keeping pace with these technological advances requires a constant upgrading of our instrumentation and technical capabilities. However, cultivating a learning organization that welcomes and embraces change appears to be an even more fundamental requirement. It is critical for the entire organization to be educated on the change process. We need to have correct attitudes and capabilities and be vigilant of driving forces and flexible to change. We have to align to a common vision and mission, and understand and live the core values of the organization. High caliber personnel with integrity, commitment, motivation and expertise are required to fit the bill.

Talent Management

People are the crown jewels and the most important asset in any forensic organization. Hence, talent must be deliberately managed and retained by identifying training roadmaps for staff, designing challenging jobs and creating strong teams. Adequate funds need to be set aside for training and development of forensic examiners. Learning opportunities must be planned and provided for them on an on-going basis to develop and strengthen their capabilities and for them to grow with the organization. They must be recognized for their efforts made in the investigative process. Talent management may be a laborious and sometimes painful organizational process but it will produce both short and long-term benefits in terms of succession planning or downsizing, ensuring a smooth transition to capable practitioners and leaders, or shedding of uncommitted and under-performing staff when casework volume declines in certain areas.

Managerial Preparation

Managers need to be equipped with the necessary management skills. Most organizations effectively prepare their managers in the technical domain, ensuring their ongoing professional development. Forensic agencies however, often neglect training senior staff for management responsibilities, which have greater ambiguity and require more interpersonal skills. Forensic managers also often lack knowledge and skills to apply techniques of marketing to strategically position their organizations.

Knowledge sharing and transfer

Knowledge resides in people's heads and is therefore a highly mobile resource. It is vital for top management to manage intellectual resources and capabilities such that knowledge is transferred, stored and institutionalized. Unlike capital and physical assets, knowledge increases when it is disseminated, used and shared. Our organizations need to offer the necessary culture and support to mandate and strongly encourage knowledge behavior by evaluating people on the basis of it and rewarding those who consistently display it. We have to develop means to keep a record of the people who have the know-how to solve specific problems so that others can quickly locate them and tap their know-how when the need arises. Continual observation and careful analysis is required to convert tacit knowledge to explicit knowledge.

Communication and relationship management

The ability to network and collaborate internally and externally is critically important in forensic science. Linkages between labs create synergies, and contacts with international counterparts enable an organization to tap new expertise, benchmark its processes and systems and shorten its learning curve. International collaboration will set new heights for quality performance and enhance an organization's reputation. Lastly, an interactive and informative service encounter crowns the service delivery process. Forensic examiners need to discuss cases with law enforcers, practice progressive reporting to convey significant results and explain the implications of the final report, whether it is intended for investigation, intelligence or prosecution.

Potential Constraints

Constraints that may potentially hinder the implementation of action plans stem from 2 major factors:

1. the organization's willingness and ability to identify and develop its employees
2. forensic examiners' ability, aptitude and willingness to learn

It is not easy for top managers to walk the talk and they have to understand their own strengths and weaknesses and be honest about what they know and do not know. It is even more difficult to cultivate a culture of sharing and learning and constant alignment to the organization's mission, vision and core values.

Conclusion

The organizational capabilities perspective provides a more holistic approach to creating quality services. However, it is insufficient to simply cling onto a bundle of capabilities. Capabilities need to be constantly reviewed, modified, honed and rebuilt to keep pace with the ever-changing demands of clients and advances in technology. Forensic organizations will have to constantly reinforce the view that producing top quality work is everyone's job. The prerequisites for quality performance are excellence in learning through the relentless benchmarking of critical measures, setting stretch targets and challenging people to achieve them. Most importantly, an organization must develop the enabling infrastructure, ideologies, resources and capabilities to support and deliver this goal.

Forensic Service, Quality, Organizational Capabilities

D53 The Role of Forensic Science as a Tool Against Violence — The Colombian Experience

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After attending this presentation, attendees will understand the importance of Interagency and International Cooperation.

This presentation will impact the forensic community and/or humanity by demonstrating active participation in the implementation of criminal policies. The importance of interagency cooperation and of sharing information. Interconnectivity among law enforcement agencies.

The purpose of this paper is to show to the audience the importance of implementing an interagency cooperation strategy, as well as the key role of international cooperation, both of which have been critical to the enormous scientific progress accomplished in Colombia for the benefit of law enforcement agencies, police officers, investigators, and prosecutors.

Historically, Colombia has been affected by high violence and crime rates. Criminal activities, such as drug trafficking, insurgent and paramilitary actions, kidnapping, human rights and International Humanitarian Law violations, and common crime have increased significantly in the last 15 years.

All of the above, together with a weak criminal judicial system and a strategic geographic location, have contributed to Colombia's position as a target of international assistance, aimed at solving these endemic problems.

Therefore, as part of the so-called Plan Colombia, an assistance program implemented by the United States, the U.S. Department of

Justice, through its agency ICITAP (International Criminal Investigation Training and Assistance Program) promoted cooperation for the development and enhancement of Colombian Forensic Sciences, as a collaborative strategy to support both investigators and prosecutors in their daily fight against the scourge of crime.

Traditionally, the criminal justice system in Colombia has been inquisitory in nature, following the European continental model. This is an obstacle to the submission of evidence by defense attorneys. The defense relies solely on the official evidence submitted by the government. This situation was aggravated by the fact that the crime labs of the law enforcement agencies acted on their own and there was no cooperation among them. This is an obviously obstacle to successful results.

The audience will see that crime rates have declined significantly in Colombia, as a result of a joint effort and will find a clear-cut link between crime reduction and investigative and forensic developments.

The paper will describe the operation of the forensic database interconnection system through the wireless networking of law enforcement agencies in various Colombian cities. Successful investigations will be used as examples of the key role of enabling information sharing among agencies. The Colombian reality of interconnectivity will be described.

Case studies concerning the use of DNA will show how the CODIS system was the tool that helped investigators solve the case of a serial rapist and arrest a rebel leader. These cases were made possible by the fact that investigators had the immediate support of the forensic experts who operate the IBIS database. Other cases concerning the identification of counterfeit drugs through the image databases shared by Questioned Documents Labs will also be described.

The Colombian experience is an example for the international forensic community. It is an evidence of how forensic scientists, concerned with the destiny of their homeland, may become both leaders and trainers who promote, design, recommend, and actively participate in the implementation of policies and strategies against crime.

Information Sharing, Interagency Cooperation, Violence

D54 A Heavy Grasshopper Infestation Creating a Delay in Blow Fly Oviposition on a Suicide Victim During Summer in Montana

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After attending this presentation, attendees will understand that there could be delays in insect oviposition caused by heavy infestations of grasshoppers in certain portions of the United States.

This presentation will impact the forensic community and/or humanity by obtaining a more precise postmortem interval.

The use of insect evidence to answer questions surrounding a death scene is becoming a common practice across the U.S. Conclusions made by forensic entomologists are based upon known behavior, biology, and growth and development of many insect species that interact with decomposing animal carrion in a predictable pattern and sequence. In most cases, there is little which will alter or affect this known succession or pattern. However, as with all trends in natural science, there are a few exceptions. Normally, when a body is placed in an outdoor environment and the temperatures are adequate (50°F or greater) blow fly female adults will initiate colonization within minutes of death. The postmortem interval estimate is based upon the oldest life stages present of a specific species of blow fly. In Texas, heavy populations of fire ants in close proximity to decomposing carrion (pigs) altered what would be recognized as the start of the initial blow fly colonization. Fire ants were observed feeding on and carrying off early depositions of blow fly eggs faster than the blow fly females could accumulate any sizable egg masses. It was nearly 48 hours after placement of the dead pig before the blow flies were able to begin an accumulation of eggs that would produce the first hatching larvae. Therefore, the estimated time of death based upon blow flies would be 48 hours later than the true time when death occurred. A case from western Montana demonstrates another example of how colonization of the blow flies can be delayed. The body of a middle aged male was discovered in an open field on August 21st. A contact gun shot wound with muzzle stamp was observed in the right temple area of the head with an exit wound seen behind the left ear. A 1991A Model Colt was seen lying on the ground beside the body. The body was removed to the Montana State Crime Lab where examination by the forensic pathologist suggested at least 24 to 48 hours postmortem due to drying of the tips of the ears and the fingers. Full rigor had been present when the remains were discovered, but rigor had passed by the 22nd when the autopsy was conducted. Investigation on the decedent's activities prior to death showed his last contact to be with the estranged wife. The wife received a phone call from the decedent at approximately 10 PM on August 19. There was a muffled noise in the background which could have been a gun shot. A cell phone was found in the pocket of the decedent. The forensic pathologist recognized the noticeable absence of fly eggs or larvae which should have been present with a body laying in an open, outdoor environment during summer for two days. Temperature data indicated daily highs for the two day period (August 20 and 21) when the blow flies should have colonized the remains were 74° and 76°F respectively. These daily highs are well above the 50°F lower limit threshold necessary for flight and egg laying activity. During body recovery, it was noted that there was a very high population of grasshoppers on the body. Artifacts of the skin were seen on the remains where it was suspected that insect feeding had taken place. These feeding areas were most likely the result of grasshoppers, due to the absence of other insect taxa (kinds). The absence of fly eggs and larvae were due, most likely, to the presence of high numbers of grasshoppers disturbing the female flies from depositing their eggs. This case is important in its documentation of high numbers of grasshoppers disturbing the blow flies from their normal egg deposition behavior and creating a delay of colonization for at least a two day interval if not longer. An explanation of a delay in colonization, as a result of high populations of grasshoppers, could have a major impact on the outcome of a death investigation.

Time of Death, Delayed Oviposition, Grasshopper

D55 A Proposed Taxonomy for Postmortem Genital Examinations With Colposcopy

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After attending this presentation, attendees will understand appropriate taxonomy that will allow us to better describe and document: the appearance of the anogenital tissues at various postmortem intervals; accurately and consistently describe anogenital tissue trauma; and more reliably compare rape-homicide trauma to the types of injury seen in living rape victims.

This presentation will impact the forensic community and/or humanity by demonstrating the development of appropriate taxonomy which will facilitate an ordered arrangement of terms, to more accurately describe the clinical findings of the postmortem genital examination. A methodical and systematic approach to documentation will hopefully: Improve the (diagnostic) acumen of the forensic examiner; provide a theoretical and practical framework for documentation of these examinations; avoid ambiguity in interpretation; and help promote consistency and reliability among examiners.

Finally, the development of appropriate taxonomy will facilitate closer cooperation between Sexual Assault Response Teams and other members of the forensic community. This will enhance both antemortem and postmortem criminal investigations, leading to improved services for victims and detection of offenders.

Baseline studies of genital anatomy and the nature of postmortem tissue changes are being conducted (Crowley & Peterson). These will allow eventual comparison to injuries noted in rape/homicide victims. A sequential methodology & evidentiary protocol has been previously described (AAFS/Crowley, 1998, 2003).

Fraser et al. (1999), modified a 1966 World Health Organization classification system, and cited "conditions or changes in the appearance" of the vagina and cervix after colposcopic examination of the vagina and cervix in healthy sexually active females. While it is helpful for the Forensic Examiner to be cognizant of classification systems used to describe findings in living subjects, taxonomy germane to the postmortem genital examination should incorporate salient terms, such as TEARS, that will be consistent and universally acceptable in the forensic community.

In a review of studies of injury patterns of women resulting from sexual assault, Sommers et al (2001) noted that "standardized classification systems to organize severity and location of injury need to be developed and tested."

Slaughter, Brown, Crowley, & Peck (1997), found that the typical pattern of injury and types of genital trauma in female rape victims consisted of tears, ecchymoses, abrasions, redness, and swelling (TEARS), all characteristic of blunt force trauma. When compared to a group of women that engaged in consensual sexual activity, there was considerable disparity in the frequency of genital trauma. As noted in this study, the development of taxonomy can help "establish a more reliable basis for forensic analysis."

During the assessment of the nature and pattern of wounds and injuries in living tissues, the astute examiner considers various gynecological conditions and factors that may influence the appearance of findings. Normal anatomical variations, nonspecific findings such as tags and adhesions, various gynecological conditions, and postmenopausal changes to the genital anatomy are part of the differential evaluation. Similarly, several factors are pivotal to a thorough postmortem genital examination. The same 11 anatomic structures in the female that are the most frequent sites of trauma in living rape victims must be equally scrutinized in postmortem cases. These include the labia majora, labia minora, peri-urethral area, posterior fourchette, fossa navicularis, hymen, perineum, vagina, cervix, anus, and rectum. Death adds its own framework to the scenario. Factors such as lividity, rigor, postmortem interval, postmortem skin slip, mucosal autolysis, and normal postmortem dilatation (vs. antemortem prolapse of the vagina, urethra, cervix, and/or rectum) will affect the appearance of the tissues. When performing the autopsy, the Forensic Pathologist is well-familiar with these postmortem factors. However, the mucous membranes and skin of the genital area have traditionally received less specific scrutiny. Certainly the attention to detail of the anogenital sites have only recently been studied (Crowley/AAFS, 2000, 2001, 2002, 2003). The utilization of colposcopy further augments the precision of evaluation.

As these cases are examined and photographed, salient information must be collected and documented. As discussed in previous presentations, conventional terminology to describe genital trauma, i.e., sharp vs. blunt trauma, is recommended to provide consistency with the rest of the autopsy. Study of determinants such as multiple vs. single sites of injury, multiple types of injuries, and frequency of location may help us to better understand and classify the degree or severity of trauma.

The taxonomy will be further refined throughout the course of clinical evaluation of a normative, core group of baseline cases, representative of various causes of death, i.e., natural, accidental, suicide, and homicide (Crowley and Peterson).

Taxonomy, Postmortem Genital Examinations, Colposcopy

D56 The Value of an Internship to a Forensic Science Education: A Student's Perspective

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After attending this presentation, attendees will emphasize the importance internship participation in the training of future forensic scientists.

This presentation will impact the forensic community and/or humanity by demonstrating the argument to require the inclusion of internship as the best method for training well rounded forensic scientists.

The climate in the post September 11/CSI/OJ Simpson era has been one of unprecedented growth in the number of Forensic Science education programs around the country. The increased popularity of the field coupled with the need better trained forensic scientists in an increasingly technical environment (especially in DNA technology), have raised demand for educated forensic scientists to new heights. With the expansion in the number of programs, there has been like expansion in the number of approaches to training, with different programs emphasizing different requirements in line with what each deems important to turning out quality graduates.

One such variable requirement is the inclusion of an internship requirement into the curriculum of forensic science programs. Some schools include this prerequisite, others do not. One program that includes such a requirement is the Forensic Science Program at Pace University. Pace is a large university with campuses in New York City, White Plains, and Pleasantville, NY, with the forensic science program based out of the New York City campus. In order to receive a degree from Pace, students are required to perform an internship of four hundred hours duration, generally performed over the summer months. It is this obligation that the authors have recently completed.

Upon learning that it would be necessary to intern as part of the program, several obstacles were encountered. The largest of which, and the most difficult to overcome, was the availability of positions with the agencies performing the forensic analyses. No requirement exists for laboratories to accept interns and many do not. Other organizations do, but limit the numbers as a way to minimize resource and training outlays. These factors, along with the increased numbers of students seeking positions, conspire to greatly increase the difficulty of even finding an internship in a given area. Combine this with the rising number of students seeking these openings and number of slots available dwindles quickly. Even if a placement were available, one must still tackle the problems of the requiring the student to effectively work full time for a summer for no pay, and the cost to the student for the credit-hours earned. All can be seen as potential detriments to a required internship.

Once the position was secured, and the formalities concluded, the perception of the internship requirement began to change dramatically. The learning experiences were three fold. Initially, there was the overview stage, where the student observed the overall workings of the laboratory, how evidence is handled, and how the laboratory tests are performed from the beginning of the process to the end. There was also the field stage, where the intern was afforded the opportunity to observe the work at scenes. There it was learned first hand the importance of the initial handling of the scene and evidence, and how all of the most sophisticated laboratory tests in the world cannot restore the probative value of evidence if the context and it's origin are lost. Finally, there came the contributory stage, where through one or more projects the intern was able to add to the knowledge base of the lab as well as demonstrating ability in a working setting.

While the primary focus of the internship experience is an educative one, other benefits soon noticed from the internships were of

an interpersonal nature. It is often said that it is not what you know so much as who you know, and this is as true in the forensic science field as any. While interning, it was evident that it was important not only to learn as much as possible and to perform tasks to the best of ones ability, but to also meet people and develop relationships that will come into play when it comes time for collaboration or the all-important hiring.

From an examination of the author's experiences, it seems that both positive and negative experiences can be associated with the internship process. For the large part, the difficulties were found within the initial process of acquisition and organization, and not with the actual item itself. Once begun, the internship was revealed to be an invaluable learning experience, offering perspective on how this field works in the 'real world.' For no classroom setting, however intricately designed, can hope to substitute entirely for hands on experience in the work setting. Internships result in better-trained forensic scientists, and that ultimately is good not only for the students, but the entire field.

Forensic Science, Internship, Education

D57 Forensic Research and Training Opportunities IMSS: Institute for Medicolegal and Surgical Sciences at the University of California, Davis

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After attending this presentation, attendees will learn of a new facility available to support research and training in the forensic sciences.

This presentation will impact the forensic community and/or humanity by demonstrating there is a significant impact to the forensic science community regarding the availability of a new facility to support research, training and education in varied disciplines.

This session is intended to inform the forensic community about a new facility available for research and training opportunities at the University of California, Davis.

The IMSS facilitates forensic research and training at the University of California, Davis, by combining the services of the Department of Medicine's Donated Body Program and the Department of Wildlife, Fish, and Conservation Biology's Experimental Ecosystem. An outdoor facility is available at which research and training can take place that may or may not utilize human specimens. Additionally. laboratory and classroom facilities can be arranged as needed.

The IMSS strives to support multi-disciplinary research projects, as well as encourages the use of the facilities for death investigation workshops or other training programs with academic merit. The forensic community is invited to submit proposals for research and/or academic endeavors to be completed at the IMSS.

Forensic Science Research, Forensic Science Education, Forensic Science Training

D58 Survey of Physician Members of the American Academy of Forensic Sciences

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After attending this presentation, attendees will understand the demography of physician members of AAFS, their workloads, satisfaction with the Academy and its Section and suggestions for improvements.

This presentation will impact the forensic community and/or humanity by providing demographic information hitherto unavailable concerning physician members of the Academy, their interests and activities in the forensic sciences, levels of satisfaction with their sections and programs, workloads, and suggestions for change.

In July 2003, there were 983 physician members of the American Academy of Forensic Sciences. Most are residents of the United States, but 130 physician members reside outside the U.S. on all six continents in 39 countries ranging from Azerbaidzhan to the United Arab Emirates. The largest number of them live in Canada, followed by France and Italy (tied for second) and Australia and Switzerland (tied for third). As one would expect, the largest number of non-U.S. physicians are found in Pathology/Biology, the largest section. But the largest percentage of non-U.S. physician members are in Criminalistics (7 of 9) and the General Section (16 of 34).

All but one of the ten sections of the Academy claim at least one physician member. The 101 physicians in Psychiatry and Behavioral Sciences must, by requirement, be psychiatrists or in residency training in that discipline.Of the 823 physician members in the Pathology/Biology section, the vast majority are specialists in pathology. But of the minority group in Path/Bio and of the physicians scattered in other sections (General, 34; Criminalistics, 9; Jurisprudence, 5; Toxicology, 4; Odontology, 3; Physical Anthropology, 3; Engineering, 1) little has been known. To partially remedy this situation a questionnaire was developed and, with the generous cooperation of Headquarters staff, circulated to every physician member and then re-circulated five weeks later. A 33.4% response was achieved. Response rate by section was: Path/Bio, 35%; Psych/Behav, 33%; General, 44%; Phys Anthrop, 67%; Jurisprudence, 40%; and Odontology, 33%. Unfortunately physician members of Criminalistics, Engineering and Toxicology did not return the questionnaire.

The majority of AAFS physicians identify themselves as pathologists and psychiatrists, of whom 80% and 89%, respectively, claim board certification. Nineteen of the 285 respondents from Path/Bio are not identified as pathologists; this is 6.7% of the total Path/Bio membership. Thus, by extrapolation, it might be expected that there are 55 non-pathologist physicians in that section which if added to other section memberships suggests that there are approximately 114 physician members of the Academy (12%) who are neither pathologists nor psychiatrists.

Non-pathologist, non-psychiatrist respondents listed a wide range of "major medical interest, practice or specialty." Board certification in some specialty was claimed by 64% of them.

"Major fields of activity, interest, or occupation in the Forensic Sciences" were identified as medical examiner, 41%; coroner, 9%; pathology (non-M.E., non-coroner), 29%; psychiatry, 12%; and other, 7%.

Respondents from Pathology/Biology and Psychiatry and Behavioral Science apparently devote more full-time activity on a full-time basis than do members from other sections where part-time activities seem more prevalent. Three-fourths of the members in Path/Bio and Psychiatry, report a work week in excess of 40 hours. About half of the physicians in Path/Bio and Psychiatry report a work week in excess of 50 hours.

Whatever their section of membership, most physicians were satisfied with opportunities for participation and advancement, with scien-

tific and educational content of AAFS programs, and with the collegiality and/or commonality of interest they found their section. Some criticisms and suggestions for improvement were offered.

Only a few respondents indicated dissatisfaction with their section membership or expressed a desire to transfer to a different section, a process for which these seems to be no constitutional provision at present.

There was scant support for formation of a new section comprised of physicians who are neither pathologist nor psychiatrist.

AAFS Membership, Physician's Forensic Interests, Physician Specialists

D59 Employing a Hypothesis-Based Approach in the Processing of Forensic Biology Casework

Jack Laird, MSc, Johanne Almer, MSc, Roger Frappier, MSc, Andrew Greenfield, MSc, and Cecilia Hageman, PhD, Centre of Forensic Sciences, 25 Grosvenor Street, Toronto, ON M7A 2G8, Canada; Tony Tessarolo, BSc, Centre of Forensic Sciences, 70 Foster Drive, Suite 500, Sault Ste. Marie, ON P6A 6V3, Canada; Jonathan Newman, BSc, Centre of Forensic Sciences, 25 Grosvenor Street, Toronto, ON M7A 2G8, Canada*

After attending this presentation, attendees will learn about initiatives taken to process casework in an efficient manner by performing examinations and interpretations, and by writing reports such that they are all reflective of hypotheses formulated from the case history.

This presentation will impact the forensic community and/or humanity by hearing about how we are striving to process biology casework in relation to the hypothesis being tested, and by hearing of several examples of initiatives implemented in light of this strategy, we anticipate that other forensic labs will be interested in applying similar strategies so that the most relevant questions in a forensic examination are answered in the most efficient and timely manner possible. We also hope to stimulate discussion so that we have opportunities to learn from the experience of other labs.

Forensic scientists working in the adversarial justice system may at times be asked to carry out certain examinations, despite the fact that inferences drawn from the results of such examinations do not adequately address the hypothesis being tested. In such instances, the limitations of a particular result outweigh its probative value without resolving the question at hand. Therefore, it is the responsibility of the scientist to make an evaluation of the potential inferences to be drawn prior to proceeding, so as to minimise the risk that any result generated may be misconstrued or abused in the judicial process. In his report detailing the proceedings of a judicial inquiry into the wrongful murder conviction of a man in Ontario in the mid-eighties, Mr. Justice Fred Kaufman eloquently expressed this principle, as it related to fibre examinations:

"A forensic scientist should approach the situation with an appropriate understanding and respect for the limitations of the fibre comparison process. The scientist should inform himself or herself of the relevant background facts or hypotheses, appreciating that they may later change or be the subject of contested evidence. If the fibre examination will clearly be worthless because it cannot permit any reliable inferences to be drawn, then it should not proceed. Only scientists - not investigators or counsel - can make that determination." At the Centre of Forensic Sciences (CFS), we have strived to employ the same philosophy in all forensic disciplines.

Furthermore, the notion of hypothesis-based testing goes beyond a decision whether or not to examine any given item. The principle extends to all elements of the testing process, including the manner in which results are interpreted and reported to clients. This presentation will describe initiatives taken at the CFS, at every stage of our work, in order to ensure that the principle of hypothesis-based testing is maintained from the outset. Specific examples will be presented to demonstrate the approach at each stage of the process.

Collection of evidence at the scene of the crime

The CFS is not directly involved in the collection of evidence from crime scenes. However, scientists at the CFS designed, in partnership with other stakeholders, a new kit for the collection of biological evidence from victims of sexual assault (sexual assaults comprise roughly 60% of our caseload). Included in the kit are instructions for nurse-examiners to collect samples in accordance with specific allegations and limitations regarding the persistence of biological evidence.

Submission of evidence to the lab for analysis

- For most homicides, case conferences are held early in the investigation, at the instigation of the Office of the Chief Coroner, and involve representatives from the police along with scientists with the requisite expertise, and representatives from other agencies, as required. These discussions, which form part of an overall Major Case Management model in the province, serve to disseminate the circumstances of the case so that hypotheses can be formulated based on shared information. From the perspective of the CFS, these meetings serve to focus the scientific examinations that are required and to narrow the list of evidence items to be submitted to the lab. The meetings allow lab staff to make specific commitments to the investigators with respect to turnaround time (target is 30 days), which in turn allows them to plan the investigation more effectively.
- The CFS has recently expanded its services in the area of high-volume property crimes, but in anticipation of a potentially overwhelming response in terms of submissions, has strictly enforced criteria for police designed to identify a single sample from each case to be submitted, such that it has the highest likelihood of yielding a DNA profile as well as the highest likelihood of the profile being attributable to the perpetrator.
- A project to examine cold sexual assault cases was initiated with a major metropolitan police service. The program has demonstrated the benefits of working in partnership with our stakeholders in order to effectively and efficiently address the relevant hypotheses. A minimal number of key items were targeted for submission and examination in each case resulting in a high success rate.

Evaluation of the service request

Although not all cases are currently assessed by scientists prior to evidence submission, they are assessed prior to starting the examinations, and only those items which would effectively address the hypothesis at hand are targeted for analysis.

Screening evidence items for body fluids or other suitable sources of DNA

Elements of the case history impact upon the sequence with which items of evidence in a given case may be examined, as well as on the selection of appropriate samples for DNA analysis. Further information regarding how we have implemented strategies for case screening in the framework of a hypothesis-based approach, as well as examples, will be outlined in a supporting poster presentation.

Interpreting and reporting results of DNA analyses

Examples of how the interpretation and reporting of DNA results proceeds in the context of the specific hypothesis being tested will be discussed briefly with reference to the following key points:

- Appreciation for the fundamental technical limitations
  - amount of template DNA
  - indications of degradation/stochastic influences
- Assumptions
- Mixtures of DNA- incidental findings and forensic significance
  - DNA profiles from intimate samples
  - factors in an evaluation as to the suitability of a DNA profile for comparison

Further information regarding how we have implemented guidelines for the interpretation and reporting of DNA results in the

framework of a hypothesis-based approach, as well as examples, will be outlined in a supporting poster presentation.

The forensic scientist is the person best equipped with the requisite knowledge, training, and experience to make decisions regarding the analysis of evidence, in partnership with stakeholders whom we rely on to provide the case history, with the understanding that alternate hypotheses may be presented at a future date. Applying the principles of hypothesis-based testing at each stage of the process, while respecting the limitations of any inferences to be drawn, ensures not only that the key objectives of a forensic examination are met but also that they are met in the most efficient manner possible.

Forensic Biology, Hypothesis Testing, Efficiency

D60 Forensic Science in a Postwar Context

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The goal of this presentation is to present to the forensic community the experience of forensic anthropologists in Guatemala, and the relation with the advancement and weaknesses of the forensic field in a post war context.

This presentation will impact the forensic community and/or humanity by discussing important issues related to the importance of forensic science.

Guatemala, a small country in Central America, lived one of the longest civil wars in Latin America, which lasted from 1962 until December the 29th, 1996, when the guatemalan government and the guerrilla movement signed the Peace Accords.

A few years before that, and due to the pressure of human rights organisations, forensic anthropology started to occupy an important place in the investigation of the recent past and the clarification of some of the most horrendous crimes that were committed during that dark period of guatemalan history.

During this period, there has been a significant advance in the quality of the work that is carried out, including, among other achievements the realisation of a big amount of forensic anthropology investigations, most of them related to the last two decades. Some of these correspond to mass graves, some of them are individual burials or hidden cemeteries. The guatemalan teams (three) have worked very hard to respond to the increasing demands of exhumations throughout the country. It has also improved the working systems at their laboratories, to make sure that the reports are submitted at the shorter term possible.

Some teams are looking forward to work not only in the forensic anthropology field but to contribute in the development of professional criminal investigation (and thus contribute in the creation of laboratories throughout the country), and to develop other sciences that could allow the creation of a solid base for the advancement of criminal investigations.

There is also the interest in making a continuing effort to build a strong relation with similar organisations, that are interested in the development of forensic sciences in the country, and with the strengthening of the national legal system.

Investigation processes about the legal system, would allow to find the problems that have to be addressed urgently. As a part these effort organisations such as the Centro de Analisis Forense y Ciencias Aplicadas CAFCA (Forensic Anthropology and Applied Sciences Centre) are also working on internal and external education processes on issues that include forensic anthropology, legal aspects of exhumations, national legal system, human rights, national recent history, among others.

There is a strong need to encourage the advance of forensic sciences in the country, by including forensic studies on a graduate and postgraduate level and also by the interaction with the national legal system.

The legal system's attitude towards the investigation of crimes needs to change. The treatment given to crime scenes in the country reflects that justice and truth are in many occasions, not the main interest. Even though serious crimes have occurred, the capacity of the national system, and the attitude towards discovering the truth through the serious treatment of evidence reflects the voids that need to be filled and the non professional attitudes that need to be corrected.

Guatemala, Forensic Sciences, Postwar Context

D61 Epidemiology and Evaluations of Findings in the Alleged Rape Victims

Purna Chand Dikshit, MD, LLB, Mukta Rani, MD, and Avneesh Gupta, MD, Department of Forensic Medicine, Maulana Azad Medical College, Delhi 110002, India*

After attending this presentation, attendees will learn about the profile of sexual assault in developing nation.

This presentation will impact the forensic community and/or humanity by demonstrating a better understanding of crimes in developing countries like India.

The study was conducted between the year 1996 and 2001 in the Department of Forensic Medicine, MAMC and associated L.N. and G.B. Pant Hospitals. The 601 cases of alleged rape victims were analyzed along with the haemotoxylin and eosin stained smear preparations which were examined for the presence of spermatozoa and parameters were discerned which would prove useful in establishing the offence of rape. It was found that the commonest age group of victims was 11-20 years (51.58%). A total of 323 (53.80%) victims were unmarried and only fourteen (2.4%) victims were pregnant. Most of the victims (93.8%) belonged to the poor socio-economic strata. In 22 cases (3.7%), some intoxicating substance was used to lower the victim's opposition. A diurnal and seasonal variation was also found. Struggle marks in the form of injuries were seen only in 26 victims (5.4%). Fresh hymenal tear was present in 15.1% cases. A total of 178 cases (29.62%) showed sperms in the vaginal smear and sperm heads could be recovered from vagina as long as 7 days after coitus.

Rape Victims, Physical Injuries, Sexual Assault

D62 Facial Comparison of Persons Using Pictures

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This paper describes a standardized procedure to perform facial comparisons, in order to make the process of performing facial comparison as objective and consistent as possible.

This presentation will impact the forensic community and/or humanity by presenting a method for visual comparison and some preliminary results without matching methods like 3-point techniques or 3D laser scanning.

In all current, and probably most future applications for facial recognition, the final confirmatory check of the identity of a person with a travel document is done by visual matching. Especially in criminal cases, were the available evidence mostly is limited, but the correct identification of the criminal is crucial, the final decision will also be made

by means of a visual check. However, this process is still subjective, and clear guidelines on how to perform such a comparison are hard to find. Therefore, we developed a procedure to standardize facial comparisons as much as possible.

Preferably, a comparison will take place with pictures taken from the same camera position, and from the same distance. If these are available, one-to-one metric comparison is possible. If a person and original camera equipment are available for comparison pictures, we use a three-point matching method to position the person according to the available pictures, and a direct comparison can be made. If the original equipment is not available, or the position of the person is hard to estimate, a 3D laser scanner could be used to take comparison pictures, followed by calculation of the most likely camera position and properties. However, in a lot of criminal cases, no additional comparison pictures can be made (e.g., when a crime suspect is still at large), and comparisons have to be performed using pictures from different time periods, camera positions and camera distances.

The method we developed comprises description of general information concerning the material, and scoring of general facial features (contours, relative measures, and positions), specific features (eyes, nose, ears, mouth, neck and throat), facial lines, folds and wrinkles, and typica like scars, moles, tattoos and piercings. Facial anthropological features are visually compared and classified as:

- SD. Similar into Details. Imaging conditions for this feature have been so good that it is to be expected that all details are visible.
- S. Similar. Imaging conditions are not optimal, in a sense that differences might be invisible.
- NO. No Observation. Observation is not possible due to circumstances.
- D. Different. Observed differences may be explained by differences in the imaging conditions.
- DD. Different into Details. Observed differences can only be explained by assuming that the features are physically different.

Features that cannot be compared due to large differences in age, facial expressions, or pose are classified as "NO."

Apparent similarities and differences are further evaluated by classifying features as:

- SD Strongly discriminating (e.g., the shape and position of a scar, a mole or a pattern of moles).
- MD. Moderately discriminating (e.g., a detailed shape of mouth and lips).
- WD. Weakly discriminating (e.g., the shape of the skull or the nose).

Conclusions from facial comparison are reported as level of support to the hypothesis that the persons depicted in the reference and disputed images are the same and/or as level of support to the hypothesis that these persons are different. The following levels of support can be given: 'very strong support,' 'strong support,' 'moderate support,' 'limited support,' 'no support.' In cases with similar support to both hypotheses, no conclusion can be drawn due to discrepancies.

Note that conclusions are not given in terms of probability, since to our knowledge insufficient quantitative data are available on the distribution of facial features in human populations. The estimation of the discriminating power of features and combinations of features is based on practical experience with facial comparisons.

It is our experience that using the above method, with a systematic list of features to be checked, forces the investigator to consider similarities and differences in a relatively objective way. The set-up of the systematic list will be used as a starting point of a system using statistical data on frequency of specific features, offering the opportunity to make the process even more objective.

Identification, Facial Comparison, Objectivity

D63 Criminal Misuse of Peroxide Explosives — Case Study From the United Kingdom

Claire McGavigan, MSc, Forensic Explosives Laboratory, Defence Science and Technology Laboratory, Building S12, Fort Halstead, Sevenoaks, Kent TN14 7BP, England, United Kingdom*

After attending this presentation, attendees will understand the experiences of peroxide explosives cases in the United Kingdom.

This presentation will impact the forensic community and/or humanity by demonstrating to laboratories who deal with explosives an appreciation of sharing the experiences of peroxide explosives cases in the UK, especially the development of a method for detecting trace levels of HMTD/TATP and presenting this evidence in court.

This presentation will concentrate on the work of the Forensic Explosives Laboratory (FEL) on one peroxide explosives case from the year 2000. Peroxide explosives are very sensitive primary high explosives that can be detonated by, for example, flame, impact and friction. The two organic peroxides most commonly encountered at the FEL are TATP (triacetone triperoxide) and HMTD (hexamethylene triperoxide diamine). The first encounter of the criminal misuse of such explosives in the UK is believed to have been in 1994 when an explosion occurred in a motor vehicle in a Jewish community. It is suspected that TATP was used as the initiator for the main charge in this explosives device, when as part of the police investigation approximately 1kg of TATP was recovered from a self-storage unit in London. Since then the FEL has dealt with a number of cases involving the criminal misuse of TATP and HMTD, in one such case the suspect had died while preparing HMTD.

The case to be presented started in November 2000 when a large quantity of sodium chlorate weedkiller, hexamine fuel tablets, citric acid and hydrogen peroxide were discovered in a small business unit by police in Birmingham, England following a large surveillance operation. These chemicals include the ingredients for the manufacture of HMTD (hexamine, acid and hydrogen peroxide). Subsequently a number of other properties in the same area were searched, with one property in particular revealing a large quantity of chemicals including HMTD powder and five improvised detonators containing HMTD. The following aspects of this case will be discussed:

- The role of FEL scientists at the crime scenes and their liaison with EOD (Explosive Ordnance Disposal) personnel and police exhibits officers.
- Significant items submitted to the laboratory.
- Procedures for examination and analysis of items. Including the need to develop a new method for the detection of trace levels of HMTD, not previously carried out at the FEL. This was achieved using the technique of LC/MS.
- Presenting the evidence from the FEL at the trial of two defendants at Birmingham Crown Court.

The results of the chemical analysis confirmed that HMTD had been found in one of the properties searched, including in the improvised detonators. A quantity of lead azide (another sensitive primary explosive) and small quantities of mixtures containing sulphur and sodium chlorate weedkiller were also identified in the items submitted. Sulphur/chlorate mixtures are extremely hazardous improvised pyrotechnic compositions due to their potential to spontaneously ignite. Trace levels of HMTD were also identified in samples from various items, for example, items of clothing.

It was concluded that the items submitted to the laboratory, including HMTD, lead azide, sulphur/chlorate mixtures and improvised detonators, indicated a serious and successful attempt to produce a wide range of explosive materials, which each posed a significant risk to public safety. They also had the potential to cause serious injury and possibly death and/or serious damage to property if directed against specific targets. The items submitted also included the chemicals to manufacture TATP (hydrogen peroxide, acetone and acid). However, no TATP or any reference to it was identified in the items examined.

Peroxide Explosives, Detection of Trace Levels, Presenting Evidence in Court

D64 The Jesse James Enigma - An On-Going Investigation on the Alleged Death of Jesse James in 1882

Ronald J. Pastore, BA, Jesse James Museum, 555 West Douglas Avenue, Wichita, KS 67213*

The goal of this presentation is to reinforce the importance of checking the facts for one's self. There is no substitute for an actual review of the original source data. This is the case in the matter of historical and contemporary data surrounding the investigation of the death of Jesse James. Though sometime hard to find due to the fact that archives are "sanitized" or records are mislabeled. It is imperative to keep searching and checking the not so obvious. Check the facts for yourself, you may find an entirely different point of view.

This presentation will impact the forensic community and/or humanity by demonstrating that in spite of the credential of the parties involved in the 1995 study and rigors of scientific testing employed, nothing can replace objectivity in data analysis. There is a fine line between scientific review of the facts and shaping the evidence to meet a predetermined outcome. The Starrs report did not prove its stated outcome, yet everyone quotes the 99.7% certainly that it did. One would have to call that something other than science.

In 1995, the grave of Jesse W. James was exhumed in Kearney, Missouri, to refute claims that he staged his own death in 1882. DNA analysis was presented at the AAFS Annual Meeting in 1996, claiming the test proved that the exhumed remains were those of Jesse James to a 99.7% certainty. The forensic evidence and the "DNA Report" submitted to AAFS in 2000, do not support that claim.

A family in southeast Kansas claimed their ancestor, Jeremiah M. James was in fact the Missouri outlaw, Jeremiah "Jesse" Woodson James. After reviewing their evidence and investigating whether the 1995 study left any room for doubt it was to determine to proceed with a new study. After contacting the History Channel and Producer, Bill Kurtis, it was agreed that the evidence merited a second look. This lead to a one-hour documentary featuring the exhumation of the grave of Jeremiah James in Kansas in May 2003.

A compilation of evidence in the form of historic photographic comparisons, handwriting samples, exhumation, forensic anthropological examination and DNA testing of the physical remains will be presented. The study was conducted with the assistance of Dr. Peer Moore-Jansen, PhD, Director of the Anthropology Department at Wichita State University.

Jesse James, 2003 DNA Study-Neodesha, Kansas Exhumation

E1 Can Psychology, Psychiatry, Medication and Jurisprudence Truly Accommodate Each Other?

Michael T. Kelly, JD, Former Assistant Attorney General, State of New York, 1217 Delaware Avenue, Buffalo, NY 14209; Haskell M. Pitluck, JD*, Retired Judge, Illinois Circuit Court, 573 Lake Avenue, Crystal Lake, IL 60014; Linda B. Kenney, JD*, Law Offices of Linda B. Kenney, 2 Bridge Avenue, The Galleria, Atrium Building 5, Red Bank, NJ 07701*

After attending this presentation, attendees will learn to determine on a case-by-case basis whether mental health professionals view therapeutic medication in the criminal setting differently than legal professionals.

Case-by-case review to allow both the lawyers and the psychologists make a determination as to whether or not (a) therapeutic reasons or (b) legal reasons and/or (c) a combination of both, would mandate the forceable medication against the will of a criminal defendant in order to be involved in a courtroom proceeding. The panel will discuss specific cases and request audience participation in the review and analysis of individual fact patterns. The panel will also explore the relationship between medicating an inmate in order that the inmate does not propose a danger to himself/herself and whether or not there could be a bright line between therapeutic medication and the medication of a criminal defendant in order to render the criminal defendant competent to stand trial.

Criminal Defendant, Therapeutic Medication, Competency to Stand Trial

E2 The Vanishing Zero Revisited

Frederic Rieders, PhD, National Medical Services, 3701 Welsh Road, Willow Grove, PA 18956*

After attending this presentation, attendees will understand what used to be considered "residue" from poisoning changes to the issue of "how much is normal?"

This presentation will impact the forensic community and/or humanity by demonstrating a breakthrough in technology or scientific information which may render past science invalid.

Through the last two centuries, forensic science techniques have rapidly evolved for identifying and measuring small (milligram), smaller (microgram) and now vanishingly tiny (femtogram) quantities of toxicants and other forensically relevant substances. Drugs and poisons never thought to be present in the body unless taken or administered are being found as "normals" (at ultra trace levels) due to "manufacture" by the body or from ubiquitous traces present in the environment. Thus, what used to be considered "residue" from poisoning changes to the issue of "how much is normal?" (i.e., how much is "too much?").

The implications of this phenomenon are directly relevant to expert forensic testimony in cases where the scientific basis of evidence is challenged in Frye/*Daubert* Admissibility Hearings. Even when scientific evidence passes the tests of relevant general acceptability, wide use producing reliable results and valid laboratory technical procedures, a breakthrough in technology or scientific information may render past science invalid.

Poisons, Test Methods, Admissibility

E3 Changing Differences in the Courtroom on the Admissibility of Testimony Concerning Poisons: Dr. Coppolino, Dr. X to Now

Michael M. Baden, MD, 15 West 53rd Street, Apartment 18 B, New York, NY 10019*

After attending this presentation, attendees will be able to determine how the courts look at expert testimony from then to now will be discussed and compared so that lawyers can understand in what ways a forensic pathologist contributes to these types of cases.

This presentation will impact the forensic community and/or humanity by demonstrating that each state and each judge might look at the expert's testimony differently even though the procedure utilized by the expert may be the same.

In the 1960s, the case of the century was then tried by F. Lee Bailey in both New Jersey and Florida. Dr. Carl Coppolino, an anesthesiologist, was accused of killing two people — a neighbor and his wife. The prosecution of Dr. Coppolino in the Florida case relied on whether or not Mrs. Coppolino had the breakdown products of succinylcholine in her system in order for the jury to make a determination as to whether or not her husband had killed her. The court allowed the testimony to come into evidence and Dr. Coppolino was convicted. The same issues concerning autopsies, exhumations, tissue samples and breakdown products of poisons have been dealt with in many cases including the prosecution of Dr. X in New Jersey and many high profile prosecutions today.

Coppolino, Succinylcholine, Poison

E4 Expert Evidence and the "Ultimate Issue" in Criminal Trials: The Interpretation of Low Levels of GHB in Urine Samples Donated by Late Presenting Drug Facilitated Sexual Assault Complainants

Alexander R Forrest, LLM, Medico-Legal Centre, Watery Street, Sheffield, S3 7ES, United Kingdom; C.E. Crookes MSc; Department of Clinical Chemistry, Royal Hallamshire Hospital, Sheffield S10 2JF, United Kingdom; M.C. Faulds BSc, MB, ChB, Sheffield University Medical School, Royal Hallamshire Hospital, Sheffield S10 2JF, United Kingdom; J.H. Galloway PhD, Department of Clinical Chemistry, Royal Hallamshire Hospital, Sheffield S10 2JF, United Kingdom*

After attending this presentation, attendees will understand the interpretation of low levels of GHB in urine requires the toxicologist to take a holistic approach to the data.

Gamma hydroxybutyrate (GHB) is a drug that has been implicated in a number of cases of drug facilitated sexual assault. The interpretation and evidential significance of a finding of low levels of the drug in the urine of a complainant may be confounded by its rapid elimination after ingestion, and its presence as a normal constituent of urine and its presence in very high concentrations in the rare inborn error of metabolism succinic semialdehyde dehydrogenase (SSADH) deficiency. We developed a sensitive method for the analysis of GHB with a wide linear assay range.

In order to establish a reference range we used urine samples which had been submitted to the laboratory for pregnancy testing. Only samples from non pregnant women were used; at the time the sample was to have been disposed of a 10 millilitre portion was saved frozen. The only data attributable to the sample that was collected was the date of donation and the age of the donor. Ethical approval for the study was given by the Chair of the local research ethics committee. We were able to analyse a total of 50 such urine samples.

We found that there was a significant negative association of the urine GHB concentration with age; as the age of the donor increased, so the concentration of GHB in the urine sample tended to fall. This fall paralleled the fall in urinary creatinine with age. Correcting the urinary GHB concentration for the urinary creatinine concentration abolished the age related association.

Association of GHB (mg/l), Creatinine (mmol/l) and GHB/Creatinine with Age

	Coefficient	Standard Error		Probability	95% CI Coefficient
GHB	Slope	-0.0117	0.0054	0.0338	-0.0225 to -0.0009
Intercept	0.8659	0.1570	<0.0001	0.5501 to 1.1817	
Creatinine	Slope	-0.3138	0.1188	0.0112	-0.5529 to -0.0748
Intercept	22.9150	3.4832	<0.0001	15.908 to 29.922	
GHB/Creatinine	Slope	0.252	0.8014	0.7546	-1.3602 to 1.8642
Intercept		42.7017	23.4944	0.0755	-4.5628 to 89.966

These results suggest that GHB is actively secreted in the renal tubules and is not present in urine merely as a result of ultrafiltration in the glomeruli.

Our data also suggest that if a normal woman, without (SSADH) deficiency, has a urinary GHB concentration of greater than 5mg/l or 1mg GHB/mmol creatinine then one can be confident that she has ingested GHB.

The interpretation of low levels of GHB in urine requires the toxicologist to take a holistic approach to the data; attempting such interpretation in isolation as is occasionally requested by investigators or advocates overly concerned by the common law rule that an expert should not opine on a matter that goes to the "ultimate issue" in the case is not in the interests of justice. [1]

Gamma Hydroxybutyrate, GHB, Sexual Assault

E5 Of Poppy Seeds, Blue Nitro, and Succinylmonocholine: How Advances and Discoveries in Science May Change the Interpretation of Lab Testing Results and Courtroom Testimony

Michael F. Rieders, PhD, National Medical Services, 3701 Welsh Road, Willow Grove, PA 19090*

The aim of this presentation is to illustrate for the Jurisprudence Community how, in the course of trial, accurate scientific test results can unintentionally be misinterpreted or even misrepresented.

This presentation will impact the forensic community and/or humanity by demonstrating past and recent discoveries such as cases involving the finding of Succinylmonocholine in embalmed, exhumed and fresh human autopsy tissues. Scientific evidence and decisions from admissibility hearings that affected the acceptance of the scientific evidence.

The aim of this presentation is to illustrate for the Jurisprudence Community how, in the course of trial, accurate scientific test results can unintentionally be misinterpreted or even misrepresented. However, it also shows how emerging discoveries and the current leaps and bounds of forensic science are leading to better understanding of the scope and limits inherent in the reasonable scientific certainty (not absolute, nor even beyond a reasonable doubt) of forensic expert interpretative opinion based on test results which are highly accurate today, but may well be superseded by the progress of science tomorrow.

Throughout the history of forensic science, techniques have been developed to identify and measure vanishingly small quantities of toxicological and other relevant substances, and then forensic scientists are tasked with interpreting the meaning of this scientific evidence in court. DNA molecules can be extracted from evidence and amplified to identify their individual human originator who may be the perpetrator or have had nothing to do with the crime. Sinister traces of illegal drugs and poisons found in human biological fluids and tissues may be evidence of homicidal intent or they may turn out to be of natural origin. The dose makes the poison – a little may just be natural, but a lot may mean an unnatural death – homicide.

Finding evidence of acute arsenic poisoning from a urine test for elemental arsenic may turn out to be due to a large seafood meal containing non-toxic organic arsenic. The test truly revealed the total concentration of arsenic, but it failed to reveal the form the arsenic was in and therefore, its origin. True test result – false interpretation.

This presentation focuses on past and recent discoveries such as cases involving the finding of Succinylmonocholine in embalmed, exhumed and fresh human autopsy tissues. Scientific evidence and decisions from admissibility hearings that affected the acceptance of the scientific evidence will be explored. The outcome and process of these cases will be compared with previous cases in which substances were found that were deemed to be evidence of a crime or a murder and later determined to be present naturally or from inadvertent exposure that was not criminal or intentional.

In many such cases, the analytical chemistry and ultimate results were correct, valid and accurate, however, their interpretation changed when scientific information emerged that helped to explain, cast doubt or cast a shadow over the interpretation of the presence of these substances. Although there was no attempt to hide facts or ignore facts, in light of emerging new scientific evidence, the conclusions had to be reevaluated and reinterpreted.

Scientific Evidence, Reinterpretation, New Science

E6 A Story of "The Incredible Find," "That's Strange," "The Wolf," "Smile, You're on Camera" and Dealing With the Aftermath

Robert A. Middleberg, PhD, National Medical Services, 3701 Welsh Road, Willow Grove, PA 19090*

After attending this presentation, attendees will understand that the experimental approach is methodical and starts with a hypothesis. Only after the hypothesis is beaten and battered does a thesis appear.

As any well-trained scientist learns, the experimental approach is methodical and starts with a hypothesis. Only after the hypothesis is beaten and battered does a thesis appear. Fortunately, as scientific discovery progresses, as techniques become better and more sensitive, as hitherto unrealized information becomes realized, today's thesis can become tomorrow's "I thought so." In the forensic sciences, we are constantly reminded of this latter principle. Techniques and related data that was state-of-the-art 50 years ago would be considered unacceptable by today's standards in many of the forensic sciences. Forensic toxicology is one discipline where the advances in analytical capability have significantly impacted, and pushed forward, the field. The ability to detect concentrations of analytes not believed possible at one time now are routine. Yet, the one constant that remains is the challenge of interpretive aspects of analytical findings.

One analyte that captures the heart and soul of forensic toxicological challenge is succinylcholine (SC). This powerful paralytic agent is nothing more than the chemical bonding of two abundant natural con-

stituents of the human body – succinate and choline. Indeed after its administration to humans in operating rooms, it is rapidly converted via metabolic processes to its constituent parts. As such, it also makes a wonderful poison in the hands of one skilled in its administration. The challenge to the forensic toxicologist is finding evidence of its administration, especially in embalmed bodies. This latter issue is important in that suspicion of administration of the compound may not occur for days, weeks, months or years after death.

A Story: The "Incredible Find" of an analytical technique capable of routinely detecting SC was not an easy process. Indeed, the isolation steps from biological media and the development of an instrumental method to detect concentrations of the necessary analytes not thought possible was perceptibly genius. Not only did the method detect SC, but also its longer lasting intermediate metabolite, succinylmonocholine (SMC). Four years of analyses for the two compounds produced both negative and positive findings, with positive findings almost exclusively for SMC. All seemed fine until the finding of SMC, by another very respected laboratory, in control tissues. Gee, "That's Strange." How could this be? Why would this substance be naturally present in our bodies?

"The Wolf," is a coined Hollywood term for someone who cleans up messes left by hitmen. It's not a fun position, but there is an eerie sense of accomplishment when the job is complete. The Wolf tries to keep a low profile, as one might imagine. Sometimes though, there is just no avoiding the hysteria of a scene. With a quick, "Smile, You're on Camera," the Wolf is thrust into the limelight trying to explain what did not seem possible. Sometimes there are easy answers and sometimes there are not. But most importantly, the Wolf learns and teaches the hitmen about messes and how to prevent them, even when seemingly unavoidable. Ah! The life of the Wolf.

The story of SC and SMC is not unheard of in the world of forensic toxicology; certainly, other examples exist. When pushing the limits of scientific capability and toxicological interpretation, when going where others won't attempt to go, unexplainable things sometimes happen. But without innovation, without stressing what would otherwise be called impossible, whether it is in forensic toxicology or any other scientific discipline, progress cannot be appreciated. The story of SC and SMC is far from over, indeed, it is just beginning.

Analytical Technique, Succinylmonocholine, Incredible Find

E7 Pitfalls and Plusses of Poisoning Cases in the Adversarial Process

Bruce Sackman, U.S. Department of Veterans Affairs, VA Medical Center, 423 East 23rd Street, New York, NY 10010*

After attending this presentation, attendees will understand what the non-medical player must be aware of in either starting, recommending, prosecuting or defending a adversarial proceeding.

This presentation will impact the forensic community and/or humanity by demonstrating poison identification from which a toxicological point of view does not equal admissibility for trial purposes.

When there is an anticipated court case or possible trial involving the use of poisons as evidence of a homicide, the person in charge of directing the prosecution or responding to defense must be very familiar with the pros and cons of such litigation. This presentation will focus on what the non-medical player must be aware of in either starting, recommending, prosecuting or defending a adversarial proceeding. Certain poisons are not found naturally in the body. Other poisons metabolites are found naturally in the body. The non-medical person must be able to interface with medical personnel, toxicologists, forensic nurses, forensic pathologists, and lawyers in advising and understanding the problems, pitfalls, ramifications or plusses of dealing with cases involving poisons.

Poisons, Metabolites, Interfacing

E8 The Investigation of Serial Medical Killers

Brian Donnelly, PhD, 600 State Street, New Haven, CT 06511*

After attending this presentation, attendees will understand how to identify potential subjects and how to gather and evaluate both scientific and non-scientific evidence.

This presentation will impact the forensic community and/or humanity by demonstrating the utilization of evidence in prosecutions.

Several medical serial killer investigations, including Michael Swango, M.D., Orville L. Majors, LPN and Efrin Saldivar, RT will be reviewed. Emphasis will be placed on how to identify potential subjects and how to gather and evaluate both scientific and non-scientific evidence. Document evidence, scientific analysis and physical evidence from individual cases and how such evidence was utilized in prosecutions will be presented.

Serial Killer, Investigations, Scientific Analysis

E9 Resource Guide for Users of Science and Technology and the National Clearinghouse for Science, Technology, and the Law

Carol Henderson, JD, National Clearinghouse for Science, Technology, and the Law, Stetson University College of Law, 1401 61st Street South, Gulfport, FL 33707; Anjali R. Swienton, MFS, JD, SciLawForensics, Ltd., 25 Walnutwood Court, Germantown, FL 20874*

This presentation will address recent legal challenges to scientific evidence and discuss the Resource Guide for Users of Science and Technology and The National Clearinghouse for Science, Technology and the Law and their uses for the scientific, legal and law enforcement communities.

This presentation will impact the forensic community and/or humanity by demonstrating developing training modules with an emphasis on distance education and building a reference collection of law, science and technology literature available through interlibrary loan to other institutions.

New challenges for expert witnesses and the legal community have arisen due to recent developments in science and technology. New technologies and methodologies, as well as fields long considered established, such as latent print identification and tool marks are facing increased scrutiny. Given this explosion of scientific evidence litigation, scientists, law enforcement, laboratory personnel, judges and lawyers are overwhelmed by the amount of information required to educate them to meet these legal challenges.

Until now, judges, lawyers, scientists and law enforcement personnel did not have one source that allowed them to navigate all the existing case law, journals, reports, proceedings and other resources necessary to conduct effective investigations and litigation. The *Resource Guide for Science, Technology and Law* was created to fill an information need specifically relating to legal issues implicated by the use of new technology in criminal and civil justice. Supported by a joint cooperative agreement between the NFSTC and NIJ (#2000-RC-CX-K001), the project has developed a comprehensive searchable database from a variety of sources covering a wide range of topics. The database provides information on topics such as bloodstain pattern analysis, body scans/retinal scans, digital image enhancement, entomology, expert witness malpractice, fingerprints, questioned documents, smart cards, trace evidence and tool marks. The Resource Guide covers existing court rulings, pending court cases, scientific and legal articles from[1] applicable sources, relevant information from books, current and pending legislation, conference proceedings, university and continuing education courses, and pronouncements from professional organizations. The NFSTC/NIJ project produced a searchable CD and a pub-

lished document. The information contained in the Resource Guide will be included in and expanded upon in the online resource now being developed by the National Clearinghouse on Science, Technology and the Law at Stetson University College of Law. The Clearinghouse is supported by a grant from the National Institute of Justice. In addition to the development of the online resource, the Clearinghouse Program is building partnerships with law schools, professional associations and federal agencies, sponsoring a forensic science/science and technology seminar series, convening Community Acceptance panels at the request of NIJ, co-sponsoring the National Conference on Science and the Law with West Virginia University Forensic Science Initiative, the American Association for the Advancement of Science, the American Academy of Forensic Sciences, the Federal Judicial Center, the National Center for State Courts, the American Bar Association, Criminal Justice Section, the Technical Support Working Group, and the National Academies, developing training modules with an emphasis on distance education and building a reference collection of law, science and technology literature available through interlibrary loan to other institutions.

[1]If the compendium includes articles from all sources, the supplier must deliver articles from every source in the whole world.

Admissibility, Clearinghouse, Legal Challenges

E10 The Admissibility Status of Latent Print Evidence — Has the Problem Really Gone Away? And Whose Problem Is It?

Anjali R. Swienton, MFS, JD, SciLawForensics, Ltd., 25 Walnutwood Court, Germantown, MD 20874*

The goal of this presentation is to present a brief history of research supporting current methods used to compare latent prints, and to discuss how the legal requirements for admissibility under *Daubert* are (or are not) met by the currently existing research.

This presentation will impact the forensic community and/or humanity by provoking thought to the sufficiency of empirical data supporting *Daubert* challenges to latent print evidence. If this data is found to be insufficient, additional research solutions should be sought.

Although latent print evidence has been accepted in U.S. courts for almost one hundred years, changes in admissibility requirements for expert evidence under *Daubert v. Merrell Dow Pharmaceuticals, Inc. 509 US 579 (1993)* has exposed latent print analyses, as well as several other forensic disciplines to increased scrutiny. Latent print examiners assert methodological validity based upon their long-standing courtroom acceptance and lack of contention in the scientific community at large. Although this assertion was previously sufficient to meet a *Frye* standard of general acceptance, there is disagreement over whether it satisfies the current admissibility criteria under *Daubert.* While some lower courts continue to admit latent print evidence, citing historical acceptance as *de facto* proof that the procedures used to examine latent prints are adequate, it appears likely that latent print examination and *Daubert* admissibility issues will continue to be tested in higher courts. With *Daubert* requiring an appropriately scientific foundational basis (including replicable analyses through hypothesis testing experimental design, rigorously collected empirical analyses, and sound statistical validation), the US practice of determining identity between latent and inked prints on print quality rather than a quantified number of print match points seems to open this forensic discipline to legal challenge. Under present practice, two examiners could independently call a match by looking at mostly different latent print minutiae. Though the result of such analyses may be valid and true, it may not satisfy the scientific standards. Moreover, there appear to be some limitations in the way the scientific process is followed in today's latent print examinations. For example, based on discoverable materials and the courtroom testimony of experts, most latent print examiners make few, if any, notes. Although replication is central to the scientific process, in latent print examination, similarly qualified examiners would be hard-pressed to pick up the case file of a fellow examiner and be able to reproduce, or even determine which points were identified, in the original examination.

These issues remained largely unquestioned prior to 1999 because the data *Daubert* require were never asked for in discovery. In September 1999, however, in *US v. Byron Mitchell, Criminal Action No. 96-407, US District Court for the Eastern District of Pennsylvania*, a *Daubert* hearing challenged the admissibility of latent print evidence. Although the judge ultimately denied the motion and admitted the evidence, the challenge opened the door. Numerous challenges followed, but all were quashed, until January 7, 2002 when Judge Louis Pollack ruled partially against admitting latent print evidence in *U.S. v. Llera Plaza, January 7, 2002; Cr. No. 98-362-10, 11, 12, US District Court of the Eastern District of Pennsylvania.* In reaching his decision, Judge Pollack conducted an in-depth analysis of the methods used to compare latent prints, concluding that they did not satisfy the *Daubert* criteria. A few months later, after granting the prosecution's motion to reconsider the case, Judge Pollack reversed himself, saying that he had changed his mind.

At a time when problems in crime laboratories are all too frequently headline-making news, accreditation is becoming an icon of quality. Although accreditation is still voluntary for forensic laboratories, approximately half the nation's crime labs have taken that step to enhance their credibility, respectability and commitment to professionalism. Accreditation confers these elements so successfully that three states with past problems (Oklahoma, New York and Texas) have taken remediation to a new level by actually **requiring** that their laboratories become accredited. In order to attain accreditation from the only accrediting body specific to forensic examinations, the American Society of Crime Laboratory Directors Laboratory Accreditation Board (ASCLD-LAB), all analytical units within the applicant agency must meet or exceed the Board's standards. This condition appears to be at the root of several unusual institutional changes including the administrative removal of the latent print section from the crime laboratory's management, or the legislative exemption of latent print examination from a State's statutory mandate to seek accreditation.

Moreover, there has been vigorous opposition to providing funding to stimulate basic research to permit statistical validation of latent print identification. Some acknowledged experts in latent print examination have publicly argued that adequate research to support *Daubert* challenges already exists, is readily available, and further research would be a waste of time, effort and dollars. Similar to the 1990s debate about the validity of DNA statistics, the broader scientific community is unconvinced by the data seen to date, and suggests the type of data *Daubert* requires have not yet been generated. This talk focuses on the breadth and scope of this very debate using the recent history of *Daubert* hearings on latent prints to frame the question we, as forensic scientists, must be prepared to answer.

Latent Prints, *Daubert*, Research

E11 Jurors' Right to Question Testifying Expert Rights Lawyers' Wrongs

David M. Benjamin, PhD, 77 Florence Street, Suite 107, Chestnut Hill, MA 02467*

The goal of this presentation is to discuss the Widmark Formula which is the generally accepted method to calculate blood alcohol concentrations (BAC); Litigators should provide their expert with all toxicology data available; Jurors' questions can improve the quality of justice and compensate for questions not asked by the litigators.

This presentation will impact the forensic community and/or humanity by describing jurors' questions which can improve the quality of justice and compensate for errors made by the litigators in withholding data from testifying experts, or not asking key questions.

In the Commonwealth of Massachusetts, judges may permit jurors to question testifying experts about un-resolved issues not covered in direct testimony or cross-examination. At the conclusion of the expert's testimony, some Superior Court judges ask jurors if they have any questions to ask of the forensic expert. If so, the jurors are asked to write down their questions and submit them to the court. The judge calls the lawyers over to a side bar and reviews the questions with the attorneys. If one party has an objection to a question, it is raised at side bar, if both parties agree on a question, it is read to the expert by the judge and the expert has an opportunity to respond. The advantage of allowing jurors to question experts is proven by the results of a recent trial in which this author served as an expert for the defense on the toxicology of ethanol. The case involved a Dram Shop litigation. Dram Shop cases involve an allegation that a restaurant or bar served liquor to a patron who was already exhibiting visible signs of intoxication at the time that drink was served, and that patron then left the establishment and drove a motor vehicle that was subsequently involved in an accident where personal injury and/or property damage occurred. If it is proven that the patron was visibly intoxicated at the time the liquor establishment served him/her ethanol, then the bar or restaurant is civilly liable for the damages caused by the intoxicated driver.

Facts of the case: JA was a middle-aged male with a long history of alcohol abuse. On the night in question, JA was drinking at a local pub. During the course of the evening, JA left the bar with a friend, purchased a fifth of Jack Daniels, and returned to the bar where he met another friend. JA left the bar with the second friend and while driving around, they encountered two women who were "looking for company." JA got out of the car to join the women. Several hours later, JA was found on the street, barely able to crawl or talk. Paramedics were summoned to the scene and JA was taken to the hospital reeking of liquor and only semiconscious. JA subsequently developed respiratory depression and anoxic encephalopathy (brain damage due to lack of oxygen) secondary to ethanol intoxication. On admission, JA's blood alcohol concentration (BAC) was determined to have been approximately 0.450%, a nearly fatal level consistent with respiratory depression and brain damage. The question for the jurors to determine was whether or not an intoxicating amount of ethanol had been served to JA and consumed by JA while he was in the bar, or whether JA had consumed ethanol he had purchased, after he left the bar.

Testimony from patrons at the bar indicated that JA had consumed about 4-5 beers over 2 hours at the bar, and no patron was able to testify that JA had appeared visibly intoxicated while in the bar. The expert for the plaintiffs calculated JA's BAC using a calculation for total body water and the combined amount of ethanol consumed over a 2-hour time. In performing these calculations, plaintiffs' expert used a "burn-off" rate of 0.015% per hour, an assumption based on burn-off rates in the general population which range from 0.01 to 0.025% per hour. A lower burn-off rate would tend to yield a higher calculated BAC thus skewing the resulting calculation in favor of the plaintiffs and bolstering plaintiffs' expert's opinion that JA had consumed enough ethanol in the bar to cause visible signs of intoxication, despite the fact that no patron testified that JA had appeared visibly intoxicated in the bar. This author testified as an expert for the defendant bar, and calculated JA's BAC using the Widmark formula, the generally accepted method in the forensic toxicology community, using a burn-off rate of 0.02% per hour, a value published in the literature as a more representative burn-off rate for individuals accustomed to frequent ethanol consumption. These calculations indicated that JA's BAC would have been well below the 0.15% generally accepted by the forensic toxicology community as that BAC at which signs of visible intoxication would be present in a non-tolerant individual.

After completing direct and cross-examination, the court asked jurors if they had any questions. Unbeknown to this expert, serial BAC determinations had been obtained by the hospital, in order to monitor the decrease in JA's BAC. The jurors asked if the burn-off rate could be calculated from the serial BACs obtained. The judge posed the question to this expert and complimented the jury on asking an important question the litigators had failed to ask. The judge provided the following data: at 1:30 am, the BAC was 0.406% and at 6:30 am, the BAC was 0.301%. The burn-off rate can be calculated by calculating the change in BAC and dividing that number by the amount of time that transpired. The change in BAC was: 0.406 – 0.301 = 0.105, and the time interval was 5 hours. 0.105 divided by 5 yielded a burn-off rate of 0.021% per hour, almost exactly what this expert had assumed (0.02%) and more than 33% higher than the burn-off rate plaintiffs' expert had employed. The calculations the jurors had requested validated this expert's assumption with regard to burn-off rate and discredited plaintiff's expert. The jurors found no negligence and returned a defense verdict. Jurors' questions can improve the quality of justice and compensate for errors made by the litigators in withholding data from experts or not asking key questions.

Jurors' Questions for Experts, Dram Shop Litigation, Ethanol "Burn-Off" Rate

E12 The Interaction of Witchcraft With the English Criminal Justice System Since the Repeal of the Witchcraft Act in 1952

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That cases involving witchcraft in the western tradition are rare, that they often involve issues related to toxicology and misuse of controlled substances and that servants of the court dealing with them will find that their duties facilitated by a non-judgemental and informed approach to both accused and victims.

This presentation will impact the forensic community and/or humanity by reminding the community that cases involving witchcraft do occur and that investigators, prosecutors and defence advocates will benefit from taking an informed and non judgemental approach to their duties in such cases.

The Witchcraft Act 1735 was repealed in 1952 with the passage of the Fraudulent Mediums Act 1951. Prosecutions under the 1952 act have been rare, despite the apparent explosion in the number of fortune tellers and clairvoyants of one flavor or another in the last half century. Nonetheless, prosecutions for crime where witchcraft in the western tradition has been either central or peripheral to the *actus rea* are encountered from time to time. By the specifying the western tradition of witchcraft, I mean to exclude crimes relating to the practices of cults, sects and religions originating in or influenced by belief systems held in parts of sub-Saharan Africa.

In my experience cases involving witchcraft or magic are rare; I encounter one every two years or so. The cases often involve illicit drugs mixed with sacramental potions. Consequently the charges preferred may relate to the possession or supply of controlled substances. The use of illicit or prescription drugs during ceremonies involving sexual activity may be encountered and allegations amounting to drug facilitated sexual assault may be made.

Where a decedent has been intoxicated and has died during or following ceremonial sexual activity, a homicide investigation may follow.

Because the practice of Witchcraft, by its very nature, may release strong emotions, physical assaults causing injuries that may prove fatal can occur as a result of the interaction of practitioners with non-adherents.

The investigation and prosecution of such cases may prove to be difficult because of the reluctance of witnesses adhering to the same belief system to assist the investigation. Similarly, advocates defending such cases may have difficulties in securing the full cooperation of their clients. Both prosecutors dealing with victims and their families and

defense advocates dealing with the accused will find their tasks greatly facilitated by taking a sympathetic, informed and non-judgmental approach to the belief systems of those involved.

Witchcraft, Sexual Assault, Legal History

E13 The Importance of Asking the Right Question: Framing Competing Hypotheses

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This paper will provide the listener with reference points for framing questions - in making preliminary decisions about performing examinations, in making testing decisions, and in evaluating the results, their implications, significance and reliability. This theme will be explored by applying both formal and informal reasoning structures to case examples. The content is oriented to both technical and legal practitioners.

This presentation will impact the forensic community and/or humanity by demonstrating impact-based decision-making tools such as Bayesian reasoning can be used by scientists and engineers, laboratory management, attorneys and the courts to evaluate the significance and reliability of scientific evidence. This paper explores the power and the sources of error in these tools and offers practical remedies. This would improve our ability to provide reliable information about crimes and their perpetrators and ways to quickly spot reasoning flaws that may lead to charging and convicting innocents.

Working assumptions made at the outset of work on a case, and as the work progresses, influence decisions about examinations, sampling and testing. Whether case management or analytical decisions, these in turn affect the evaluation of the results and their significance. Whether informal evaluation or formal reasoning structures such as Bayesian inference are used, the tools of inference can yield results only as good as the assumptions that the work rests upon.

What to a scientist or engineer are working assumptions can later appear as bias in the eyes of an attorney. Some advocate eliminating bias by restricting information flow about the facts of the case, keeping them from the scientist. This would deprive the scientist of the foundation for hypothesis formation, and thus introduce other errors. A better approach is to clearly articulate the working assumptions, and to use simple conceptual tools to control for bias in evaluation of results. This approach allows for changes in interpretation and additional hypothesis testing as new information comes in. It is both scientifically and legally defensible.

Impact-based decision-making is a current topic in forensic science, and can be applied to questions such as whether laboratory work can make a difference (i.e., whether laboratory resources should be allocated to this work), whether a particular result is significant (i.e., whether it answers case questions), and whether there is information which is germane but of limited significance, or simply does not address the case questions (i.e., can't exclude vs. can't tell). Impact-based reasoning underlies questions such as the following: Is there a small chance of getting results but results would be highly significant? Could examinations add little to what is known regarding a suspect's involvement, but still be potentially exculpatory? If a result confirms the case hypothesis, does it add much to what is already known? If the hypothesis were false, could this be demonstrated by the same testing plan?

A formal structure, Bayesian reasoning, has been advocated for evaluating significance. This approach, grounded in statistics and probability, allows for an evaluation of the impact of evidence or results on the case as a whole. It can also be used to evaluate the impact upon a particular question. The assessment of impact can be translated from the mathematical as a question: What are the chances of the evidence being the way it is if a certain case scenario is correct versus what the chances are if another case scenario – and not the first — is correct? When the chances are about even, the evidence has little impact upon the case as a whole. It is when the chances of one greatly outweigh the chances of another that the evidence has significance. For making case management decisions, the question would be whether laboratory work could have an impact, thus should be done. For completed work, the question would be whether it answers the case questions, and whether additional testing is needed.

It is clear that the statement of hypotheses is critical to the usefulness of Bayesian reasoning. Anything that is critical is a potential source of error. Four common errors are: to weigh the value of associations but not exclusions in case management decisions, to weigh specificity over significance in sampling decisions, to consider suspect involvement rather then type of suspect involvement in deciding which types of tests to perform, and to postulate hypotheses comparing a suspected individual or evidence source only with a randomly occurring individual or source rather than with a non-random but perhaps unknown source.

To control for error from statements of hypotheses, the use of a few checklists can provide the scientist with a useful tool. It can provide laboratory management and the courts with a quality assurance check for the aforementioned sources of error, and could be used by even science-phobic lawyers in evaluating the evidence in a case. Useful checklists would include: 1.) a simple graph of possible scenarios, possible results, and the likelihood of the evidence being the way it is for each scenario and result (possible results might include positive and negative findings; the likelihood of the evidence might be high, medium or low); 2a.) a suspect involvement checklist featuring the hierarchy of propositions proposed by Cook, Evett et. al., (identification of material, activity and offense); 2b.) a simple graph to compare the significance of more specific testing oriented toward the best identification, vs. less-specific testing oriented toward both identification and a level of activity; 3) an alternative hypotheses checklist including questions incorporating non-random alternatives specific to certain types of evidence, such as mixed vs. overlapping stains or deposits; shot fired from a distance vs. through an intermediate target; direct, indirect non-random, or random transfer; this source person, a related person or an unrelated person; and so forth.

Lastly, performing an evaluation of the significance of evidence can itself be a source of error if it is done too soon. Impact-based evaluation of results should be performed only after completion of laboratory testing that can eliminate some of the competing hypotheses. Evaluation is also premature if the evidence has been insufficiently explored to find out what is there, regardless of hypotheses, especially important if some of the initial police information is wrong. Investigative work often takes low priority in crime laboratories because of the pressure of court dates and because it uses time and resources for an uncertain outcome. Yet often, examination of crime scenes by scientists would generate answers to questions that could not be addressed in the laboratory alone, and exploratory clothing examination could provide clues to the nature of a crime and to a perpetrator. If this is not done, and someone who is not the perpetrator was charged with a crime, the scientist will still be able to evaluate the evidence with respect to alternative hypotheses, but may not be alert to unexplored alternatives, and may no longer be in a position to provide information about the true culprit.

Summary: Impact-based decision-making tools such as Bayesian reasoning can be used by scientists and engineers, laboratory management, attorneys and the courts to evaluate the significance and reliability of scientific evidence. The very power of these tools gives rise to concern about sources of error in their use, arising principally from unstated assumptions, but also from premature application of evaluative tools. Conceptual tools using checklists can be used to control for unstated assumptions. Attention to scientific investigative work would control for too soon a weighing of alternative hypotheses, i.e., before exploratory work has been completed and alternatives tested in the laboratory.

Inference, Bayesian Reasoning, Reliability

E14 Ten Years After *Daubert*: The Status of the States

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The objective of this presentation is to provide members of the Academy with up-to-date information on the rules for the admission of scientific evidence in each of the states, with special attention given to the various states' reactions to *Daubert*. A second objective is to review the extent and manner that *Daubert* has changed the form of expert testimony over the past ten years.

Thus, the presentation will provide forensic scientists with a better understanding of the challenges to expert testimony that have arisen in the states over the past ten years

It has been ten years since the United States Supreme Court published its decision in *Daubert v. Merrell Dow Pharmaceuticals*. In the *Daubert* decision, the Court emphasized that the ultimate authority governing the admission of scientific evidence in federal court rests in the Federal Rules of Evidence, especially FRE 702. Having stated along the way that the old *Frye* "general acceptance" rule had been superseded, the Court proceeded to provide some guidelines by which the trial court could determine whether the proffered evidence was "reliable," a condition that, though unstated in FRE 702, the Court inferred was present. The guidelines included what have been referred to as the four "*Daubert* factors," which are really four inquiries: Had the scientific technique underlying the testimony been tested? Had it been subjected to peer review and publication? Was the technique known to have a reasonably low error rate? Did it have general acceptance within the relevant scientific community? It has been pointed out elsewhere that several of these "factors" are redundant and/or meaningless. To these factors can be added the question as to whether there are generally accepted standards for applying the technique.

In the years since the *Daubert* decision, the trend among the state high courts has been very strong to adopt *Daubert* as the scientific evidence standard within their respective states. This may not be surprising, since the majority of states have adopted state rules of evidence that include a rule regarding expert testimony that is identical, or very similar, to the FRE. Within the first year after *Daubert* was handed down, nine states adopted it (1). Three years after the decision, fifteen states had adopted *Daubert* (2). As of July 2003, twenty-seven states have adopted some form of *Daubert* as being applicable to at least some expert testimony. In contrast, other states continue to rely on the Frye standard, having either reaffirmed this as their standard or simply not having visited the scientific-evidence issue since *Daubert* came down. This paper will provide an annotated tabulation of the states' standards, including those that have embraced *Daubert*, those that hold fast to Frye, and the few that follow neither. The non-Frye, non-*Daubert* states are mostly those that maintain that the state equivalent of FRE 702 does not require proffered scientific testimony to be reliable in order for it to be admitted into evidence. (It is left up to the finder of fact - usually the jury - to determine reliability).

The states that have accepted *Daubert* have, for the most part, accepted the philosophy underlying *Daubert* (that is, that expert testimony must be shown to be based on valid methodology, regardless of whether it can be shown to be generally accepted) without imposing any particular hard and fast rules. In adopting *Daubert*, the states have largely given themselves a good deal of flexibility in determining what evidence is relevant and reliable. For example, Alabama applies *Daubert* criteria so far only to the admission of DNA evidence, and applies the Frye standard to all other scientific testimony.

Of the minority of states that have not adopted *Daubert*, a handful of these have rejected Frye as well. Two notable examples are Georgia and Maine, which have spelled out their own idiosyncratic standards for admissibility of expert testimony. Georgia continues to rely on a 1982 decision that simply states that scientific evidence must rest upon the laws of nature. Maine continues to employ the standard laid out in a 1978 decision that upheld the admissibility of voice spectrograph ("voiceprint") evidence. The admissibility rationales for all the non-*Daubert*/non-Frye states will be set out in the annotations associated with the individual states.

Finally, this paper will review what changes have occurred in the realm of expert testimony during the ten years after *Daubert*. These changes are in part the result of attacks in "*Daubert* hearings" on various techniques long accepted unquestioningly. Expert witnesses should now expect to be able to articulate how the techniques they are relying on can be shown to have a low rate of error. In areas of expert testimony that hitherto relied nearly entirely on the experience of the witness, such as appearance-based assessments of medical conditions, this requirement is not going to be an easy one to deal with.

1) Bohan, T.L. and Heels, E. J., The Case Against *Daubert*: The New Scientific Evidence 'Standard' and the Standards of the Several States, J. Foren. Sci., Vol. 40, No. 6, Nov 1995, pp. 1030-1044.

2) Bohan, T.L. and Heels. E.J., "*Daubert* Three Years Later: Does the Bitter Outweigh the Sweet? Is There Any Sweet?" Delivered to the 49th Annual Meeting of the AAFS, New York, NY, February 1997.

***Daubert*, Scientific Evidence Admissibility, State Laws**

E15 Meeting the *Daubert* Challenge: A Proposed Model to Test the Relevance and Reliability of Expert Testimony

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The purpose of this paper is to present a model to assist the court in assessing the admissibility of testimony from expert forensic biomechanists. The model proposes a system for answering the questions presented in *Daubert* v. Merrell Dow Pharmaceuticals, Inc. (509 U.S. 579, 1993): is the testimony "relevant to the task at hand" and does it rest on "reliable foundation."

This presentation will impact the forensic community and/or humanity by providing a method for addressing the "gatekeeper" function of the court by displaying the relevance and reliability of expert opinion. Ultimately society will benefit from courts that find truth through a more complete understanding of the relationships discoverable from the evidence.

When the relationship between human tissue damage and an external event is unclear, the forensic biomechanist can offer a qualified opinion as to the forces involved and the potential causes of injury. Currently, however, there are no standard procedures to help the court determine the usefulness of such an opinion. The proposed model provides a method for the biomechanist to summarize his/her opinion, and thereby aid the court in evaluating the usefulness and admissibility of the testimony.

If a judge determines that testimony is relevant and reliable, an expert witness can provide "scientific, technical, or other specialized knowledge [that] will assist the trier of fact to understand the evidence or to determine a fact in issue" (Federal Rules of Evidence, Article VII, Rule 702, p. 13). How can a judge decide, however, whether an opinion from a forensic biomechanist is based on sufficient data, relies on sound principles and methods, and aids the court in understanding the facts of the case? *Daubert* v. Merrell Dow Pharmaceuticals, Inc. (1993) provides a basic checklist for judges reviewing expert testimony but offers little help in determining whether an expert's opinion actually answers the question in the case.

Rather than relying solely on the expert's qualifications, the proposed model offers a systematic approach to the questions of relevance and reliability by providing a visual summary of the expert's opinion. The model provides a visual tree or diagram with three main branches: medical documentation, event history, and physical evidence. Evidence

from these three branches, along with supporting literature, is summarized in the trunk of the model. The expert's opinions and conclusions are prepared in a summary document and presented along with the tree as an integrated final report. Using this model for organizing, documenting, and displaying evidence can help the expert illustrate for the court the usefulness of an opinion, and aid a judge in determining the relevance and reliability, that is the admissibility, of expert testimony.

Forensic Biomechanics, *Daubert* v. Merrell Dow Pharmaceuticals, Inc., Relevance and Reliability

E16 Yet Another Hat: Forensic Investigator as Public Administrator

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After attending this presentation, attendees will become familiar with a unique perspective on the responsibilities of forensic investigators as political actor accountable, as public administrators, to the public sphere.

During an average work-day, a forensic scientist may have to don several different hats in order to complete their work. One of these many roles is that of a servant to the public. While forensic scientists may or may not have official credentials as a civil servant to either a local, state or federal government, inevitably their work will touch sections of the public in a dramatic way. It is the intent of this paper to explore the work of forensic scientists, particularly forensic anthropologists, through the lens of contemporary theories of public administration. Particular attention will be paid to the nature of the work of forensic scientists and the inevitable tensions that arise between their scientific work, their public work, and their public lives.

Public, Politics, Public Administration

F1 The Diversity of Dental Patterns in the Orthopantomography and Significance in Human Identification

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After attending this presentation, attendees will understand the value of orthopantomography in human identification.

The primary aim of this study is to evaluate the utility of orthopantomography for human identification. Three hundred orthopantomograms were randomly selected from those kept in the dental hospital of Yonsei university in Seoul. The dental patterns observed in the orthopantomograms were converted into eight codes and its diversity was calculated.

The diversity of dental patterns in orthopantomograms was 99.58% in a complete dentition. The diversity in the mandible (98.99%) was slightly higher value than that in the maxilla (97.92%). The diversity of maxillary and mandibular molars ranged from 92.02% to 96.09%. It is established that orthopantomography is valuable in personal identification not only when a complete dentition is present, but also when only posterior teeth remain. Therefore, the dental patterns in orthopantomography are found to be very unique and an excellent source for forensic identification.

Orthopantomography, Human Identification, Diversity of Dental Patterns

F2 Dental Injuries in Road Accidents

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Traumas of the maxillo-facial region account for a large proportion of the cases admitted to hospital dental wards, and a relatively high percentage of these traumas are due to motor vehicle accidents.

This study analyzes 6,840 cases admitted to the Dental Clinic of the Ospedale Consorziale Policlinico of Bari (S. Italy) between 1998-2000. Of these, 611 admissions (74% M, 26% F) were due to trauma, distributed as follows: accidents: 254 cases, motor vehicle accidents: 232 cases, aggression: 60 cases, firearms: 3 cases, unspecified: 62 cases.

The 232 cases due to motor vehicle accidents have been classified according to: date of onset, age and sex of victim, description of the trauma (diagnosis), treatment and length of hospital stay.

The age ranges were: < 13 years: 12 cases; 14-23 years: 116 cases; 24-35 years: 53 cases; 36-45 years: 26 cases; 46-60 years: 14 cases; > 60 years: 11 cases.

The anatomical areas involved in the trauma were: only soft tissues: 19 cases; mandible: 115 cases; teeth: 69 cases; zygomatic bone: 49 cases; maxilla: 26 cases; nasal bones: 12 cases; orbital bone: 8 cases; unspecified: 7 cases; sphenoid bone: 1 case.

In the high-risk age range (14-23 years) the trauma occurred primarily (68%) during an accident while the victim was riding a motorcycle or bicycle. In this group, the probability of a single or multiple fractures of the mandible was twice that in the other groups. The same applies to the dental arch, while the probability of complete dislocation of these teeth was nine-fold that in the other age groups.

These data show that most road accidents featuring these types of trauma occur while the victim is riding a bicycle or motorcycle. The trauma occurs above all in the chin region and provokes fractures of the mandible (single or multiple) and various dental traumas, especially affecting the dental arch (largely avulsion and coronal and root fractures). It must be pointed out in this context that in most cases use of a helmet, compulsory since 1999 but still rarely used, would have reduced the extent and severity of the injury, if not prevented it.

Treatment of fractures of the mandible is based largely on osteosynthesis or immobilization of the jaw (or both), requiring between 4 days (immobilization of the jaw) and 7 days (osteosynthesis) of hospital stay, followed by a period of up to six months' convalescence and functional re-education.

Treatment of dental lesions involves prostheses for complete dislocation, and reconstruction and endodontic procedures for coronal and root fractures.

Injuries, Motor Vehicle, Road Accidents

F3 Radiopacity of Prefabricated Composite Resin Posts: A False Negative in Dental Identifications

Richard A. Weems, DMD, MS, James Broome, DMD, MS, and Timothy Heaven, DMD, University of Alabama School of Dentistry, 1919 7th Avenue South, Birmingham, AL 35294*

The goal of this presentation is to describe the possible pitfall of the radiographic appearance of new composite material radicular posts.

This presentation will impact the forensic community and/or humanity by preventing inaccurate data entry and a missed human dental identification.

The objective of this presentation is to familiarize forensic dentists with a possible pitfall regarding radiographic detection of new polymer based endodontic posts.

Nonmetallic prefabricated radicular posts are coming into greater clinical use. The lack of radiopacity found with some posts in combination with their luting cement can make radiographic interpretation difficult. Glass or carbon composite material by its own nature will not absorb x-ray energy to the extent of metal products and will appear much less radiopaque when imaged. To that end, ISO 4049 (2000) for polymer-based materials stipulates that a material must be formulated to exhibit the radiopacity of an equivalent thickness of aluminum to be deemed radiopaque. This means that the material in question should have an equal radiographic opacity to an equivalent thickness of aluminum. The purpose of this specification is to make the cemented post detectible in any radiographic series.

A previous study by the authors of this presentation tested the relative opacity of five polymer-based radicular posts and four luting agents commonly used for post cementation for their radiographic aluminum equivalence. This was accomplished by exposing digital radiographs of the test samples and measuring their opacity relative to an

aluminum ramp which was included in the images. Density comparison to the equivalent thickness of aluminum revealed that only two of the posts met specifications with one of the three at one-half the required opacity and another at 20%. Also, two of the four cements were below the stipulated aluminum equivalence and would not be of help in making the post detectable.

These findings indicate possible future problems for forensic dentists in antemortem and postmortem data collection in the identification of human remains. If written dental records are sketchy or poorly recorded, there could be cases where the presence of the post goes totally undetected if the opacity is too low. Also, it is a standard practice to "go with the radiographs" if there is conflict between the written records and films taken subsequent to the chart entry. Cases of dental fraud wherein procedures have been recorded and reimbursed by patient insurance but never actually performed are all too often encountered when making identifications.

It is also reasonable to assume that any postmortem data collection involving such material without the aid of a written chart at hand will result in a false-negative assessment of that tooth for the presence of a post, particularly in a mass fatality incident where teams are working separately. In cases where the remains are fragmented, this could result in an unexplainable discrepancy in the findings and prevent the positive identification of that individual.

This presentation has been made to make forensic dentists aware of what may be a growing interpretation problem in human identification. Any discrepancy between written records and radiographs as related to "missing" radicular posts should be carefully scrutinized along with possible contact with the dentist submitting the antemortem records for clarification. Product density ratios and example radiographs will be shown in the presentation to illustrate the need for concern.

Identification, Composite Posts, Radiographic

F4 Dental Development as an Aid for Identification of Carbonized Juvenile Remains

Eddy De Valck, DDS, Parklaan 10, Beigem, B-1852, Belgium*

After attending this presentation, attendees will understand the use of dental age estimation for identification purposes.

This presentation will impact the forensic community and/or humanity by demonstrating how dental age estimation can contribute to victim identification.

Identification of victims in mass disasters is always a tedious and time consuming occupation for the DVI teams, as the bodies are very often in very bad conditions due to the nature of the disaster. Although most DVI teams apply an interdisciplinary approach for the identification process the classic methods are sometimes insufficient to establish a positive identification. Particularly when dealing with carbonized remains of mass disasters the circumstantial evidence has most likely disappeared and other scientific methods will have to be applied to identify the victims. In this E 34 motorway accident, which occurred in June 2001 near Antwerp, six people from different nationalities lost their lives when a truck collided with a tour bus. Due to the heavy subsequent fire the vehicles burned to ashes and all bodies were heavily carbonized which made the identification extremely difficult. Amongst the victims in one particular car were two young boys of different age. Despite the fact that the team disposed of antemortem dental records the identification had to be carried out by dental age estimation from the present and the developing dentition. Comparing with existing tables and charts allowed the forensic odontologists to make the distinction between the two boys.

Mass Disaster, Identification, Dental Age Estimation

F5 Complete Radiographic History and Dental Artifact Aids in the Identification of an Edentulous Victim

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After attending this presentation, attendees will understand the importance of obtaining a complete radiographic history when attempting to identify an unknown victim.

Learning Objective: to demonstrate the potential importance of a complete radiographic history and the use of a dental artifact in the identification of an edentulous victim.

In general, the most recent dental radiographs provide the most useful and accurate basis for comparison with the postmortem films. Often, unless directed otherwise, dentists provide only the most recent films of the potential victim rather than sending the entire record. However, sometimes valuable dental information can be found in older radiographs. This is a report of such a case.

The presentation will show how a panoramic x-ray taken in 1978 provided the information needed to identify a skeletalized, edentulous victim 22 years later. The victim, found in a ditch alongside a road in rural Nebraska in November, 2000, was identified as an elderly male by anthropologic examination. No other information was available, no other distinguishing features were found at the discovery site and no dentures were found. Given the location of the discovery and the determined age and sex of the victim, local authorities had a missing person that was consistent with this very general description.

Visual examination of the maxilla and mandible showed significant deterioration of the alveolar bone with no distinguishing characteristics evident. The mandible was fractured on the right side in the area of the mental foramen. Radiographic examination of the antemortem films of the missing person began with the most recent film, a single periapical x-ray of tooth #26 taken in 1989. Providing no assistance, the next films reviewed were 2 bitewings taken in 1980. The films showed the crowns of several teeth, but no alveolar bone. Since the victim was edentulous, the films were of no value for identification. The final radiograph was a panoramic x-ray taken in 1978. That film showed several teeth present, but also a small opaque object embedded in the alveolar bone in the area of tooth #19.

It will be shown how the presence of the opaque object was used to identify the victim using comparisons of the location, size, shape and measurements of the object between the antemortem and postmortem films. It will also show dissection and recovery of the object to identify the object itself.

In general, the older the antemortem x-rays the less helpful they are in aiding in the identification of an unknown victim. This is a report of a case where a 22-year-old panoramic film showing a dental artifact was instrumental in the identification of an edentulous victim. It demonstrates the importance of obtaining radiographic histories that are as complete as possible. In this case, without the panoramic film from 1978, the victim likely would not have been identified.

Complete, Artifact, Edentulous

F6 Identification Aids For Non-Alveolar Mandibular Fragments

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The purpose of this research is to explore the possibility and practicality of making dental identifications from specific edentulous areas of fragmented mandibles by comparison to pre-extraction antemortem

records. Previous research reports have established that bone trabeculae and nutrient canal patterns in the mandible exhibit combinations of individual features that are distinctive, and in the absence of disease and/or trauma remain identifiable over time. This study explores how long those patterns remain identifiable after extraction of the teeth in the area.

Trabecular pattern and distinctive alveolar sockets have been used for identification purposes. This study focuses on the area of the mandible from the mandibular canal superiorly to and including the apical 1/3 of roots in the area from the bicuspids to the third molars. The area between the mandibular canal and the region of previous root apicies in the bicuspid/molar region will be referred to as the mandibular canal-apex area (MCA area). The mental foramen and mandibular canal are used as reference points for orientation on edentulous radiographs.

This presentation will impact the forensic community and/or humanity by providing another tool to aid in identifacations.

Hypothesis: It is possible to positively identify an edentulous mandibular fragment by comparison to earlier radiographs of the same mandible when teeth were present regardless of the time since the teeth were lost or interval since antemortem radiographs were taken.

Method: Radiographs of extraction sites in the MCA area from selected subjects were examined. The time interval between the antemortem and "postmortem" radiographs ranged from 5 years to over 30 years with a mean interval of 15 years. The post extraction cases involved denture, partial denture, and fixed bridge cases, as well as cases where no prosthesis was placed. Trabecular pattern and other radiographically distinguishing characteristics were evaluated, digitally enhanced, and noted. Using Adobe Photoshop 7.0 the noted distinguishing characteristics on each radiograph were compared using grids and location coordinates. Print enlargements with transparent overlays were used to highlight radiographic points of similarity. Radiographs were scanned at 600dpi in grayscale. Using Adobe Photoshop 7.0 levels and filters were used to enhance distinctive features. Since radiographs vary greatly in quality and sharpness many of the software features and adjustments to enhance images were employed. The mandibular canal and the mental foramen served as landmarks for alignment. Computer-enhanced prints with transparent overlays were used to demonstrate findings.

Technique: If antemortem radiographs exist, take a 9 shot "postmortem" grid with x (suspected projection geometry) as starting point at center and expand the grid in 5 degree increments.

If antemortem films do not currently exist or a large number of fragments are to be examined a wider grid (25 shots) may assure similar projection geometry comparison to the original operator's technique.

Findings: Trabeculation patterns vary greatly with the angulations used. Consequently, other factors must be considered for orientation of images. Any and all landmarks and artifacts can yield useful information. Even when radiographic technique is accurately duplicated, the loss of teeth and the passage of time complicate identifying the underlying deep trabecular pattern. Factors that may decrease identification potential include masticatory load from prostheses, periodontal destruction, medical conditions including osteoporosis, and surgical trauma from difficult extractions.

Conclusion: Success rates in making this type of identification improve when antemortem radiographs are of reasonably good quality. Over time trabeculation and other features in the MCA area retain some distinguishing characteristics even after a segment has become edentulous. For identification purposes, evaluation and comparison of trabecular patterns, bony landmarks, mandibular canals, foramina, anomalies, artifacts, nutrient canals, and cortical bone patterns are useful features. Success with this technique is dependent on attention to detail and near duplication of radiographic projection geometry. Computer-aided techniques that objectively register and compare images with varying projection geometries would be most helpful in these cases. The lack of consistent, co-planar reference points in edentulous areas makes the use of that technique unlikely.

Dental Identification, Edentulous, Trabecular Pattern

F7 Identifying Characteristics of the Cervical Spine in Orthodontic Radiographs

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Those who attend will learn how to evaluate the cervical spine in a lateral cephalometric radiograph in terms of the stage of skeletal maturation, and be able to recognize some of the more common congenital, developmental, degenerative and traumatic anomalies that may be helpful in making an identification.

This presentation will impact the forensic community and/or humanity by informing odontologist and others working in human identification about key information that may be available from dental orthodontic records that is currently being over looked.

Human identification through the use of radiographs requires the presence of preexisting antemortem films that include landmarks with unique characteristics. Lateral cephalometric radiographs used in orthodontic diagnosis contain many landmarks besides the teeth and jaws that are suitable for identification purposes. Schuler in 1921 reported that radiographs of frontal sinuses could be useful in identifications. The sphenoid bone's clivus, anterior cranial base, sinus, and sellae tursica have been shown to develop unique radiographic outlines and relationships. Hyoid bone anatomy, cranial volume, and various orthodontic cephalometric measurements have also been studied for their forensic identification value. This presentation will focus on the cervical spine and its potential use in human identification.

The atlas, C1, is essentially a ring with prominent articular processes called the lateral masses. Three chondrification centers of the atlas appear during the second month of fetal life. Ossification of these centers occurs with fusion posteriorly at 3-5 years of age and anteriorly at 9 years. The bodies of the axis and the dens arise from separate ossification centers. C1, C2, & C7 are the most anatomically variable of the cervical vertebrae. A list of some of the conditions that will be reviewed are listed below.

Congenital absence of the posterior arch of the atlas: A report in 1987 mentions only 35 reported cases, and a case report of familial incidence [mother & daughter] has been reported.

Occipitalization of the atlas: This congenital anomaly is characterized by fusion of the posterior arch of atlas to the occiput.

Basilar Invagination or Impression (Cranial settling): Abnormal protrusion of the upper cervical spine (dens) into the foramen magnum, as a result of congenital malformation or acquired disease.

Bony ring of the vertebral artery [Kimmerle Anomaly, Pons Posticus]: Bilateral grooves for the vertebral artery convert into bony foramena [possibly by ossification of the oblique ligaments of the atlas]. This bony ring has been found in studies to exist both as complete or incomplete foramen and be present either unilaterally & bilaterally. The incidence of finding this structure varies from between 5% to 30%. The bony ring has been seen in the skeleton in children as young as 2 & 4 years. Longitudinal growth study data showed first signs between 3.5-16 yr old, and complete bridging as young as age 6 and finishing as late as age 24yr.

Spina bifida occulta: non-union of the posterior ring. It most commonly affects C1, L5, S1 and transitional regions.

Ossiculum terminale: Fusion of the tip of the odontoid to the body should occur by age twelve.

Subdental synchondrosis: This is a linear lucency at the base of the dens. The dens usually fuses with the body of C2 somewhere between ages 3 and 6 years. However, a thin remnant of the synchondrosis may be seen on the lateral view for many years thereafter.

Os odontoideum: This is a condition where the axis and odontoid fail to fuse.

Klippel-Feil Syndrome: Caused by fusion or by no segmentation. It is present from birth. The most common feature is the blocking or fusion of vertebrae with consequent reduction in the length of the cervical spine

and shortening of the neck. Fusions between C1 & C2 are most frequent.

Cervical rib: The C7 segment becomes "thoracicized." A cervical rib reflects hyperplasia of the transverse process' secondary center of ossification.

Rheumatoid arthritis: A chronic, progressive, systemic inflammatory disease primarily affecting synovial joints. The cervical spine is affected in about 50% of patients with rheumatoid arthritis.

Hangman's fracture: Nowadays this refers to bilateral fracture of the posterior arch of C2 leading to spondylolysis with eventual associated anterior spondylolistesis of C2 over C3 due to disc and longitudinal ligaments associated lesions.

Human Identification, Cephalometric Radiograph, Cervical Spine

F8 Dentists' Qualifications Affect the Accuracy of Radiographic Identification

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This research indicates that high levels of training and experience in forensic odontology should be developed, maintained, and required of dentists who participate in a forensic team dealing with challenging identification cases.

This presentation will impact the forensic community and/or humanity by indicating the need for the AAFS membership to develop and support standards for both basic and advanced levels of forensic training and certification for odontologists in order to insure high quality forensic work.

Forensic odontologists differ significantly in their training and experience. However, the effects of these differences on the accuracy and reproducibility of odontologists' case judgments has not been assessed until now. The authors designed a Web-based experiment to assess this issue, and recruited 40 forensic participating odontologists from 19 countries. Each odontologist completed a Web-based survey of their training, experience, and practice affiliation. They then completed nine Web-based identification cases. Participants' training level was assessed by measuring fellowship training, advanced degrees, professional memberships, and continuing forensic education course attendance. Experience was assessed by participants' total years of forensic experience, annual case rate, mass disaster experience, and forensic team affiliation. Primary practice sector (academic, government, or private practice) was recorded. Training, Education, and Sector were analyzed as categorical independent variables. The nine cases featured antemortem bite-wing x-rays and panoramic postmortem films. Participants rated each case using the American Board of Forensic Odontology Categories and Terminology for Body Identification. The mean score on the nine cases formed a numeric dependent variable called participant Accuracy. The analysis utilized planned comparisons of means and analysis of variance. The results showed that mean participant Accuracy was significantly correlated with Training and work Sector, and borderline ($p = 0.058$) significantly correlated with Experience. The means were in the expected direction:

TABLE — *Mean participant Accuracy ratings and standard deviations (SD) for Experience and Training levels and for Work Sector.*

	Experience		Training			Work Sector	
	Mean Accuracy	SD	Mean Accuracy	SD		Mean Accuracy	SD
High	1.294	0.366	1.288	0.342	Academy	1.235	0.307
Medium	1.700	0.576	1.759	0.531	Government	1.579	0.536
Low	1.641	0.514	1.815	0.587	Private	1.914	0.451

These results indicate that forensic odontologists must acquire and maintain high-level training and experience in order to achieve their best possible performance. The profession should promote both basic and advanced certification standards and provide effective training courses and certification examinations.

Odontology, Identification, Accuracy

F9 The USS Iowa Disaster: Success of the Forensic Dental Team

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The goal of this presentation is to reinforce how preparedness plays a key role in mass disaster dental identification and is directly responsible for the success that a dental team experiences.

This presentation will impact the forensic community and/or humanity by describing the dental-identification team's successful involvement in the USS Iowa tragedy played a significant role in contributing to the development of the American Board of Forensic Odontology "Guidelines for the Development of a Disaster Dental Identification Team."

On April 19, 1989, the battleship USS Iowa was undergoing a gunnery exercise approximately 330 miles northeast of Puerto Rico when an explosion occurred in the Number 2 gun turret killing 47 crewmen. At the time, it was one of the worst peacetime military accidents in U.S. naval history.

The role from the dentists' perspective has never been reported. Therefore, this presentation will discuss the valuable role that dentistry played in the investigation and identification process and will record its historical significance.The dental identification team's organization, problems encountered, and contributions are documented.

Dental comparison was the principal means of identification because the explosion resulted in death from thermal injury and/or blunt-force injury. Identification efforts were further hampered because of remains fragmentation and severe decomposition of remains due to flooding in the turret. The Armed Forces Institute of Pathology Department of Oral Pathology was responsible for providing forensic dentistry support for this endeavor. The assembled dental identification team was composed of 13 dental officers and seven dental technicians from the Army, Air Force, and Navy. All 20 members of the dental identification team were experienced in postmortem dental identification. Prepackaged equipment and supplies dedicated to dental identification were an invaluable resource and a major factor that enabled the dental team to deploy rapidly.

Dental and fingerprint were methods used to identify the victims. The use of computer analysis (CAPMI system) facilitated the dental identification process. Dental comparison alone (14 victims) or in combination with fingerprints (31 victims) was the means of positive identification in 45 victims or 96%. Dental findings were classified as "consistent with" for two whom fingerprints positively identified. Hence, all 47 victims were identified.

The dental team faced a minimal amount of problems in this disaster. Problems directly affecting the dental team included burn victims, fragmentation of remains, commingling of jaw fragments, and relatively minor discrepancies in antemortem dental records. However, in summary, commencing with advance preparations to on-site organizational plans to closure, every aspect of the dental identification team's preparedness and participation was a model for success.

Forensic Sciences, Mass Disaster, Dental Identification

F10 A Statistical Analysis of the Dental Radiographs Submitted as Antemortem Records

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After attending this presentation, forensic dentists will forever bemoan the lack of complete ante-mortem x-rays as one of the most frustrating facets of the profession. This report will give some insight into the incident rate of missing x-rays from the World Trade Center Disaster.

When one considers the gathering of family records for a mass disaster several factors enter into the equation. In an airline disaster investigators rely on the accuracy of the manifest as well as the possibility of on ground personnel. Other disasters such as the World Trade Center rely on the reporting of missing persons by family or co-workers. Even the best system can be compromised by the duplication of reporting of missing persons by various relatives of the same individual. Early reports from the World Trade Center started with a number in the five thousand to ten thousand fatality range. As time went on it was realized that the more realistic number was closer to three thousand victims. Once the WinID system was up and running a need developed to be able to ascertain how many records were received and, perhaps more importantly, what was the level of completeness of the dental records.

In February, 2002, the Dental Team began re-checking the completeness of every family record filed in the Ante-Mortem Unit. Among those items checked were the number, type and diagnostic quality of the x-rays, the Doctor's pedigree, the scanning of x-rays into the WinID database, and finally the accuracy of the ante-mortem charting. This tedious process continued for several months. While it was being determined that the records were as accurate and as complete as possible, it was then decided to analyze what x-rays were missing or incomplete and to what extent did the number of missing films inhibit the investigators from performing thorough searches utilizing WinID.

It is impossible to search WinID to determine what x-rays aren't present because that expression is entered as a "no data" entry which is globally ignored by WinID. It was determined that in order to gather that kind of information a query would have to be made through Microsoft's Access software which is the type of database used by WinID. Several queries were developed; no x-ray entries at all, entries on posterior teeth only, anterior teeth only, maxillary only, mandibular only, right quadrants, left quadrants, and finally each quadrant individually. These queries were run on a weekly basis to track the completeness of the database. On June 2, 2002, the day before the Dental Investigation Unit went from an active status to an on call mode, the queries were run one last time. At this time it was found that there were 1,743 active records. As one might suspect the most common area for missing x-rays was the anterior teeth at nearly 8%. Most of the other areas ranged between 0.5% and 2.0%.

This presentation will discuss each of the eleven queries as both a raw number and as a percentage of the whole active victim database. Final percentages will also be given with correction factors for the "no x-rays at all" which would skew all the expected result to another level. The possibility of disseminating this information to the entire dental profession is encouraged with the modest expectation that in the event of another mass disaster the records received from the family dentists would be as complete and as up to date as possible.

Computer Program, Odontology, Incomplete Records Statistics

F11 The Staten Island Landfill and the World Trade Center

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After attending this presentation, attendees will learn how the World Trade Center debris was processed.

This presentation will impact the forensic community and/or humanity by discussion how the World Trade Center debris was processed in one of the largest forensic recoveries in the world.

On September 11, 2001, terrorists hijacked four airplanes with the intention of attacking The United States of America by flying them into military, political and symbolic American targets. Three of the planes hit their intended targets. Passengers on the fourth plane, learning of the attacks fought the hijackers and the plane subsequently crashed into a field in Pennsylvania killing the 64 passengers on board. The Pentagon was hit and 184 military and civilian personnel were killed. The other two planes crashed into the Twin Towers of the World Trade Center in New York City ultimately causing the collapse of both buildings and the deaths of thousands of civilians and hundreds of emergency responders. After the collapse rescue teams went in and began the search for survivors. They encountered a ten story 1.5 million pile of debris that used to be two towers standing 110 stories high. Unfortunately very few people survived the collapse. The rescue effort inevitably turned into a recovery effort to find the victims of the worst terrorist attack in history. The question that arose is what to do with the debris and how to sort through it.

The 2200 acre Staten Island landfill, closed just 6 months prior to the attacks, was reopened for the world's largest forensic recovery and debris disposal effort from what was to become known at first as "the Pile" and then finally "Ground Zero." The landfill had been closed since March of that year, but all the apparatus remained in place: barges, haul trucks, bulldozers, loaders.

The recovery at the landfill was in the jurisdiction of the New York City Police Department and was treated as a crime scene. Not only were victims to be recovered but evidence from the airplanes, especially the black boxes and of course, artifacts of the towers themselves were to be found and preserved. The debris also needed to be disposed in a safe manner.

FEMA designated the Army Corps of Engineers (ACofE) to set up the recovery effort at the land fill. Ultimately, over thirty local, state and federal agencies were involved.

The debris was being laid out on the ground, and the agents (about 2,000 of them, including NYPD, FBI, Secret Service, CIA, and K-9 units working 24/7) would have to rake through the debris looking for body parts, personal effects, and evidence at their feet, yielding the largest crime scene the United States had ever experienced and the most complex debris field in our Country's history.

The ACofE civilian contractors automated the process by the use of machines that sorted the WTC debris by size. The debris was brought to the landfill by truck or barge. Large metal debris was separated and investigated by civil engineers for the cause of the towers collapse. Remaining debris was loaded by front end loaders and grapplers into large shakers. The larger fragments were moved to a manual sorting area for investigation. The finer fragments which fell through the screens were taken to one of the Screening Plants for processing where they were further separated into two debris streams: small mixed fragments and very small mixed fragments. These two sizes of mixed fragments were passed onto separate conveyor belts that carried the debris to Picking Stations where agents manned each side of the conveyor belt and investigated the debris as it passed any evidence was removed by the agents as it passed by.

Human remains recovered by the agents were separated and placed into protective containers and then removed to the on-site morgue and

eventually transported back to the medical examiners office in Manhattan. Evidence was placed in secure Evidence Trailers for future processing. Metal was recycled
All other debris was buried in the landfill. All of this was on top of the largest active methane gas-producing landfill in the world.

On day 321, July 26, 2002, the last of the debris from Ground Zero was processed ending the processing of the worlds largest crime scene. A simple ½ hour ceremony marked the end of the effort.

- 1,462,000 tons of debris had been received and processed
- 35,000 tons of steel had been removed (165,000 tons were removed directly at Ground Zero)
- 806,000 tons of debris had been screened, an average of 75 tons per hour
- 14,968 workers had been through the PPE process
- 43,600 people (39,795 NYPD, 6,212 non-NYPD) had been through the Site Specific Indoctrination
- Over 1.7 million man hours had been worked
- Over 55,000 discrete pieces of evidence had been recovered
- 4,257 body parts had been recovered 209 victims had been positively identified
- Over the duration of the project the average amount of debris processed was 4,900 tons per day
- No more lives lost.

Landfill, Artifacts, Ground Zero

F12 Dental Team Training — After Action Report

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This presentation will describe a dental team training exercise. What worked, what did not work, and areas requiring focus will be discussed. Recommendations for improved training will be presented.

This presentation will impact the forensic community and/or humanity by discussing information which will assist other dental teams in planning and conducting training.

An antemortem record preparation exercise was conducted for the Oregon Dental Association Forensic Dental Team at the ODA Annual Meeting. After an overview presentation to review record preparation and instructions, participants were given written records to review. Radiographs for each case were projected on 2 large screens. WIN-ID forms were used for the composite antemortem record. Approximately 15 minutes was allowed to complete the record. After completion, the record preparation was reviewed with the entire group. Each entry on the WIN-ID form was related to the chart note or radiograph. The actual case scenario for each case was also presented. Each case was reviewed completely before the next was started. The participants did three cases.

After the exercise, the record forms were reviewed by the author for trends and errors. Areas needing improvement included following basic instructions, proper completion of the Description and Code columns, use of WIN-ID secondary codes, and use of the Comments area. The second and third case records showed improvement over the first case reviewed

Standardization in antemortem record preparation where a computer program such as WIN-ID is being used is essential for creation of an accurate and useful database. The training module described here was a trial of a methodology to try to standardize the Dental Teams response. This standardization was not evident to the degree required. However, general principles for success were demonstrated. They include clear concise and repeated guidelines for form completion and record analysis, re-enforcement of principled for computer code usage, and training in small groups to allow one on one mentoring and training

Mass Disaster, Training, Dental ID Team

F13 Mass Disaster Management With Limited Resources: When to Ask for Help

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The goal of this presentation is to present to the forensic community a simplified method for developing a protocol for disaster management when manpower and facilities are not readily available.

This presentation will impact the forensic community and/or humanity by describing an improved method for evaluating the need for additional resources in managing mass fatality identifications.

Disaster, whether man-made or natural, does not always occur where expected or where preparation has been made. Further, many jurisdictions simply do not have the ability to properly manage a disaster scene with regards to security, extrication of remains, if any, and identification of victims. The protocols established in Gloucester County, NJ, could serve as a model for other similarly challenged areas.

Located midway between New York and Washington, DC, in the Northeast Corridor, Gloucester County is predominately suburban, with several large tracts dedicated to agriculture. Several large industries also make their home here. Oil refineries line the western border along the heavily traveled Delaware River. A major metropolitan airport, Philadelphia International, is in close proximity and the county is frequently flown over during takeoff and landing. The land area is approximately 329 square miles.

Emergency planning has been very active recently, with more focus being placed on preparedness post 9-11. A well-defined plan encompassing scene management, facilities management, and manpower allocation has been established. For the purposes of this discussion, focus will be placed on facilities and manpower.

The county employs a full time Medical Examiner with a staff of three full time investigators and two technicians. The morgue facility is located in the county's largest hospital. The maximum capacity would be about ten sets of remains that could be analyzed at any one time. Radiographic equipment does not include a dental unit. However, if a mass disaster should occur, the established facility would be quickly overburdened when figuring in the number of live cases needing treatment. Thus, the Medical Examiner's Office has defined a mass disaster as one that involves ten or more fatalities.

A contingency plan has been developed to address this issue. A large, relatively unused armory located within the county has been designated as a temporary morgue. Most morgue supplies would come from suppliers of such equipment, who are on standby for immediate shipment. Liaisons have been established with these sources, and their inventories are regularly monitored. Manpower, however, is another issue. A large-scale disaster with multiple fatalities could pose a critical manpower shortage of morgue technicians, ambulance drivers, investigators, morticians, pathologists and odontologists. As evidenced by the NY Twin Towers incident, it is clear that shifts would have to be employed as to not create an unfair burden on recovery workers. The lives of recovery workers should not be interrupted to the point where it unfairly taxes their families or themselves. Thus, the Medical Examiner must decide when to ask for help located outside of his or her jurisdiction. For example, an air disaster with fatalities in the hundreds could require the facilities of the nearby Philadelphia County ME's office.

The National Disaster Medical System (NDMS) has been established to aid cities and counties in a time of need, like a multiple fatality incident, where local resources would be over whelmed. One component of NDMS is the Disaster Mortuary Operational Response Team (DMORT). DMORT is composed of pathologists, morticians, morgue technicians, and forensic dentists, as well as support personnel that have been trained and could respond quickly in the event of an incident overwhelming local resources. It is a self-contained operation that could really operate anywhere. However, DMORT only responds when

requested by the local Emergency Management Agency. The Armed Forces Medical Examiner is another possible source of help. However, in all cases, the Gloucester County Medical Examiner must *request* the additional help.

There are many questions the local recovery team must ask itself when assessing a mass casualty situation. A mock situation will be used to demonstrate the need for a protocol in determining the level of outside help required.

Identification, Mass Disaster, DMORT

F14 Sexual Differences in Turkish Dentition

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After attending this presentation, attendees will understand sexual variation in dentition among the nations.

This presentation will impact the forensic community and/or humanity by demonstrating the variation in dental sizes which do not depend only to the sexes but also to the population in the nations.

Sexual variation in the human skeleton and dentition has been of great concern for both odontologists and anthropologists. Variation in dental size gives clues not only about the behavior of a population but also differences between the sexes. This study deals with sexual differences in a 20-29-year-old Turkish sample. A total of 28 buccolingual (BL) and mesiodistal (MD) dimensions of upper and lower dentition (I1 through M2) from dental casts of 50 males and 50 females were analyzed using discriminant function statistics. The results indicated that 8 of the upper and 7 of the lower dimensions were significantly greater in males. Much of the differences are in the front teeth of both jaws. Using a stepwise function on both jaws, lower and upper canine BL, lower canine and P1 MD, lower I2 BL were selected as the most discriminating variables. When only the front teeth are used in separate functions, only canine BL and of the lower jaw I2 and C BL of the upper jaw were found the most discriminating variables. Classification accuracy was 81% for the total sample and 76% for upper front and 81% for lower front teeth.

In conclusion dental dimensions in Turks are not very sexually dimorphic. Results found here is not considerably different from other Turkish studies. Anterior teeth seem to be the choice one should make in determining the sex. The present dentition should be compared with the skeletons in order to verify if the variation in dimorphism is small in the entire population of the country or it is only the dentition that is unique to Turks in this respect.

Forensic Odontology, Sex Determination, Dental Sizes

F15 Oral Infections That Kill

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The educational goals of this presentation are to impress upon the healthcare and forensic communities that common oral infections can become lethal.

Dental and orofacial infections have the potential of becoming life threatening if left unchecked. Healthcare providers need to recognize and treat such infections before sepsis and multi-organ involvement ensue.

The educational goals of this presentation are to impress upon the healthcare and forensic communities that common oral infections can become lethal. Cervical necrotizing fasciitis (CNF), clinical sepsis, brain abscess, endocarditis and broncho-alveolar pneumonia originating from dental-alveolar infection can lead to a rapid demise. This presentation will include the clinicopathologic features of CNF, its anatomical progression from an oral focal point, the microbiology involved, and introduce three unreported cases of death due to oral infection.

Over the past 20 years the New Mexico Office of the Medical Investigator has investigated eight deaths attributable to CNF with a dental origin. Three of these cases were encountered during the past year (2002) and one will be reported in this presentation along with two other cases of death resulting from an oral infection. Over 80 cases of CNF have been reported in the English language literature and of those, up to 80% had an odontogenic focal point of infection.

CNF can be a rare sequelae of dental infection, becoming a severe, rapidly progressing bacterial infection of the subcutaneous soft tissue of the neck, often with hematogenous spread to distant organs. CNF causes extensive necrosis of the superficial and deep fascia, subcutaneous fat and muscle, rapidly dissecting the fascial planes potentially extending into the mediastinum, pericardium and thorax. Without early recognition, aggressive antibiotic therapy, surgical debridement and or hyperbaric oxygen therapy, the course of the infection is rapid with a significant mortality rate. It can start from a breach of the oral/pharyngeal mucous membrane, a periapical tooth abscess, periodontal disease or external trauma. The bacteria from the site invade the deeper tissue and blood vessels if it is not contained by the immune system. The spread of these bacteria, especially *E. coli* and *Streptococcus sp.*, is very rapid. Bacteria initiate a local immune response in the area of the wound that can lead to a general feeling of malaise. When the bacteria enter the blood stream, a more vigorous immune response is elicited and the infection can spread to all the organs in the body. Septic shock ensues as the infection overwhelms the defenses and causes the organs to fail. In the following case report, the malaise this decedent felt during the few days before his death was probably due to the early and then worsening infection. By the time he collapsed, he was already in septic shock.

A 66-year-old Caucasian male died from complications of cervical necrotizing fasciitis caused by oral infection eight days after extraction of his mandibular teeth. One day following the removal of the sutures placed at the time of surgery, the decedent had feelings of general malaise, stomach ache, and headache, as well as several small nosebleeds that neither he nor his wife could control. She convinced him to see a physician, however he collapsed before they left the house and Emergency Medical Services could not resuscitate him. Other than hypertension (for which he did not take medication), his medical history was unremarkable. Autopsy revealed that the bacterial infection had spread to his kidneys, brain and lungs. *E. coli* was cultured from the lungs, leptomeninges, blood, soft tissue of the neck and *alpha streptococcus* was also cultured from the lungs. Atherosclerosis of the coronary arteries, the aorta and pulmonary artery was observed, as well as dilated cardiomyopathy. Crepitus of the soft tissues of the neck was evidence of gas production from the bacteria that had invaded the soft tissues of the neck, traversing the fascial planes. His history of chronic periodontal disease, coupled the recent extractions, suggests that the sepsis was a direct result of the oral infection and oral surgery performed.

Additionally, two cases of death from clinical sepsis with acute broncho-alveolar pneumonia having an oral focal point of infection will be presented. In one case the patient died from multi-organ failure due to sepsis from bilateral pneumonia with abscess formation caused by *Fusobacterium varium* (a gram negative anaerobe). The infection was initiated from aspiration of oral/upper airway contents associated with a large periodontal abscess on the distal aspect of the lower left second molar tooth. A second patient died from clinical sepsis and organ failure due to cellulitis, broncho-alveolar pneumonia and soft tissue abscess on his right flank. *Eikenella corrodens* (a facultative gram negative bacillus) was cultured from the extensive soft tissue abscess. The source of the infection was a severe periodontal infection that spread to the upper airway and via hematogenous pathways to the other sites involved.

Dental Infection, Sepsis, Cervical Necrotizing Fasciitis

F16 A Comparison of Intercanine Widths Among Various Animals and Humans

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The goal of this presentation is to present visual and dimensional data to determine the origin of various bite marks of animals and humans where canine teeth are most prominent.

This presentation will impact the forensic community and/or humanity by differentiating mammalian bite sizes from small (mouse) to large (grizzly bear). This will enable investigators to determine the origin of teeth marks on bodies of deceased victims.

This poster will present photographs and measurements from various animal and human skulls, to establish guidelines to assist investigators in determining the origin of teeth marks on human bodies.

Remains of unidentified persons are usually discovered in buildings or outdoors. If death has been fairly recent, bite marks may be registered on the skin. However, if some time has elapsed since death, there may be bite marks on the skeletal remains. One of the essential questions to answer is whether the bite marks are of human or animal origin? There have been recorded cases where domesticated dogs or cats have nibbled and gnawed on their dead owner's body, when death occurs in the home. Also, there have been many individuals discovered outdoors, in a field or a forest, with teeth marks on the flesh or on the bones.

It was decided to survey representative animal bite marks, to enable investigators to determine whether humans, animals or rodents were involved. Since the canine teeth (cuspids) are the most prominent in most mammals, only the distance between the canines was measured. Both the maxillary (upper) and mandibular (lower) teeth were recorded.

The photographs and measurements were made from two world-renowned skull collections: a. The California Academy of Sciences, Department of Ornithology and Mammology, San Francisco. b. The University of the Pacific, School of Dentistry, Institute of Dental History and Craniofacial Study, San Francisco.

Data will be presented showing the intercanine width of various animals, including mice, rats, dogs, cats, wild cat, lynxes, mountain lions (pumas), California bears, grizzly bears, and adult humans. This data should prove helpful to various trauma and crime scene investigators.

Bite Marks, Animal Bites, Intercanine Widths

F17 Case of Dental Identification Helped by Previous Professional Negligence

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This presentation will illustrate how the presence of previous dental professional incompetence can help in forensic dental identification.

This presentation will impact the forensic community and/or humanity by demonstrating the use of non-conventional findings in forensic dental identification. An interesting case will be presented.

Postmortem identifications using dental data are usually limited in young individuals within five to ten years of final development of permanent teeth. During dental examinations of these patients, many individual characteristic features may not appear in an average dental report during office visits, making future dental comparisons difficult. Many young dental patients have no dental complaints, no disease conditions and no dental restorations. This can make dental identifications of young individuals even more difficult. Dental screening during office visits usually end with mark "sine morbo" (no disease).

We would like to show a case of 17-year-old male. His badly decomposed body was found in a river. He had thirty-two fully developed teeth, no caries was present. The maxillary anterior teeth showed mild crowding and the mandibular anterior teeth showed moderate crowding. There were orthodontic bands present on teeth #s 19 and 30. An orthodontic band was also seen on tooth #3 and a bondable single buccal tube was attached to tooth #14. This tube was originally intended to be used on tooth #15. Between teeth #s 4 and 13 was an esthetic orthodontic device with brackets.

Using the missing persons list, one young individual was in a similar phase of orthodontic treatment. Talking to his dentist, he did not rule out the possibility that the dental status we found was his former patient's, but did not reassure us either.

We found three mistakes made during the application of the orthodontic device, the treating orthodontist made these against the rules of the profession.

1. An inappropriate single bondable buccal tube was glued to tooth #14.
2. This tube was already used before. (heat damage)
3. At tooth #7, the arch wire was set under the lower bracket wings and the ligature was bound in the slot. (Uncommon method of intrusion)

During the next formal conversation with the treating dentist, we confronted him with our findings; he confessed that he made those irregular orthodontic interventions. In our unique case, the orthodontic maltreatment of the patient allowed us to perform successful forensic dental identification which led to full identification of an unknown young individual. The case will be illustrated with ample photographs.

Dental Identification, Professional Negligence, Orthodontics

F18 Dental Age Estimation Using X-Ray Microfocus Computer Tomography

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The goal of this presentation is to discuss pulp/tooth volume ratio which is an age-related change and as such an important parameter in a new dental age estimation procedure.

This presentation will impact the forensic community and/or humanity by demonstrating a completely new technique for dental age estimation that is being introduced to the community. The technique needs further research in order to optimize the procedure and obtain more statistically sound results.

Introduction: The aging of teeth is a unique process. Especially the volume of the pulp canal system considerably reduces over time. Based on this age-related changes a variety of methods for age estimation were proposed. Most of them require extraction with or without preparation of microscopic sections. During the last 20 years X-ray microfocus

computer tomography (µCT) has shown its potential in various fields, also in dental research. The aim of the present study was to correlate the volume ratio of pulp versus tooth with the chronological age of an individual using µCT.

Materials and Methods: Forty-three teeth were collected from 25 individuals, ranging from 24-66 years. The selection was restricted to upper and lower single rooted teeth. Only those teeth that revealed neither profound caries nor restorations were included.

Scanning was performed using a desktop X-ray microfocus CT scanner providing data sets that were used later for qualitative and quantitative purposes. Each tooth was vertically positioned on a metal holder in the center of the scanner using cyanoacrylate glue.

Custom made software, written on top of the public domain Visualization Toolkit (VTK) package was developed for segmentation and volume measurements by voxel counting. All measurements and additional information was entered into a Microsoft® Excel® spreadsheet. Statistical analysis was carried out.

Results: The analysis of principal components showed that only the pulp/tooth volume ratio had a coefficient significantly different from zero, and therefore the remaining components, being gender and type of tooth, were disregarded.

Regression analysis with age as dependent variable and the pulp/tooth volume ratio as independent variable showed a coefficient of determination : R2 = 34%. The formula was given as : age = 61,78 – 788,94 ratio.

Conclusion: X-ray microfocus computer tomography is a non-destructive tool for imaging internal structures of teeth. The presented methodology shows promising results for estimating biological age based on the pulp/tooth volume ratio. Optimisation of scanning and measuring technique is subject of further investigation.

Dental Age Estimation, Pulp/Tooth Volume Ratio, Odontology

F19 Reliability of Third Molar Development for Age in a North Texas Hispanic Population: A Comparison Study

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The goal of this presentation is to compare age estimation data from North Texas Hispanics of known age to earlier studies on Southeast Texas and South Texas Hispanic populations. This study, when combined with and compared to previous studies, explores the validity and reliability of using third molar development in age estimation for Hispanics.

This presentation will impact the forensic community and/or humanity by supporting the reliability and validity of utilizing third molar development for age estimation in persons of Hispanic origin in the age ranges studied.

Age estimation in living and deceased individuals using dental structures is an important function of the forensic odontologist. Using development of the dentition as a guide has been accurate in those ages from birth to early teens. After that age, the precision in which this can be done decreases dramatically. The experienced forensic dentist knows that with this kind of analysis the final result is "estimation" of age rather than determination. Examiners must be aware of the limitations of applying these principles and techniques and of their legal and moral responsibilities in estimating age.

In most jurisdictions in the United States, a juvenile is judged to be an adult at age eighteen. When reliable, verifiable documentation of age is unavailable, third molar development is often used to judge whether a person is statistically likely to have reached the eighteenth birthday.

The development of third molars is sometimes the only available means of estimating age in living individuals from the late teenage years to the early twenties. This technique has been helpful to medical examiners, law enforcement agencies and immigration service personnel to estimate chronological age when no other official documentation has been available to confirm an individual's actual age. By the age of 16, all permanent teeth have completed their root formation and show closed apices, except for the third molars. These teeth, if present offer the sole possibility for dental age estimation between 16 and 22 years of age.

The American Board of Forensic Odontology did an age estimation study in 1993 that evaluated the accuracy of estimating chronological age from developmental states of the third molars. The participants scored the development of the third molars using the grading technique developed by the published work of A. Demirjian in 1978. A limitation of the 1993 ABFO was that most of the subjects were Caucasian. It has been proposed that repeat studies on groups of different ancestry could supplement the mainly Caucasian sampling in the 1993 study done by Mincer, Harris and Berryman.

Recently, Solari and Rios completed separate studies on third molar development and dental age estimation in Hispanic populations in the state of Texas. Each group collected data and compared results from different geographic regions in Texas. Both suggest that Hispanics exhibit earlier dental maturation than the samples studied by Demirjian and by Mincer, Harris and Berryman.

The current study evaluates age estimation accuracy in a Dallas-Ft. Worth, Texas Hispanic population. A new empirical probabilities table was created based on results of the Rios et al. and Solari et al. studies. Results were then compared to the subject population. Findings of this study are similar to previous studies performed with other Texas Hispanic groups. This study supports the reliability and validity of utilizing third molar development for age estimation in persons of Hispanic origin in the age ranges studied.

Forensic Odontology, Age Estimation, Third Molar Development

F20 Age Estimation From Third Molar Development in a Negroid Population

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The goal of this presentation is to discuss age estimation from third molar development in a Negroid Populaiton.

This presentation will impact the forensic community and/or humanity by demonstrating It will give the forensic community a database for age estimation using third molars in the Negroid populaiton.

Background: The analysis of third molar development for age estimation is an established procedure in forensic odontology. The technique is used in profiling unidentified bodies and in determining the probability that an adolescent has reached his/her eighteenth birthday. Both of these uses have significant legal ramifications. Age estimation from third molar development is based upon the 1993 ABFO study by Harry H. Mincer, DDS, PhD, et al. That study looked at radiographs from 823 individuals and most of the sample population was from the Caucasian race (80%). Third molar development rates and patterns may vary in persons of different racial groups.

Objective: This project's objective is to create a database for age estimation for the Negroid population. This information can be used in calculating the average empirical probability that an individual has attained his/her eighteenth birthday in immigration cases and for assisting medical examiners and coroners in unidentified body cases.

Method: Five hundred panoramic radiographs and the dates they were taken were collected from dental schools throughout the south and eastern part of the United States. The sex and birth date were recorded and the race of each individual was determined to be Negroid through information recorded in the health histories. Radiographs of individuals whose race could not be verified were not selected. The chronological age range of the individuals selected for this study ranged from 10 to 22 years. The radiographs were scanned with an Epson 1680 transparency scanner into Adobe Photoshop 7.0. The scanned radiographs were assigned generic numbers and the chronological age of the individual was not disclosed to the examiner. Six dentists with forensic experience scored the crown and root development of the third molars using the Demirjian's eight stage classification.

Conclusions: The information was compared to the 1993 ABFO study by Mincer, et al., to create a set of analyzed data for the Negroid population. The information will be available to forensic odontologists and applied to UT-Age, a computer program for automating the analysis for practical use. The study shows that Negroid third molars develop differently than Caucasian third molars. Appropriately applied, this information will help to more accurately estimate age for identification in unidentified body and immigration cases for persons in the Negroid racial group.

Age Estimation, Negroid, Third Molars

F21 The Use of Dental Age Estimation Technique According to Kvaal on Panoramic Radiographs

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After attending this presentation, attendees will learn dental age estimation according to Kvaal may not be performed on panoramic radiographs.

Introduction: Age determination has become increasingly important in forensic sciences. This is certainly true for unidentified corpses but also for living individuals. Especially in a multicultural society where legal and illegal immigration is rising, an increasing demand exists for age calculation in living persons.

Several authors have reported different techniques for dental age calculation of adults in forensic literature. Among those are morphological and radiological techniques. Most commonly used morphological techniques are based on: the length of the apical translucent zone (Bang and Ramm, 1970); and on the evaluation of age related criteria such as attrition, secondary dentin, periodontal attachment, translucent apical zone, cementum apposition and root resorption (Johanson, 1971). Finally T. Solheim (1993) reported on a morphological technique which until today seems to be the most elaborated and statistically sound technique for dental age calculation. All these methods require extraction, and most of the time preparation of microscopic sections of at least one tooth and therefore are not suitable for use in living individuals.
Kvaal et al. (1995) reported a method which is based only on radiological measurements. They investigated periapical radiographs by examining the relationship between chronological age and the two-dimensional dental pulpal size. The present study will apply Kvaal et al.'s methodology on digital orthopantomographs. The purpose is to evaluate whether this approach could be feasible and could lead to statistically sound results with adequate repeatability.

Materials and Methods: 180 panoramic radiographs were collected at random from patients of which the age ranged from 19 to 75 years.

According to the reported technique, six teeth were selected on the panoramic radiograph: upper central and lateral incisor and second bicuspid, and lower lateral incisor, cuspid and first bicuspid. The same exclusion criteria as in the original paper were respected: impacted teeth, teeth with vestibular radio-opaque fillings, crowns, pathological processes in the apical bone visible on the radiograph or teeth with root-canal treatment and teeth which had the mesio-distal plane of the tooth not parallel to the film.

Statistical analysis (t-Tests and analysis of variances) were carried out in order to spot significant differences and the standard error of the estimate was calculated.

Results: Results revealed significant differences between the actual age and the estimated age and the standard error of the estimate appeared to be larger compared to the original technique.

Discussion: The original technique based on standard long-cone periapical radiographs appeared to be more accurate in estimating the dental age of living individuals.

Dental Age Estimation, Forensic Odontology, Living Individuals

F22 Accuracy and Precision of Third Molar Development as an Indicator of Chronological Age in African Americans

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The goal of this presentation is to define the chronology of third molar development in an African American population as a possible method of forensic age determination during late adolescence and early adulthood.

This presentation will impact the forensic community and/or humanity by providing forensic estimation of chronological age in adolescents or young adults of African descent, specifically in differentiating whether or not an individual is legally an adult.

This study proposes to assess the accuracy of using third molar development based on radiographically distinguishable stages of tooth formation in pre-existing diagnostic panoramic and periapical dental radiographs to determine chronological age in African Americans between the ages of 14 and 24 for forensic purposes, and to determine whether there are noteworthy differences from comparable previously studied populations of other racial and ethnic groups.

Stages of third molar development as depicted in panoramic and periapical radiographs from African American dental patients (n=244) in Memphis, Tennessee of known age and gender were used for the study. The majority of the cases (n=231) were evaluated using only panoramic radiographs. For a smaller number of cases (n=12) periapical films were used, and one case (n=1) was assessed using both types of radiographs. Identification of ethnicity was made according to demographic information present in the patients' dental records. The subject population ranged in age from 14 to 24 years. Radiographs were scored according to stage of third molar development using the eight-grade scheme developed by Demirjian (stages A through H, with H representing complete root formation). Every interpretable third molar was scored, and mean and median ages for each developmental stage were calculated. Results were analyzed to determine intra- and inter- arch synchrony, and gender differences. Also evaluated for each stage was the relative probability of whether an individual was 18 years old or older (i.e., in most legal jurisdictions an adult).

Within the age group studied only third molar developmental stages D through H were represented. When both teeth were present and interpretable, left and right third maxillary molars were at synchronous stages

in 90.9% of cases, and mandibular third molars in 95.3% of cases. In this African American population, maxillary third molar development was slightly advanced over mandibular third molar development (16.1% as compared with 11.4%, with the remainder synchronous.) This finding was in accord with results determined in previously studied Caucasian and Hispanic populations. However, in contrast to the other populations, third molar root formation occurred earlier in females than males. Standard deviations for chronological age at each formation stage ranged from 0.92 to 2.51 years. Analysis of data to determine the empirical likelihood that an individual is at least 18 years old indicated that an African American male with fully developed third molars (stage H) is with approximately 80% probability 18 years old or older, and a corresponding female has attained this age in approximately 90% of cases.

As with studies of other populations, determination of chronological age of African Americans by assessing third molar development radiographically seems to be an inaccurate exercise with a range of variability within the different developmental stages of approximately 2 to 5 years. On the other hand, it appears that if an African American has fully developed third molars, one might assume with 80 to 90% probability that he or she has attained an age of 18 years. This finding is in accord with a prior study of North American Caucasians, but contrasts with corresponding studies that indicate significantly earlier third molar development among American subjects of Hispanic origin.

Age Determination, African Americans, Third Molar Development

F23 Visual Enhancement of Conventional Radiographs Using MICS

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The goal of this presentation is to present a new software application which will enable the forensic community to increase information available from conventional radiographs.

This software dramatically increases the availability of information which can be obtained from conventional radiographs. Forensic dental identifications can be both facilitated and validated. Clinically, the extent of both dental and osseous pathology can be determined using conventional radiographs and efficacy of treatment evaluated.

Conventional radiographs are currently interpreted by comparison of contrasting grayscale values. Two hundred fifty-six grayscale values exist. The human eye is capable of perceiving approximately 25 to 32 of these values. This means that when a radiograph is viewed by the unaided human eye, approximately 12% of available information is processed and approximately eighty-eight percent of available information is lost.

Measurement of Internal Consistencies Software (MICS) is a unique solution to this human limitation. A 2- dimensional radiograph is scanned into the MICS 2.0 software program. Each pixel is assigned one of the 256 grayscale values and displayed as one of 256 elevation values. This results in the conversion of a 2- dimensional radiograph into a 3-dimensional image representing all 256 grayscale values.

MICS is a robust program which allows the investigator to select a region of interest and observe the minutiae of that region in detail while manipulating the image in the x-axis, y-axis and z-axis. A history is generated from each input for documentation purposes. Side by side viewing is available and useful for comparing ante-mortem to post-mortem radiographs for forensic identification purposes or comparing pre-treatment to post-treatment radiographs for clinical purposes.

Forensic Software, Conventional Radiographs, Clinical and Forensic Application

F24 Validation of a Conventional Forensic Dental Identification Using Measurement of Internal Consistencies Software (MICS)

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The goal of this presentation is to present a case report using MICS to validate a forensic dental identification made by conventional comparison of ante-mortem and post-mortem dental x-rays.

This presentation will impact the forensic community and/or humanity by presenting a case report which demonstrates image enhancement using MICS as a means to validate the comparison of dental radiographs by conventional means alone. This software has the potential to be used as a primary tool in the process of dental identification. During a mass fatality incident, MICS could be used in conjunction with other software such as WIN ID to greatly facilitate and expedite victim identification and return of remains to family and loved ones.

Medicolegal death investigation revealed that a 30-year-old male had strangled his wife and young daughter. He placed them side by side in bed and left the residence in his truck. After purchasing 1 gallon of gasoline at a nearby gas station, he proceeded to a side road and stopped his vehicle. With the windows rolled up, it is believed that the gasoline was emptied throughout the cab and ignited, resulting in both an explosion and fire. After the fire was extinguished, the carefully recovered remains were transported to the West Virginia Office of the Chief Medical Examiner for examination and identification.

Original dental radiographs and clinical records were obtained from the primary care dentist of the alleged perpetrator. Post-mortem radiographs of recovered jaw and dental fragments were obtained in the morgue. A positive dental identification was made based on a distal occlusal amalgam restoration on the maxillary right first molar and a partial amalgam restoration on the occlusal surface of the maxillary right second molar.

Both ante-mortem and post-mortem radiographs were then scanned into MICS (Measurement of Internal Consistencies Software). Correlation was observed among multiple comparable regions of interest when compared side by side. A detailed history was generated for each input to the images.

The application of MICS for the purposes of forensic dental identification is promising. Well defined parameters of acceptable correlation will need to be established prior to using this software as a means for primary identification.

Forensic Identification, Image Enhancement, Identification Validation

F25 The Effect of Geometric Optical Distortion of Photographs on the Forensic Image Superimposition Analysis

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This presentation will describe the optical errors produced by different photographic and video camera lenses, as well as their effect on the morphology of the photographic image, all this to be presented to the forensic community in order to pursuit the standardization of forensic photo and video superimposition analysis.

This presentation will impact the forensic community and/or humanity by documenting the process of the geometric optical distortions of photographs during the application of forensic superimposition analysis. The listener will develop a better understanding of the

methodology for the ideal comparison between the questioned images. The early detection of radial distortions, as well as their precise correction, will promote the fulfillment of better standards concerning the management of forensic images. The results of this experiment could be extrapolated to the rest of forensic imaging analysis.

Every time we take a still image or a video scene with a photographic or video camera, we make the assumption that, what we see through the viewfinder is what we get on our photograph or video clip, but this is not always the true story. All the photographic lenses produce some kind of geometric distortion, and for the forensic point of view, documenting this physical variable, plays an important role in the standardization of this technique. Since the results of the forensic superimposition analysis, depend on the degree of coincidence between related anthropometric landmarks located on two different photographic or video images, the optical quality of the images used, should be documented in order to standardize the technique.

Geometric distortion occurs due to an optical aberration of the photographic lens, as the light from the object passes through their glass. The distortion modifies the resulting image radially, producing a difference in magnification between the center and the periphery, this geometric distortion is also known as radial distortion. There are two types of radial distortion: pincushion distortion (positive), produces an image with outward corners and contracted sides resembling a pillow shape; barrel distortion (negative), produces an image with inward corners and expanded sides resembling a barrel shape. Both distortions show a redistribution of the original image coordinates relative to the center of the image area, modifying the shape of the photographic image, rendering a non-utilizable picture for measuring or morphological analysis.

In order to evaluate the amount of radial distortion produced by different photographic and video camera lens, a research protocol was designed. It was decided to test a sample of photographic and video systems including: 35 mm and Advantix® film cameras with fixed and interchangeable lens, one-time-use 35 mm and Advantix® film cameras, digital video and still cameras with fixed lens and digital still cameras with fixed and interchangeable lens. The decision was based on the big amount of photographic and video camera models available on the market. The experiment consisted on a first set of photographs taken at different magnification ratios for close range photography (1:1 to 1:10) with the group of photographic and video cameras with close-up capabilities (macro lens and close-up accessories), a second set of photographs taken at a magnification ratio for medium range photography (1:40) with the complete group of photographic and video cameras; and a third set of photographs taken at different magnifications for medium and long range photography (1:40 to 1:oo) with the complete group of photographic and video cameras. For the first two sets of photographs test targets were created for the different camera format size tested. The test targets consisted on a set of rectangular grids of different sizes (magnification ratios), created on a computer with a commercially available drawing software. The cameras were located in front of the targets, perpendicular to the target plane and aligned to the center of the grid with the aid of a mirror. The target distance from the camera lens was modified according to the magnification ratio tested. The first set of photographs was taken with the cameras mounted on a copy stand and the second set with the cameras mounted on a tripod. For the third set of photographs we utilize rectilinear architectural structures as a test targets, mounting the cameras on a tripod and aligning the system with a spirit level.

Professional imaging systems with special interchangeable lens and close-up capabilities presented the lesser amount of radial distortion. Consumer imaging systems with fixed lens and zoom capabilities presented the higher amount of radial distortion.

Conclusion: The results of this experiment confirm the existence of radial distortion on photographs taken with different photographic and video imaging systems. The results also validate the differences between radial distortion and angular distortion. Forensic imaging systems should be tested in order to document the amount of radial distortion incorporated on the imaging process, as part of the standardization of the forensic image superimposition analysis.

Optical Distortion, Forensic Photography, Forensic Superimposition Analysis

F26 Reliability of a Visual Identification

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After attending this presentation, attendees will understand visual identifications which may be inherently flawed.

This presentation will impact the forensic community and/or humanity by making forensic odontologists aware that the visual identification of a body could be flawed. Take the dental radiographs when given the opportunity.

The Hughes 369D helicopter was operating in the Hawaii Volcanoes National Park, giving a tour of the lava flows. The crash occurred around 10 a.m. on June 15, 2003, Father's Day. A park service firefighting helicopter was dispatched to the downed helicopter and dropped buckets of water onto the burning debris. Four bodies were recovered that day. The autopsies were performed on June 17, 2003. The body of John Doe 2 was visually identified as that of the pilot by a co-worker at the scene of the accident.

After the tissue and fluid samples were taken for the FAA, the chief ranger asked the forensic odontologist if dental radiographs should be taken. The dental radiographs were taken, and they eventually proved that the visual identification was in error.

Can we rely on visual identifications? A visual identification is more subjective and lacks the objective criteria that is present in comparisons based on DNA, fingerprints, and dental radiographs. Whenever possible, take the dental radiographs.

Visual Identification, Reliability, Dental Radiographs

F27 A New Odontologic Computer Program to Aid in the Rapid Identification of Mass Disaster Victims

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The goal of this presentation is to familiarize the attendee with a new odontologic computer program to be used in conjunction with Dr. James McGivney's WinID© dental identification program. The attendees will be introduced to the increased functionality of the "add-on" program and understand its usefulness in a "megadisaster" such as the September 11th attack of the World Trade Center.

This presentation will impact the forensic community and/or humanity by introducing the computer program which will help expedite the identification of victims of a mass disaster or bioterrorist attack by odontologic means. Since the risk of such attacks remains high, its usefulness in the field of forensics and its impact on humanity is general is incalculable.

Dr. James McGivney's WinID© dental identification program has been the gold standard used by forensic odontologists for many years. It usefulness in mass disasters have been well documented and the program has been continually modified, updated and improved. During the World Trade Center terrorist attack it proved invaluable in identifying over 600 dental fragments. At the time, certain suggestions made by both DMORT as well as local forensic dentists working at the medical examiners office suggested that an "add-on" program would be useful in certain types "megadisasters."

The strength of WinID© lies in its ability to discover matches based on restorations present. Dr McGivney's algorithms take into account

that dental changes may have occurred between the time of the last antemortem radiograph (or record) and the postmortem charting of the victim. This flexibility allows for grading of every antemortem fragment against a single postmortem. Unfortunately, in a "megadisaster," where the number of antemortem records can number in the thousands, the amount of time involved in sifting through these radiographs can be enormous.

Filters, which in computer jargon are referred to as queries, are designed to reduce the number of possible matches by eliminating "impossible combinations." For instance, if a specific tooth (such as a wisdom tooth) is present in a mass disaster victim we can immediate eliminate all antemortem -individuals where the tooth was extracted. The purpose of Query Analyzer for WinID© (QA For WinID©) is to selectively reduce the amount of victims based on the use of Standard Query Language (SQL) filters and the current information of a specific postmortem victim. It attempts to improve on WinID© not only allowing you to "include" characteristics (which WinID© does) but also to "exclude" characteristics which WinID© can only do on an extremely limited basis. This filtering is done automatically by QA For WinID©. However, a powerful interface is included to allow manual modification to further refine the filtering. It does not require any knowledge of the SQ Language.

QA For WinID© is designed to directly interface with WinID© thereby eliminating the need to reenter the antemortem and postmortem data. In addition, numerous improvements to the interface have been included to further aid the forensic specialist. Designed to work on a network the program also includes a setup utility that allows each workstation to be set up by a team leader and therefore requires little adjustment by users. QA For WinID© also includes limited image modification tools for contrast and brightness adjustment. The program can be set up to directly interfaces with Adobe® Photoshop® and thereby allow for the editing of images. Enhancements to the viewing module, such as a local image magnification tool, and to the odontogram module are also included.

Following this presentation the attendee will be thoroughly familiar with the concept of SQL filters and how they can be used to narrow the number of possible matches for a forensic odontologic identification. The attendee will understand how QA For WinID© automates this task and will become familiar with the enhancements of the program in order to speed up the .identification process.

Computer Program, Odontology, Mass Disaster

F28 Innocent People Convicted by Bite Mark Evidence: Is There a Problem?

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The goal of this presentation is to demonstrate that innocent people are being convicted of crimes based upon erroneous bite mark identification evidence. This is a serious problem. The educational objective of this presentation is to identify common errors in bite mark investigations and propose strategies for improving objectivity in bite mark analysis and comparison. The attendee will be able to understand the need for caution in reaching a conclusion of culpability solely upon bite mark evidence.

This presentation will impact the forensic community and/or humanity by demonstrating that innocent people are being convicted of crimes based upon erroneous bite mark identification evidence. This is a serious problem. The attendees will be able to understand the need for caution in reaching a conclusion of culpability solely upon bite mark evidence.

The problem of innocent people being convicted and unjustly imprisoned for crimes they did not commit is a growing national concern which has recently been receiving public acknowledgment by politicians and is catching the attention of the general public. Advances in DNA identity testing have led to the exoneration of a number of innocent people. Some exoneration cases involve bite mark comparison evidence. Ray Krone, convicted by bite mark evidence, was the 100th innocent person convicted of capital murder to walk free from prison since the reinstatement of the death penalty in the United States. Mr. Krone maintained his innocence throughout his incarceration. Mr. Krone was sentenced to death in 1992 for the brutal murder of Kim Ancona, a Phoenix bar manager. Krone spent three years on Arizona's death row before his first conviction was overturned. Krone was retried and convicted a second time and sentenced to life in prison in 1996. Ray Krone, who had been branded as the "snaggletooth killer," was proved innocent of the murder of Kim Ancona by DNA testing. After being cleared by DNA, Ray Krone walked out of an Arizona State Prison a free man after 10 years.

The murdered bar manager, Kim Ancona, had been cleaning the CBS Lounge in Phoenix, Arizona on the evening of December 28, 1991. Her naked body was found in the men's restroom the following morning. She had been stabbed eleven times. An examination of the body revealed that she had been bitten on the left breast through the tank top she was wearing. There were unidentified shoe impressions, fingerprints, and hairs. Other evidence indicated she had been sexually assaulted. There was blood at the crime scene and on the victims clothing, but it was typed as ABO Type O, the same as Ancona, Krone, and some 43% of the population. Forensic DNA technology available at the time of the prosecution could not identify the blood of the perpetrator.

Ray Krone, a U. S. postal letter carrier without a criminal record, and honorably discharged from the U.S. Air Force, knew the victim; he had socialized with her and had been a customer of the CBS Lounge. There was little evidence that tied Krone to the killing except for evidence of a bite mark on the victim's breast, which an American Board of Forensic Odontology (ABFO), Board Certified Forensic Odontologist said positively, was better than a fingerprint and matched the dentition of Ray Krone. Despite evidence of his innocence presented at both of Krones trials, the States weak circumstantial evidence bolstered by the forensic bite mark evidence that was controversial and disputed by other ABFO Board Certified forensic experts, Mr. Krone was convicted. There is no question that it was the bite mark testimony of the State's dental expert that convinced two separate juries that Krone was Anconas killer. After Krone's second conviction and after his appeals were exhausted Krone sought post-conviction DNA testing. Krone's lawyers asked that the tank top, through which one of the bites may have been inflicted, be examined for saliva. Not only was saliva found, but the results of testing showed that neither Krone nor the victim could have been the genetic source of the saliva. Comparison of the genetic profile of the saliva donor against the FBI Combined DNA Index System (CODIS) database that the State of Arizona Maintained on its inmates, associated the DNA evidence with a 36-year-old inmate of the Florence, Arizona prison, Kenneth Phillips, who had been convicted of attempted child molestation.

The Krone case is clear proof, again, of the power of DNA. Not only did the DNA test show that Ray Krone was excluded as the perpetrator, it also identified a different individual who was already incarcerated in the penitentiary for an unrelated sex crime. The odds were 1.3 quadrillion to one that Kenneth Phillips was the contributor of the saliva DNA found on Kim Ancona's tank top. After the DNA match, Phillips hair was found to be consistent with evidence hairs found on the victim's body. Phillips confessed to being present at the time of the murder of Ancona in a tape recorded interview. Phillips blood was genetically identified on the inside and outside of the victims jeans and underwear. Phillips fingerprints were found in the mens room of the CBS lounge where Kim Anconas body was found.

The Krone case is another in a growing number of cases where bite mark evidence has been shown to be erroneous. Bite Mark identification evidence is at serious risk of being held to be a junk science. If bite mark evidence is to remain as viable evidence of identification, measures should be taken to correct circumstances where errors and miscarriages

of justice occur. Lessons learned from the Krone case should include: 1.) Avoid overstatement of the validity and certainty of a bite mark identification; 2.) Recognize the problem that marks can be made postmortem that can be misinterpreted as part of a bite mark injury pattern and; 3) Develop a minimum threshold of objective criteria for the suitability of a suspected bite mark before a comparison is attempted.

In conclusion, a scientific technical working group of forensic scientists should be formed to objectively study the viability of forensic bite mark evidence.

Bite Mark, DNA, Innocent

F29 Taking the Bite Out of Crime

Michael N. Sobel, DMD, Allegheny County Coroner's Office, 5873 Forbes Avenue, Pittsburgh, PA 15217-1601*

After attending this presentation, attendees will be advised to exercise caution and completeness in the evaluation of possible bite mark evidence or other patterned injuries.

This presentation will impact the forensic community and/or humanity by issuing a wakeup call to use care, caution, and completeness in the evaluation of patterned injuries, including bite marks.

When a forensic odontologist is consulted on a bite mark case, all too often the momentum is toward verifying that a human bite mark is indeed present and subsequently link it to the suspect at hand. In the interest of time, there is mounting pressure to "…at least give some rough idea so we can close this case, Doc!" However, in order to arrive at an unbiased conclusion, the thrust should be to first gather and then evaluate all related evidence in the case. Otherwise, the inherent danger is that we may proceed on a wild roller coaster ride based on incomplete preliminary conclusions, before one can fully appreciate the full scope of the evidence.

Two recent cases, in this presenter's experience, serve to amplify the wisdom of first locating, and then evaluating, the complete spectrum of evidence before issuing an opinion. Only then should that opinion contribute to the direction of the case.

Case 1: The body of a white female was found in the trunk of her car. Two suspects were initially felt to be persons of interest: her lover and a former lover. The manner of death was homicide and cause of death was manual strangulation. At autopsy, some faint marks were observed in the area of the right elbow which were examined by a local dentist under alternative light source and documented with photographs. The dentist, a consultant for the local police, identified the patterned injury as a bite mark and proceeded to compare the dental models of the two suspects with the injury. His conclusion was that the former lover's dentition "matched in most areas." Subsequently, this presenter was contacted by the defense to evaluate the patterned injury evidence and requested the full evidence file. On review, there appeared to be problems with calling the injury a bite mark. After viewing the scene photos of the car trunk floor, an object was found beneath the body. A review of the police property records showed the object to be a 7 inch piece of a woman's plastic hair band. Placing an overlay of the hair band on the like-sized photo of the patterned injury showed a point for point match. The "bite mark" evidence was withdrawn.

Case 2: A physician was accused of biting his heavily sedated critical care patient on the inside of the left thigh. Although the police photos showed a patterned injury which resembled a bite mark, there were some inconsistencies. Dental models of the suspect were compared with the injury, as were 52 other dental models of various hospital staff members. Prosecution's experts felt that in most aspects, only the suspect's models matched the "bite mark." I examined the hospital records of the "victim" and found that, previous to the discovery of the patterned injury, a urinary catheter had been taped to her leg in the same location. Film overlays of the catheter coincided with the patterned marks. The suspect was acquitted by the Court.

Bite mark conclusions should be offered only after a full evaluation of the evidence, and, only then, should contribute to the pathway the investigation may follow.

Bite Mark, Patterned Injury, Evidence Evaluation

F30 Pattern Injury Bite Mark Investigative Protocol

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The goal of this presentation is to discuss protocol for bite mark investigations.

This presentation will impact the forensic community and/or humanity by documenting and differentiating the patterned injury which must precede a bite mark work up.

"Thorough documentation and thoughtful interpretation are essential prerequisites if justice is to be done."- Joseph H. Davis, MD. The role of the forensic odontologist in bite mark cases is first to be able to recognize bite patterns and differentiate them from other surface traumas. A protocol should be followed and a differential diagnosis made before the forensic odontologist begins his bite mark work up and analysis. Misinterpretation of patterned injuries has led to tragic consequences that could have been prevented if the appropriate investigative protocol had been followed. Investigative opinion and evidentiary opinions are not the same and the understanding of the difference as well as the application of these opinions will be discussed. First things first. Documentation and differentiation of the patterned injury must precede a bite mark work up.

Bite Mark, Odontology Protocol, Odontology

F31 A Mathematical Approach to Bite Mark Analysis Using BiteMark2003 Software© — Phase Two

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The goal of this presentation is to present to the forensic community the continuing research on an objective, mathematical bite mark analysis that can be performed using the aid of a computer program.

In 1952, Doyle v. Texas was the first known case in the United States to reach the appellate level. Since that time, the use of bite mark evidence and evaluation in the justice system has increased dramatically. It has been the goal of the forensic odontology profession to make methods of bite mark analysis more objective and scientific.

Until phase one of this research, bite mark analysis has had no mathematical foundation. In the past, methods most used in this area of study have been empirical in nature by relating the suspected biter's teeth to a photograph of a bite mark.

At the 2003 AAFS meeting, Brumit and McGivney presented a paper that illustrated how a dentition could be described mathematically. The study showed that the mathematical description was unique enough to allow a particular dentition to be specifically identified from other similar dentitions.

This study extends that line of research begun one year ago. In the 2003 study, sets of upper and lower dental models were collected, labeled, digitally imaged and mathematically described. These models were imprinted into a suitable impression medium. The imprints of the dentitions were labeled, digitally imaged and mathematically described as well. Descriptions of the dental models were compared to the mathe-

matical descriptions of the imprints. The results of the comparisons showed that a specific dentition could be linked to the correct imprint.

For this second phase of study, dental models of 20 individuals were obtained. These models were divided into two groups with ten of the individuals having normal occlusion and ten having malocclusions. The teeth chosen to study in each case are premolars, canines and incisors.

After the forty models were selected, they were randomly numbered. Each was imprinted into a suitable impression medium. Different types and consistencies of dental bite wax were used for this portion of the study. The imprints of the dentitions were labeled, digitally imaged and mathematically described.

Each dental model and bite exemplars were scanned at 72 dpi bitmap and saved as bitmap images with a Hewlett Packard Scanjet® 447c 1200dpi/48 bit color flat scanner.

The generation of the mathematical descriptions of the dental models and the imprints was accomplished using BiteMark2003 Software. This software also compared the mathematical descriptions and selected that best matches using a least-squares analysis. BiteMark2003 software was written in Microsoft Visual Basic® 6. The software stores data in a Microsoft Access® 2000 database accessed via ADO data accessibility.

The system to mathematically describe dentitions and dental imprints has been developed and tested. This system demonstrates the usefulness of mathematical descriptions in bite mark analysis. The software used in this system may facilitate the development of a national database. This database could prove useful in the apprehension of serial criminals and in identifying unknown human remains.

The system presents a useful tool to allow the forensic odontologist to properly collect, document and characterize dental evidence in a step-by-step manner. This evidence can then be used to facilitate inclusion or exclusion of suspects.

Bite Mark, Computer, Mathematics

F32 Bite Mark Analysis: Findings of an Exercise Designed to Measure Accuracy and Reliability

George A. Gould, DDS, 6101 Puerto Drive, Rancho Murieta, CA 95683; Anthony R. Cardoza, DDS*, 266 B Avocado Avenue, El Cajon, CA 92020*

The primary objective of the experiment is to document and compute the ability of the participants to arrive at the correct associations of dentition to their respective bite marks and to discover that this was an open population condition. The results of this experiment are to be presented at this conference.

This presentation will impact the forensic community and/or humanity by demonstrating the results of this experiment, which using known sources, will establish that bite mark analysis can be reliable and achieve accurate findings when the evidence is of acceptable quality.

Bite mark analysis is a reliable scientific method.

In a laboratory setting, ten individuals' mouth models were used to impress bite marks in two different mediums, modeling clay and the skin of a living human volunteer. One objective of this experiment is to observe the effect on accuracy when comparisons are being made on two surfaces with entirely different dynamics, one being essentially static and the other having the yielding and rebounding phenomenon of human skin.

Digital color Photographs, using a Sony MVC-FD Mavica camera, with appropriately positioned ABFO No. 2 © scale, were taken immediately following the placement of the bite marks. The authors did not want to introduce distortion that is a well known to develop rapidly as a post-injury physiological response.

The authors generated hollow volume overlays of the ten models, using an improved version of the Adobe© Photoshop© technique developed by M. Bowers, DDS, and Raymond Johansen, DMD.

A package containing photographs of the ten models with their respective overlays and photographs of ten bite marks, in black and white and color, were sent to 40 forensic dentists that had agreed to participate in this experiment. The experience level of the participants varied from Diplomate of the American Board of Forensic Odontology, to individuals that only recently entered into this field of interest.

The participants were asked to compare all of the overlays, with all of the bite marks, and to rank their findings according to the seven categories of confidence shown in the 3rd edition of the *Manual of Forensic Odontology.* These categories are:

1. Reasonable medical certainty, to represent the opinion that it is a virtual certainty that this dentition made this mark. This finding may be applied to cases with a few possible responsible individuals or to a situation where there is no limit on the possibilities, also referred to as an open population.

In this experiment, the manner in which the material was formatted and submitted it was the author's intention to lead the participants to assume this is a closed population situation. This would mean that each of the ten models could be associable to only one mark in the clay and one mark in the skin.

The authors did not inform the participants that this was in reality an open population exercise, in that one of the bite marks did not have an associable dentition and one of the ten models did not make any of the bite patterns.

2. Very Probable to mean more likely than not.
3. Possible to say it is consistent and cannot be excluded- could be; may or may not be; can not rule out.
4. Improbable-unlikely the dentition
5. Excluded-eliminated; no match; incompatible; not of common origin.
6. Inadequate information-inconclusive
7. Non-diagnostic- of no evidentiary value.

The primary objective of the experiment is to document and compute the ability of the participants to arrive at the correct associations of dentition to their respective bite marks and to discover that this was an open population condition. The results of this experiment are to be presented at this conference.

The results of this experiment, using known sources, will establish that bite mark analysis can be reliable and achieve accurate findings when the evidence is of acceptable quality.

Bite Mark, Analysis, Reliability

F33 Stereometric Analysis of a Human Bite Mark

Robert G. Williams, DDS, 11661 Preston Road, #141, Dallas, TX 75230*

After attending this presentation, attendees will understand that it is possible to reduce examiner subjectivity in bite mark analysis by stereometric and photogrammetric techniques.

This presentation will impact the forensic community and/or humanity by potentially allowing the forensic odontologist a more objective methodology for the analysis of human bite marks. Reducing the examiner's subjective bias in bite mark analysis will aid in enhancing the credibility of all forensic odontologists.

The utility of the photogrammetric technique of stereometric analysis for geometrically characterizing human bite marks in forensic applications is demonstrated for a pair of overlapping photographs of a bite mark inflicted by a known perpetrator. In particular, the ability of this technique to support detailed measurements of a variety of bite mark topographic and morphological parameters, suitable for populating a multi-component feature vector, is established. A subset of the bite mark

feature parameters, extracted by stereometric analysis, is quantitatively compared against the corresponding values measured from the perpetrator's dental exemplar. The derived error bounds for the selected feature parameters are employed to estimate the probability of match between the bite mark measured features and the corresponding features measured from the perpetrator's dental exemplar, illustrating the potential of this technique as an objective method for quantifying the degree of certainty.

Bite Mark Analysis, Stereometric Analysis, Photogrammetry

F34 A Comparative Reliability Analysis of Computer-Generated Bite Mark Overlays

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The educational goals of this presentation are to present research results from a comparative analysis of two different Adobe Photoshop techniques used to create computer-generated bite mark overlays. The techniques evaluated during the study will be illustrated and the assessment of the reliability analysis will be explained.

This presentation will impact the forensic community and/or humanity by helping to satisfy the judicial requirements for the admissibility of bite mark evidence.

Courts have recently taken an aggressive approach toward the scientific foundation of expert testimony. The validity and reliability of scientific techniques used in the courtroom have brought many previously accepted methods of forensic investigation under closer inspection. Significant cases such as *Daubert* and *Kumho* have demonstrated that scientific evidence must meet a minimum level of judicial scrutiny before testimony is accepted.

This study compared the reliability of two different methods to produce computer-generated bite mark overlays. Two key elements assessed during the study were: 1) How often one examiner could produce an overlay that was similar to that produced by another examiner, and 2) How consistent the repetition of overlays produced could be achieved using the two different techniques.

While researchers have examined individualized methods for generating computerized bite mark overlays, no study had yet to directly compare two different methods. This study focused on the production of overlays by using two techniques: a) Adobe Photoshop Magic Wand Tool, and b) Adobe Photoshop Inversion Tool. These are two popular techniques used in North America (Sweet and Bowers) and Europe (Naru and Dykes).

Scanned images of twelve dental casts were sent to thirty examiners. Examiners were divided into three research groups based on their forensic odontology experience level. These groups included Diplomates of the American Board of Forensic Odontology with extensive bite mark experience, forensic dentists with limited bite mark experience, and second-year dental students at the University of British Columbia with no bite mark experience. Examiners were instructed to produce an overlay for each cast image based on the instructions provided for the two techniques.

After the overlays were submitted, measurements of the area of the biting edge and the x-y coordinate position of each of the six upper and six lower anterior teeth were obtained using Scion Image® software program. The inter- and intra-reliability assessment of the measurements was performed using an analysis of variance and calculation of reliability coefficients. Of significant interest were the differences seen between the research groups and the individual variations amongst the casts selected.

The analysis of variance results showed that the forensic experience level of the examiner and the cast variations contribute significantly to the variances seen in the area for both techniques. The inter- and intra-examiner reliability coefficients are low. The results for the positional measurements showed that the forensic experience level of the examiner contributes no significant differences to the variances. The differences are seen within the cast variations. The inter- and intra-examiner reliability coefficients are exceptionally high. It was concluded that both techniques were reliable methods to produce bite mark overlays in assessing tooth position.

Bite Marks, Computer Overlays, Reliability

F35 A Survey of the Etiology, Anatomic Location, Victim Demographics, and Legal Disposition in 250 Bite Mark Cases Involving Human Victims

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After attending this presentation, attendees will have a better understanding of the distribution of bite marks, as it relates to age, gender and differing crimes.

This presentation will impact the forensic community and/or humanity by providing information of interest to a myriad of professional disciplines including forensic odontologists, medical examiners, detectives, profilers, emergency room personnel, coroners, psychologists, and family service counselors, as bite marks provide both physical and biological data.

A study of the etiology, anatomic location, victim demographics and legal disposition of bite mark cases was made with the purpose of updating and augmenting previous research in the field. The information may be of interest to a myriad of professional disciplines including Forensic Odontologists, Medical Examiners, Detectives, Profilers, Emergency Room Personnel, Coroners, Psychologists, and Family Service Counselors, as bite marks provide both physical and biological data. While bite marks were found on all anatomic regions of the body some sites are significantly more likely to receive bites, and the frequency that an area is bitten may vary with the type of crime. Sex and age of the victim may also impact the resulting location and frequency of bites.

A survey form for bite mark cases was created and mailed to all diplomates of the American Board of Forensic Odontology. The survey form was also included in the American Society of Forensic Odontology newsletter. The survey requested that the recipient fill out a separate form for each case for which the recipient was the primary investigator of a pattern injury. The resulting surveys were mailed and faxed, and the information entered into a Microsoft Excel spreadsheet. The responses detailed two hundred thirty two (232) bite mark cases that included seven hundred (700) individual bite marks.

Harvey (1976) published a study of 74 bite marks in coroner's cases finding the highest percentage of bites to the breasts (31%) and the extremities (13%). In 1983 Vale and Noguchi published the paper *Anatomical Distribution of Human Bite Marks in a Series of 67 Cases*, a Los Angeles County Medical examiner based study from 1970 through 1981, which included 164 bite marks. They found the areas most frequently bitten were upper extremities (22%) and then breasts (10.4%).

In 2000 Sweet and Pretty published a study entitled *Anatomical Location of Bite marks and Associated Findings in 101 Cases from the United States*. They searched the U.S. Court of Appeals database for the time period 1972-1999 and selected 101 cases, which totaled 148 bite

marks. They found that breasts (31.3%) were most frequently bitten followed by the arm (18.8%).

Each of these studies looked at specific populations. Harvey, as well as Vale and Noguchi's research involved cases from corners offices, therefore all bites were on deceased subjects. Sweet and Pretty's research revolved around a search of the United States Court of Appeals database. There subjects were victims of significant crimes that the perpetrator appealed. The specificity of the populations may have influenced the outcomes of their specific research.

Methodology: The survey form was sent to approximately 1100 forensic dentist in 26 countries. The forensic experience level of the dentists varied from neophyte to very experienced.

The survey was designed to elicit information about the victim, the country in which the incident occurred, the nature of the incident (if criminal in nature, the type of crime), and the quantity and distribution of the pattern injuries. The responder was asked to give his or her opinion of the evidentiary quality of the bite mark(s) and to discuss the legal disposition of each case. The survey also asked questions about the alleged perpetrator or perpetrators. It further asked whether suspect information was collected, how many suspects were involved, and if any of the suspects were bitten and if so the location of the bite(s). The age and gender of the suspect(s), and if there was a conviction in the case, was also information that was requested on the form. Areas were also provided for the respondent to give any other information they deemed pertinent. The results were entered into a Microsoft Excel spreadsheet then analyzed and compared to previous studies in the field.

Results: Fifty-two forensic odontologists from seven countries responded. Nineteen responders were diplomates of the American Board of Forensic Odontology. The number of cases reported by each responder ranged from one to thirty three and the average number of cases reported was 4.5.

In this broad based study females were bitten more often than males. The average male victim was younger than the average female victim. Males that were victims tended to be either very young or very old. The youngest victim was a two month old boy and the oldest victim a 95-year-old woman. The data were also analyzed and sorted for various types of crimes, age, gender, and number and location of bite marks.

Perpetrators were male more often than female and there was an average of 1.4 suspects per case. The results show that most bites occurred on the arm, followed by the breast. If broken down by gender, males were bitten on the arm more than females, and females were bitten on the breast more often than males. This data was also filtered for differences in types of crimes, gender, age, distribution, and location of bites.

The data show patterns in location and number of bites that seem related to both the type of crime and the age of the victim.

Forensic Odontology, Bite Marks, Distribution

F36 Bite Mark or Snowblower Injury? The Forensic Odontologist's Role in Evaluating Bite Mark Injuries

Richard D. Dial, DDS, 363 South Harlan Street, Suite 110, Lakewood, CO 80226-3552*

After attending this presentation, attendees will understand the importance of completely reviewing all of the data before deciding to accept or decline a bite mark case.

This presentation will impact the forensic community and/or humanity by describing the proper evaluation of case data which is paramount in rendering an effective expert opinion in bite mark cases.

Learning Objective: to examine the dental evidence in a kidnapping and rape case where a unique and less than ideal pattern injury was determined to be a human bite mark. Ultimately, the forensic conclusions assisted the prosecution in presenting the facts of a case to a jury.

If a pattern injury is suspected to be a human bite mark, the role of the forensic odontologist is to provide expertise in the evaluation of all of the evidence before rendering an opinion. The American Board of Forensic Odontology has published Guidelines and Standards for the proper terminology and identification of a bite mark, a specific type of pattern injury. Furthermore, the ABFO has similar guidelines for the terminology used to associate or "link" a suspected biter with a particular lesion. If all the data associated with the case isn't properly evaluated, a lesion that may initially appear to have a low evidentiary value may result in an insufficient work-up of the case.

In the final days of the month of January 1997, a 39-year-old woman escaped from the home of a male companion that she had met earlier in the week at a local bar. The woman had been kidnapped, repeatedly raped and bound for two days. The victim informed the police that she had bitten her abductor. After the suspect was arrested, multiple pattern injuries were noted on his hands. The suspect reported to police that he had injured his hands "repairing a snowblower." The author evaluated a small lesion on the left ring finger and nail of the suspect. The report sent to the police stated that the lesion was "consistent" with a human bite mark.

Later, the victim consented to a forensic odontologic examination that included photographs, radiographs and impressions of her teeth. Subsequently, dental models were made from the impressions and a hand drawn acetate overlay was constructed. Comparisons of the overlay were made to life-size or 1X1 photographs of the injuries on the suspect's finger. A very unique "V" shaped lesion of the finger matched well with the portion of a fractured cusp on the victim's lower right first permanent molar. A strong correlation was made between the pattern injury and the victim's dentition. The district attorney was advised that the victim "most likely" made the injury.

Eventually the case went to trial and the bite mark information was presented. The forensic evidence aided the jury to show that this horrific event was not consensual in nature as claimed by the suspect. The 47-year-old male was found guilty of sexual assault and kidnapping. He was sentenced to 18 years in prison.

In conclusion, the initial bite mark evidence presented in this case was minimal and less than ideal. However, after other forensic dental evidence was obtained, the uniqueness of a single lesion proved to be an effective factor in linking injuries on a suspect's finger to the dentition of a victim.

Finally, the forensic odontologist should evaluate all of the evidence possible before deciding to accept or decline a case. Many times, there is insufficient or poor quality bite mark evidence initially to render an opinion. However, this case supports the theory that after all of the forensic dental data is evaluated, there may be ample information available to provide an expert opinion even though the initial evidence may appear less than ideal.

Human, Bite Marks, Odontology

F37 Forensic Bite Mark Identification of a Killer Alligator

Kenneth Cohrn, DDS, and Steven Cogswell, MD, Medical Examiner's Office, 5th Judicial District, 809 Pine Street, Leesburg, FL 34748*

The goal of this presentation is to discuss information regarding animal bite mark identification.

This presentation will impact the forensic community and/or humanity by presenting a rare case which provides insight into the capture and bite mark identification of a killer alligator in Florida. There is limited forensic information regarding animal bite mark identification, particularly involving a fatality. There have been only 13 reported alligator related fatalities in Florida since 1948.

This paper will present the coordinated efforts of the Fifth Judicial District Medical Examiner's Office, Chief Forensic Odontologist, Florida Fish & Wildlife Conservation Commission, and the Lake County Sheriff's Department in determining the identity of an alligator responsible for the death of a 12-year-old male.

On Wednesday night June 18, 2003, a 12-year-old, 98-pound male was attacked and killed while playing with friends in the Dead River, Tavares, Florida. Factors precipitating the attack include harassment of the gator, time of day (dusk) and mating season. A consultant in reptile and alligator behavior indicated that based on the severity of the attack and because the animal was provoked the gator's intent was to kill the boy as opposed to feeding behavior. Standard procedure for the Florida Fish & Wildlife Conservation Commission following an attack of this nature is to canvas the immediate area for suspicious alligators. Trappers are sent to kill the gators with a "bang stick," a long metal pole that fires a shotgun shell or bullet when its tip is struck against the alligator. The decision to kill large gators in the area of the incident is to aggressively address a problem threatening the community.

By Friday morning the hunt was over. Eleven gators had been collected with seven of them sent to the Fisheries Lab in Gainesville, Florida for necropsies. The animals ranged in length from 7–foot 6-inch to approximately 14-foot.

Eleven gator heads were delivered to the Medical Examiner's office in Leesburg, Florida for examination and potential identification. Based on the size and shape of the injuries on the decedent three gators were ruled out as too small. Tooth patterns and measurements eliminated an additional six animals leaving two suspects of the appropriate size and dentition. One gator had been seen in the area of the attack exhibiting aggressive behavior had been injured by the prop of a boat two weeks prior to the incident. This gator was the primary suspect.

Autopsy by the chief medical examiner noted numerous bite mark lacerations and abrasions on the victim's face, torso (front and back), legs and feet. There was a subtotal traumatic amputation of the left hand, 8 x 6 inch partial avulsion of the skin of the left buttock, fractured ribs #6, 7 and 9 and a deep, crushing laceration of the liver. Cause of death is drowning and multiple blunt force injuries.

After limiting the suspect gators to two animals, bite mark analysis was conducted by matching the maxillary and mandibular teeth of the gator to the wounds on the victim. The violent nature of the attack resulted in numerous, widely distributed tooth marks making it was difficult initially to align the teeth with the wounds. However, after hours of careful examination by the forensic odontologist, the chief medical examiner, and the wildlife biologist, six distinct concordant bite marks were established. Additional but less conclusive matches were also found. A positive identification was made on a 10'4", 339-pound male gator by Friday 3:30 pm. The family was immediately notified and a press release issued.

The fatal attack on the 12-year-old victim is illustrative of the increasing danger of encroachment of the more than 17 million Floridians into gator domain. With humans populating space along every river and lake the chances of deadly encounters continue to escalate. Gator complaints have jumped nearly 200 percent since 1978 to 14,798 in 2002. There have been 280 attacks since 1980. The death on June 18, 2003 marked Florida's 13th alligator related fatality since 1948. No other state in the Southeast has had more than one fatality in the past 25 years.

Odontology, Alligator Attack, Animal Bite Fatality

F38 ABFO Image Collection: Revised and Updated 2004

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Attendees will preview images related to forensic odontology that will be available from the American Board of Forensic Odontology (ABFO). The objective is to preserve, enhance, and make available in digital format forensic odontology images previously available only as 35 millimeter slides. New and updated images are added to the collection intended for information, education, and training. The new collection features images and information available in two formats: 1) PowerPoint® presentations on specific subjects, and 2) high and low resolution image files organized into categories.

This presentation will impact the forensic community and/or humanity by providing an updated image and information resource for public and professional education and professional training in forensic odontology.

The presentation introduces, previews, and highlights available presentations and collections of images provided by Diplomates of the American Board of Forensic Odontology. Presentations detail four categories: 1) History and scope of forensic odontology, 2) Oral and maxillofacial identification in individual and multiple fatality Incidents, 3) Recognizing and evaluating bite mark evidence, and 4) Abuse of humans by humans; children, adults, and the elderly.

Imaging Process: All images taken with film cameras were scanned, digitized, and archived. Each film-based image was scanned at 2000 dpi using a Microtek ArtixScan 4000tf scanner. Enhancements were made using Adobe® Photoshop® 7.0 to correct brightness, contrast, sharpness, and color fidelity. Each image was watermarked with the ABFO logo, cropped if needed, and saved as a 72 dpi JPG and 2000 dpi TIFF format for archival purposes. Images are saved in folders by topic.

Archiving/Preservation: The archiving and preservation of digital master files will be at the University of Texas Health Science Center, Center for Education and Research in Forensics (CERF) main computer database and at a site designated by the ABFO.

Conclusion: This project provides an updated image and information resource for public and professional education and professional training in forensic odontology.

Forensic Odontology, Forensic Dentistry, Images

F39 Who Was the Perpetrator?

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After attending this presentation, attendees will understand how the integration of different forensic specialties, including odontology, has allowed collection of a number of findings of interest to justice in the forensic investigation of a case with no credible witnesses.

This presentation will impact the forensic community and/or humanity by demonstrating the importance of multidisciplinary work in a specific case, but also the possibilities and limitations of the current investigation methods that provide answers to the questions raised, while leaving other issues unresolved.

On a winter evening of 2002, in a small snow-covered mountain village, a 7-year-old boy leaves his home in the company of his 4-year-old brother and their dog, a 6-month-old German shepherd. Approximately one hour later, the mother of the two children returns home and notices their absence and the absence of the dog. She leaves

the house to search for her children in the night and eventually finds the jacket of her elder son in the snow. She whistles, the dog appears before her and she hears her younger son crying. The dog leads the woman down a meadow where first, other pieces of clothing are found, and then, the boy himself, - lying half-naked in the snow. The mother takes the unconscious child in her arms and carries him to the closest house where different individuals, including a medical doctor called in an emergency, attempt to resuscitate the child who is suffering from cardiorespiratory arrest with bilateral fixed mydriasis. The child also presents with multiple superficial skin lesions on the face, the thorax, and the limbs. The victim is driven to a hospital where resuscitation is continued, but with limited success. The child is later flown by helicopter to the nearest hospital where warming measures are applied.

The initial forensic investigations include the examination of multiple dermabrasions associated with hematomas. Toxicological analysis only reveals substances administered during the medical treatment. A search for sperm yields negative results. DNA analysis reveals the possible presence of canine genomic DNA but formal identification is not possible.

The police investigate the scene the same evening and uncover several pieces of partially torn clothing belonging to the boy.

Other specialists participate in the investigation: a child psychologist, a pedopsychiatrist, a veterinary behaviourist, and a hypothermia specialist.

The family of the child insists on the participation of one or more external party experts in the investigation. The case is transmitted to a second judge who orders new investigations in the beginning of 2003 that would answer his own questions about the case. This action calls for the intervention of a new team of forensic specialists, including an odontologist, to study the available evidence to determine the nature and origin of the lesions found on the body of the child.

The integrated analysis of the conclusions of each expert is presented. It illustrates not only the importance of multidisciplinary work, but also the possibilities and limitations of the current investigation methods that provide answers to the questions raised, while leaving other issues unresolved.

Odontology, Bite Marks, Multidisciplinary Approach

F40 Tooth Prints: Dentistry's Role in the Identification of Missing and Unidentified Children

Kathleen M. Crowley, DMD and David Harte, DMD, Office of the Chief Medical Examiner, 720 Albany Street, Boston, MA 02118*

The goal of this research project is to introduce tooth prints as a reliable dental method in the identification of unknown remains in the absence of diagnostic dental records.

This presentation will impact the forensic community and/or humanity by introducing an additional forensic tool available for all specialists in the rapid identification of missing and exploited children utilizing the dentition as well as facial recognition and saliva for DNA analysis.

The disappearance and identification of missing and unknown children have received much attention in the national and local media. Dentists have historically helped in providing dental information on missing individuals when requested from law enforcement agencies and have continued to be a vital participant in the identification of unidentified human remains. Unfortunately, diagnostic dental records/radiographs are not available on all forensic examinations for comparative identification. Reasons for this increasingly common dilemma focus on the young age of the individual, length of time of non-active dental status of the person, or records which have been accidentally misplaced, or, even worse, destroyed. Because the human dentition continues to depict an individualized uniqueness, bite impressions provide a reliable method for identification purposes. This presentation introduces tooth prints as the bite impression technique in the establishment of a record of an individual's dentition at a given point in time, as well as providing a saliva sample for DNA identification.

Tooth Prints, Bite Registration, DNA

F41 Observations on Dental Structures and Restorative Materials Subjected to High Temperatures in an Animal Model: Experimental Preliminary Studies

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The aim of this presentation is to describe the behaviour and the changes that endodontically treated and restored teeth surrounded by soft tissues undergo when exposed to high temperatures. This to compare the results of previous in vitro observations with the results of the same experiments done in a particular animal model.

This presentation will impact the forensic community and/or humanity by describing the use of the suggested animal model which seems to be a reliable experimental method suitable to produce a reference database helpful to forensic odontology identification research.

Teeth represent an ideal identification tool in situations of advanced decomposition, destruction of soft tissues by fire, traumatic mutilation from a collision or massive trauma. Regardless the conditions of the body usually the dentition is preserved and. Not only teeth are able to withstand extremes from fire, but various restorative materials used for fillings, prosthetic devices and a large number of possible combinations of dental related characteristics are also able to adequately withstand the thermal assault. Following the results of our previous in vitro studies on dental prosthetic devices, restored and non restored extracted teeth exposed to a range of high temperatures, we decided to study in such an experimental situation the relevance of the protection given by the soft and hard tissues surrounding the teeth by the means of an animal model.

Six heads from pigs (10-12 months old) freshly slaughtered and preserved in a refrigerator have been utilised. The mandibular and maxillary teeth, all caries free, in situ, have been either considered as sound controls (group 1) or specifically restored for the research (group 2): i.e., first endodontically treated and sealed by means of an endodontic cement and gutta-percha (condensation technique), then restored with amalgam or composite fillings. Before the high temperatures testing, periapical radiographs of all the samples were recorded. The tests of exposure to heat were carried out in a oven: each mandible and the respective maxilla surrounded by the belonging soft tissues were subjected to one of the prestablished temperatures (200, 400, 600, 800, 1000 and 1100°C) reached at a rate of increase of 30°C/minute. At the target temperature, the samples were removed from the oven and allowed to cool to room temperature. Finally the specimens were examined macroscopically, observed by stereomicroscopy and periapical radiographs of all the samples were taken. The results table was edited reporting the macroscopic, microscopic and x-rays findings for each specimen related to the different temperature levels of exposure and the results discussed and compared with the observations drawn from the experiments previously carried on human extracted teeth.

Our experiments showed that at 200°C the surface portion of the soft tissues was partially burnt, the dental tissues and the dental restorations did not show signs of alteration. At 400°C, the outer soft tissues were partially carbonised and the inner soft tissues were preserved; the crowns were intact showing only a slight colour change of the enamel

surface and the fillings were intact. At 600°C, the outer soft tissues were completely carbonised and the inner soft tissues were preserved showing a vitreous-like coating substance; the crowns showed a non uniform change of colour tending to light brown; the fillings were in place showing a marginal fissure. At 800°C, some portions of the outer soft tissues were completely carbonised and the exposed portions of the hard tissues were calcinated; the inner soft tissues were partially carbonised; the crowns showed a change of colour from grey to black and the enamel showed some fractures; the fillings were in place showing a large marginal fissure and both the amalgam and the composite fillings were dark grey. At 1000°C, the soft tissues were completely destroyed and the hard tissues were calcinated; the crowns showed an enamel portion yellow-greyish and it was visible a white part of the roots; the crowns showed deep fractures and the cracks spread over the roots; some fillings were in place remarkably altered in the shape showing a state changing. At 1100°C, the hard tissues were partially destroyed; some crowns were partially disintegrated showing a chalky white colour with pinkish spots and some fillings resulted still in place even if remarkably altered in the shape and showing signs of a state changing.

The results of these preliminary studies show that it is possible to compare the effects of the same heat exposure in the animal model with the results of the our previous studies on extracted human teeth since (1) the dental tissues, endodontic treatments and restorative materials undergo a range of changes which correlate well with the various temperatures of exposure. These changes are a consequence of the nature of the materials and their physiochemical characteristics, individual components can remain recognisable and identifiable even at very high temperatures. For example, after exposure at 1100 °C it is possible to recover and identify residues of amalgam restorations. At the same temperature the teeth are well recognisable and not completely destroyed thanks to their mineralised structure. (2) It is possible to observe the endodontic sealing material surface by microscopic analysis and all the endodontic sealing residues in the root by the radiographs.

On the other hand, differences are detectable as stronger damages of the dental structures and of the restorative materials when extracted human teeth are used. For this, the animal model seems to best simulate the real life conditions. In our experiments all the samples were exposed to a single, brief, thermal insult. In real life various factors can further modify recovered remains: the duration of the exposure to fire, the way in which the fire develops, the rate of increase of temperature, and substances used to extinguish the fire.

From our experiments we conclude that the use of the suggested animal model seems to be a reliable experimental method suitable to produce a reference database helpful to forensic odontology identification researches.

Forensic Odontology, Identification, Animal Model

F42 The Danielle van Dam Homicide Case in San Diego 2002: A Circumstantial Case That Included Pathologists, Odontologists, Criminalists, and Entomologists

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The goal of this presentation is to discuss a case study that illustrates how the specialties listed above, working closely with prosecutors, led to the death penalty for the suspect.

Despite the absence of a confession and the fact that there was not a witness to this homicide, the circumstantial case presented by the prosecution, was strong enough to persuade the jury panel to find the suspect guilty. This case required the expertise of a pathologist, an odontologist, several entomologists, and especially evidence technicians and criminalists. The analysis of blood stains, fibers, and the victim's head hairs was crucial to this case.

The U.S. Criminal Justice system will review this case for years to come, as far as the objectivity and accuracy of all the involved investigators. Compared to the O.J. Simpson case, it was a model for forensic excellence.

On the morning of February 2, 2002, a nightmare began for the family of Danielle van Dam, a seven-year-old, when she was found missing from her bedroom and house. She lived in the affluent community of Sabre Springs, in San Diego, CA. This event eventually led to the arrest of a neighbor, David Westerfield, a fifty-year-old father of grown children and a design engineer, on February 22, 2002. He was charged with kidnapping and burglary. Three days later, on February 25, 2002, he was charged with murder.

Remarkably, two days later on February 27, 2002, volunteer searchers found the body of a young victim. The body was found decomposed and ravaged by animals and insects. Sources disclosed on this same day, that defense attorneys and prosecutors were considering a life without parole sentence rather than the death penalty, if the suspect were to disclose where he had left the victim's body. When the body was found that day, all attempts at plea-bargaining were terminated.

Thus, began one of the most notorious murder trials in the history of San Diego County at the same level as the Cara Knott homicide committed by California Highway Patrolman Craig Peyer, which was reported by this presenter to the AAFS, 15 years ago.

Amidst revelations of the parents' lifestyle, bringing strangers into their house, with three young children at home and the fact that David Westerfield had no criminal background but had casually known the mother and daughter prior to the missing person's report, the trial began. The presenter was contacted by Captain Ron Newman of the San Diego Police Department, Homicide Unit, in charge of the case, on the same day, the victim was found.

An autopsy began the next day and was halted briefly so that a forensic dental examination could be performed. Supplied with antemortem radiographs of the victim, positive identification was announced within 1 hour by the presenter, through comparison of the postmortem films. Several teeth were missing from the anterior maxilla. One deciduous and one permanent incisor were found in the vestibule area.

Days later, the police department asked the presenter to examine marks on the arm and leg of the suspect. Initially, they were believed to be either human bite marks or human fingernail scratches. This contention was denied by the presenter, and that evidence was not part of the District Attorney's case. Her dental identification was verified by fingerprint and DNA evidence weeks later, as the motor home and house of the suspect were combed for evidence.

The evidence was as follows:

1. Victims blood (DNA) on the jacket of the suspect plus the victims blood (DNA) in the motor home of the suspect which had been driven over 600 miles during the weekend when she was reported missing.
2. Her hair (DNA) was found on the pillowcase and sheet of his home bedroom, two doors from the van Dam's home.
3. The victim's hair (DNA) was also found in the sink drain of the motor home.
4. Fibers from the van Dam house were also found in the interior of Westerfield's motor home next to the bed.

Several forensic entomologists testified during the trial. Their testimony appeared confusing and contradictory as to establishing the time of death. (Westerfield was not arrested for three weeks, but was on continuous police surveillance). The defense team felt that the fly and insect activity would prove that Westerfield could not have committed the murder and disposed of the body because he was under a 24-hour watch. At the trial, Medical Examiner Brian Blackbourne was unable to provide a cause of death or a time of death due to the condition of the child's body.

On September 17, 2002, David Westerfield's jury decided that he should die for the kidnapping and murder of 7-year-old Danielle van Dam.

Odontology, Pathology, Criminalistics

F43 Custom Dental Jewelry Links Suspect to Attempted Homicide

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After attending this presentation, dental practitioners should be aware that certain segments of society have custom-fabricated dental jewelry made and that this jewelry can be used for both identification purposes and in cases where ownership is contested. Furthermore practicing dentists should investigate with their own licensing authorities the legality of this practice in their jurisdiction.

This presentation will impact the forensic community and/or humanity by making the forensic community aware of dental jewelry as items of potential identification.

The author presents a case in which custom dental jewelry provides a link between a suspect and a victim of an assault with a deadly weapon. The victim of the incident attended a social occasion sporting an upper and lower custom-cast gold-colored partial overdenture. At the social function the victim was approached by two adult males who suggested that he part with his new teeth and donate it to them. The victim vehemently refused and a verbal and later physical altercation broke out. The gold-clad victim was assaulted and received a gunshot wound that resulted in a spinal cord injury. Following this it is alleged that the two male suspects physically removed the jewelry from the victim's mouth and left the social function. The altercation was witnessed. The victim was left permanently paralyzed from the chest down. Some time later the Toronto Police Service apprehended one of the suspects who by chance happened to be wearing what he called his new custom made gold teeth. The police arrested him and seized a set of custom cast gold teeth from him. Upon closer inspection the teeth were partially-filled with paper tissue in an attempt to make them fit better to their alleged new owner. The question posed to the forensic dentist was: Whose teeth fit the custom cast jewelry - the victim or the accused ? The author suggested to the police that the jewelry not be "tried-in" to the victim's mouth because this would necessitate sterilization which could have damaged the material and because it could be contended that the teeth were forced onto the victim's teeth.

In order to determine whose teeth these were the author visited the victim in the paraplegic hospital and examined his teeth and the inside of the cast teeth recovered from the suspect. The victim said that the teeth were his. The author made vinyl polysiloxane impressions of the victim's teeth and subsequently poured these in ADA type IV dental stone. In addition the tissue was removed from the inside of the casting and composite resin (Z-100, 3M corporation, Minneapolis Minnesota) was flowed into the inside of the teeth and cured with a light-source. This positive was then recovered. The nature of the metal used for the casting was not determined. After recovery the casting was tried onto the model of the teeth and it fit well. Additionally the composite resin was compared to the stone model. These bite marks in gold resulted in a report which definitively linked the victim to his own teeth and left the suspect with some explaining to do.

After the case work-up the author contact the provincial college licensing authorities who advised him that this procedure may constitute the illegal practice of dentistry in as much as the devices were not produced by a licensed dentist. Following this the author located Internet sites which provide custom fitting decorative overdentures. At the time of writing the author has elected to not report the maker of the over denture pending the outcome of the trial.

Odontology, Jewelry, Bite Mark

F44 The Prince and the Princess — A Deadly Combination

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The goal of this presentation is to present a case of a dog mauling death to show how the assistance of a forensic odontologist may have been helpful in the investigation.

The "Prince" was Prince Elias, a 22-month-old registered Rottweiler known as "Max." The "Princess" was Kristin A. Jolley, a 12-month-old girl who lived across the street from Max.

October 21, 2001 was a chilly autumn day in Lovell, Wyoming. Jackie Ann Jolley, Kristin's mother, left her one-year-old daughter in the front yard of their home while she allegedly went into her trailer to do some laundry. It was reported that Jackie was talking with Kristin's father, H.B., on the bed in the master bedroom. H.B. was apparently working the night shift at the local bentonite mine and was trying to catch up on his rest during the daylight hours.

Discovery testimony elicited two different explanations: One, that the gate on the front yard fence was faulty; the other that the front gate was left open when Kristin was left alone to play. Whatever the reason, Kristin proceeded to exit the front yard, cross the city street and walk into the maw of an allegedly malnourished dog at the end of a 5-foot chain.

At approximately 1:30pm that day two construction workers were driving down 2nd Avenue when they saw a large dog mauling what they thought was a baby. One of the workers drove two blocks to obtain help from their foreman. The other worker knocked on the door of the neighbor's house and the son of the owner came out to help. The worker then ran across the street to the Jolley's house and was unable to get a response from either Jackie or H.B. Jolley. When a police officer arrived, one of the workers shouted, "Get your gun and shoot the dog. It's eating the baby." The police officer witnessed Max standing on the girl's chest, "chewing the flesh from her face." The officer used his pepper spray twice and was able to get the dog off of Kristin. Due to the severity of the injuries, rather than summoning an ambulance one of the construction workers held the baby while the officer drove to the hospital. It wasn't until approximately fifteen minutes after the incident was discovered that Kristin's mother came out of her trailer to investigate the commotion across the street. She finally asked about her child and was escorted to the hospital by a friend. Kristin's father didn't appear on the scene until several minutes later. Several attempts were made to resuscitate the child at the emergency room of the North Big Horn County hospital to no avail. Kristin was pronounced dead at 2:47 pm.

Many incidents occur where the investigations might be enhanced by the assistance of a forensic odontologist. One forensic odontologist was subpoenaed for this case to testify about the wounds allegedly caused by the dog. Unfortunately, the odontologist was not the person who gathered the evidence. In addition, the photos taken following the incident weren't presented to the forensic dentist until one week prior to the scheduled court date. Forensic odontologists need to do everything possible to educate members of the courts, law enforcement, and health care institutions as to the resources available in the forensic community.

Max was owned by defendant Ann Shine and co-defendant Matthew Martinez. The two had obtained Max from a local breeder, Ms. Hytrek, who had purchased the dog from a breeder in Montana. Ms. Hytrek was looking for a good home for Max, apparently due to his habit of chewing up the underclothes of the breeder. Ms. Hytrek had just purchased a new home and didn't want Max tearing up her belongings. Several people who knew Mr. Martinez, including a former girlfriend, testified that he had spent several years looking for a rottweiler that he could train to be a guard dog. Ms. Shine was happy to have a vicious dog on the property because, "he would keep everybody from looking in the windows."

Two years prior to this incident Mr. Martinez was fined $130 for an animal cruelty violation. His neighbors had called the local police department because one of the dogs he harbored at his place of residence was observed to be on the end of a 6-foot chain, dead. Mr. Martinez was allegedly belligerent to the police officer who arrived on the scene.

Ms. Shine and Mr. Martinez had owned Max for approximately two months. Several photos were taken with the children of the former owner showing how docile Max had been. The breeder stated that her 8-year-old daughter walked Max on a regular basis. Max also slept with her 17-year-old son.

According to court documents, Max weighed approximately 105 pounds when Ms. Shine acquired him. At the time of the necropsy following the incident, Max weighed 65 pounds, a loss of 40 pounds. The stomach contents of Max were also examined at the time of the necropsy. The local veterinarian found absolutely no fecal material in the digestive tract. The only thing found in the stomach contents was the four cups of food that Max ate upon arrival at the vet's office along with hair, skin, cartilage, teeth, and an eyeball apparently from the baby girl. The dog's body was sent to the Department of Criminal Investigation in Cheyenne, Wyoming for DNA analysis. Tooth and cheek swabs were also taken of "Chyna" a female rottweiler found upon the premises of Ms. Shines to see if that dog was involved in the attack. Numerous neighbors testified that they had never seen Max given food, water, or shelter.

Following the incident Ms. Shine was upset that authorities asked to have the dog euthanized. Also, she asked the police "what that girl was doing in my yard to begin with?" Ms. Shine and Mr. Martinez were not at home at the time of the attack.

The county coroner was not notified of the death until approximately 20 hours after the incident. By the time forensic odontologists were contacted, the autopsy was about to commence over 130 miles away. Upon examination of autopsy photos semicircular contusions were noted on the left wrist and the left thigh. The forensic pathologists did not pursue further investigation of these wounds compared to the massive number of puncture wounds and fresh lacerations.

On December 17, 2002, both defendants plead guilty to the charge of involuntary manslaughter. Each received split sentences of two years imprisonment with six months to be served in the Big Horn County Jail with work release, if appropriate. The balance of the sentence to be suspended and the defendants placed on five years supervised probation. The defendants must refrain from owning any dogs during the term of their probation. Though the prison sentences were to commenceJanuary 2, 2003, neither defendant has appeared to serve their terms in jail.

Dog Bite, Bite Mark, Death Investigation

F45 Just Another Routine Day in the Office

Frank J. Pappas, DDS, and Konstantinos H. Cherpelis, DDS, Office of Chief Medical Examiner NYC/Consultant, 33-03 Bell Boulevard, Bayside, NY 11361*

The goal of this presentation is to discuss how juggling a general dentistry practice and dealing with the unexpected difficulties of forensic odontology.

This presentation will impact the forensic community and/or humanity by demonstrating how forensic identifications aren't always as they seem. Additionally, describing how being a full time general dentist and having a forensic emergency can sometimes become a jiggling act and ways you must modify and adapt.

The purpose of this lecture is to demonstrate how daily office routine can be interrupted by having to perform an "emergency" comparison.

As we all know things can occur at the most inconvenient times and sometimes extreme measures to solve a case are necessary. In this case skeletal remains, a skull from a missing person of three years, was brought over to my dental office for comparison. If the detective's investigation was correct the missing person was murdered and the suspect who had known dealings with the deceased was under surveillance. The arrest warrant was pending the positive identification of the remains. Thus time was of the essence in order to obtain a warrant and arrest the suspect prior to him fleeing.

This case was pending for over three years. The police were very anxious to solve the case due to the fact that the victim was a minor who was brutally beaten via blunt impact injuries to the head and part of the body was charred. During an interrogation of a burglary investigation new leads were obtained, which led the detectives to the suspect who had known sexual relations with the minor. Upon obtaining the name of the minor all the pieces of the three year old puzzle fell into place. All the while steps were taken by missing person's detectives to identify the skeletal remains of this minor. The skull was sent to the FBI lab in DC for fabrication of a computer generated photo based on specific facial points on the skull. However, this was to no avail, the case was still open. This new lead could possibly solve the missing person's case as well as the homicide.

The detectives were anxious for the results of the dental identification. The examination and radiography of the skull where performed in the dental office in between patients with the detectives waiting. To complicate the issue of time constraints, this was not a routine identification. There were issues with the antemortem records; discrepancies between charting and radiographs. The possibility of some type of insurance fraud committed by the treating dentist or some type of charting error.

What do you do when you have a match on radiographs but very specific charting with contradictory information? Is this enough evidence to make a positive identification to subsequently obtain a search warrant? What about your patient in the next operatory mid root canal procedure? Do you contact the treating dentist? Will he sign an affidavit stating he committed Medicaid fraud? What do you do?!?!

Just Another Routine Day In The Office.

This case study will highlight some of the difficulties a forensic odontologist may encounter. It will exemplify how things are never as easy as they seem; how routine identifications aren't always routine; how nuts and bolts always get thrown in to the system; and how we need to adapt and modify.

Forensic, Dentistry, Emergencies

G1 Penetrating Wound of Head by Slingshot: Medicolegal Aspects

Bhanwar Lal Bhootra, MD, Forensic Pathology Services, Limpoo Province, PO Box 1944, Polokwane, 0700, South Africa*

After attending this presentation, attendees will understand the occurence of medicolegal problems when medical doctor conducts incomplete/improper examination of head wound; and understand the consequences of negligent conduct of doctor during trial.

This case of slingshot intracranial head injury is very unusual. Attention of medical officers is once again drawn to the medicolegal problems that can be caused by the improper/incomplete examination of wound.

The author autopsied an unusual case of penetrating wound of head by slingshot (piece of stone).

The case was initially discharged from casualty after stitching the head wound. The patient died at home of intracranial infection. Autopsy revealed a skull fracture and intracranial stone piece.

This case highlights that no head injury should be ignored as trivial injury. Careful examination of the wound could have prevented a fatality and possible medico-legal problems.

Head Injury, Slingshot, Homicide

G2 Suicide by Hanging in Children

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After attending this presentation, attendees will consider cases of hanging in children and the consequences of suicide in children.

Death from hanging is common in suicide youth. There's no large series dealing with such a death but numbers communicated even though small are significant.

Aim: we aimed to examine the epidemiology and pathology findings of 16 cases of suicide from hanging in children and suggest prevention.

Material and Methods: we considered cases of suicidal death from hanging in children referred to the department of forensic medicine of the university hospital Fattouma Bourguiba of Monastir from 1991 to 2002.

Sixteen cases of children committed suicide by hanging were reported. These cases were preceded by age, gender, manner of death, past history, surrounding circumstances and pathology findings.

Results: the 16 children were found dead. The age range was 11 to 17. The greatest share of suicide was found in the age of 17. The majority was males (15 /16). Rope for ligature was more common, string was used in 2 cases. A previous suicide attempt was reported in 1 case. Two cases were with a borderline personality and one case was with a medical history of juvenile diabetes. In 14 cases, hanging occurred within the decedent's home. We couldn't provide a statistic valid seasonal risk. However afternoon seems to be the most chosen time for hanging (10/16). Complete suspension was seen in all cases. Most of children were from rural areas.

The autopsy showed usual external injuries of asphyxial death. No injuries of the larynx or trachea were reported. Contusion hemorrhage of neck muscles was found. Petechial hemorrhage was not seen.

Conclusion: death from hanging in children is rare. Our report is a contribution to several series dealing with such a death. Prevention is possible in some cases by parental supervision and by providing education and mental health care to adolescent. It's important to carry out prospective studies in order to determine the specific character of such occurrence, so we can provide a specific prevention measures.

Suicide, Death From Hanging, Children

G3 The Effects of Liquid Bleach on Pig Decomposition in Southeastern Pennsylvania

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After attending this presentation, the participant will understand the effect of liquid bleach on carrion decomposition. This poster has two objectives to compare the rate of decomposition in pigs treated with and without bleach; and demonstrate the importance of understanding the impact chemicals have on corpses for criminal investigative purposes.

This study demonstrates that an easily accessible and common household chemical such as bleach can significantly influence decomposition rates and postmortem interval (PMI), leading to the possible incorrect estimate in the time of death of a victim.

Suspected use of bleach on the victim in a recent homicide trial in San Diego, CA, led the prosecutor to question if bleach on a body would affect a flies reproductive cycle. This case not only exemplified how forensic entomologists were unable to corroborate estimations of a postmortem interval (PMI), but also how the effect of such chemicals may influence arthropod colonization and utilization (if any) of a corpse, thus affecting PMI estimations.

To date, empirical studies published on the effect of controlled substances and other chemicals such as pesticides, have examined the effect on particular insects and provided logical implications of the potential impact on a PMI estimate. However, few field studies exist on how decomposition is influenced by any chemical substance. We hypothesized that the topical application via dousing of common household bleach would negatively impact insect colonization of pig carcasses directly, and indirectly slow decomposition.

The objective for our first experiment was to determine the effect of bleach on pig decomposition. In two later experiments we are comparing decomposition rates between habitats, each with and without bleach treatments, and determining the rate of degradation of bleach between habitats. Stillborn pig carcasses were used in this study. Control pigs (n=3/habitat), i.e,. not treated with bleach and experimental pigs (n=3/habitat), i.e., treated topically with a dousing (≈ 4 liters) of Ultra Clorox® liquid bleach, were placed onto individual plastic trays inside separate animal Have-a-Hart® cages. In experiment 1, all cages were placed in an open field exposed to full sunlight. For experiment 2 and 3, cages will be placed in an open field (full sun light) and a wooded area (complete shade). Temperature probes (Tidbits®) were inserted into two pigs, 1 control and 1 doused, to monitor internal temperatures. Daily temperatures were recorded from a local weather station and a max/min thermometer located in the open field. Temperature data was used to determine degree-day totals for each habitat. The pigs were observed daily to record physical changes in decomposition. The pigs were weighed to the nearest gram to monitor percent weight loss. Dead/live insects were sampled from the pigs on days 2, 7, 14, 21, and 28 and preserved for identification.

Five stages of decomposition were easily distinguishable for the control and doused or bleach treated pig: fresh, bloat, decay, post-decay, and dry. The use of bleach appeared to affect the physical aspects of decomposition. Decomposition in the control pig progressed from the fresh to dry stage in 11 days. Preliminary results showed that bleach dousing slowed decomposition of pigs by 7 days. Insect colonization on experimental pigs was similar to control pigs, however insect feeding was negatively impacted through observations of dead maggots and a recolonization period on day 10.

The rate of decomposition as a function of weight loss was most rapid for the control pig. Decomposition rates for pigs treated with bleach tended to be similar initially but slowed overtime possibly due to decreased insect activity. Accumulated degree-days estimates were less for control pigs and significantly greater for pigs treated with bleach in full sunlight.

Results from the first experiment focused on the first objective of our study, the effect of bleach on pig decomposition. These results show that decomposition was slowed by the presence of bleach on the pigs. Our preliminary evidence suggests that decomposition and lack of insect activity may influence PMI estimations when bleach is topically applied to a corpse. We are currently conducting two additional experiments to examine the effects of habitat on the rate of decomposition, as well as extraction and detection techniques of bleach from carrion flesh.

Forensic Entomology, Bleach, Postmortem Interval

G4 The Use of Whole Body Donors in Forensic Research

Charlotte A. Wacker, MS and Brandi J. Schmitt, MS, University of California, One Shields Avenue, 3301 Tupper Hall, Davis, CA 95616*

After attending this presentation, the attendees will learn how whole body donors can facilitate research in forensic science.

Whole body donors are used everyday for the advancement of medical research and education. These studies include, but are not limited to, surgical trials, biomechanical research, and emergency procedures, as well as the academics of anatomy as it is taught through dissection. On the contrary, research in forensic science is generally prompted by current casework and is performed as a byproduct of an investigation. It is important to note that the use of whole body donors for studies could help answer questions before cases even occur. Many fields within the realm of forensic science can benefit from these altruists in our society. Included are the disciplines of forensic entomology, odontology, pathology, biology, anthropology, and toxicology and can extend into aspects of the physical sciences as well.

One location has facilitated human donor studies important to the associated fields. However, they are conducted in a manner that is specific for the climate, flora and fauna of that area. In other areas, decomposition studies and the like have been performed with the use of porcine materials as a substitute for human materials. These studies are not reported here as invalid, but in order to apply the most appropriate and applicable science to matters of evidence, it is imperative that the most realistic methods and materials are used. Recognizably, the diversity of these United States requires the application of continuous studies to varied geographical areas and academic disciplines to achieve the best and most accurate results.

Thousands of people each year become donors to the 112 university sanctioned whole body donation programs throughout the U.S. The lack of research is not due to the unavailability of human specimens, but is a result of low numbers of requests by appropriate researchers. This may be attributed to the idea that many researchers are just not aware of the possibilities that exist for their projects. Questions regarding the ethical uses of whole bodies for science may further reduce the use of human remains by forensic researchers. It is the intention of the writers to provide a comprehensive presentation of the utilization of whole body donors to facilitate forensic research in the most appropriate manner possible.

Whole Body Donor, Forensic Research, Forensic Science

G5 Pediatric Homicides Related to Burn Injury

William F. Zaloga, DO, Wake Forest University Baptist Medical Center, Department of Pathology, Medical Center Drive, Winston-Salem, NC 27157; Kimberly A. Collins, MD, Medical University of South Carolina, 171 Ashley Avenue, Charleston, SC 29425*

After attending this presentation, attendees will be able to assign manner of death with more confidence in pediatric homicides related to burn injury.

This presentation will impact the forensic community and/or humanity by adding to and supporting the current literature of pediatric burn related homicides.

Burn related injuries and fatalities are usually thermal but may be placed into six categories: fire (including smoke inhalation injuries), scald, contact with a hot object, electrical, chemical, and ultraviolet radiation (sun). Many injuries are mistakenly referred to as "accidents" because they occur suddenly and are seen as unpredictable and uncontrollable; however, injuries often occur in predictable patterns.

We reviewed all forensic cases referred to the Medical University of South Carolina Forensic Pathology Section over the 28-year period from January 1975 through December 2002. All cases with victims 17 years of age and younger were analyzed and included in the study. We examined the age, sex, and race of the victims; type of burn injury; reported location; time of year; cause and manner of death; scene history; any perpetrator; injury-death time interval; and the autopsy and toxicology findings.

In our study there were 124 cases of pediatric burn related fatalities. The ages ranged from 6 months to 17 years. Categorized, the cases were 121 fire related fatalities (97%, 1 fire due to high voltage electrocution), and 3 scald fatalities. There were no burn related fatalities from contact with hot objects, chemicals, or ultraviolet radiation. Ninety of the burn related fatalities were in the 0-5 year age group (73%), with a peak (29 cases) in the 2 year age group.

The manner of the burn related deaths was also analyzed with 108 accidents, 12 homicides, and 4 undetermined. No cases were classified as suicide. Eleven of 12 burn-related homicides also occurred at the home (9 of 12 fire related and 3 of 12 scalds) with all of the victims in the 1-8 year age group. The perpetrator of the arsons was the mother in 5 cases, the sister in 1 case, and undetermined in 2 cases. Homicide involved a car fire in 1 case in which the father caused an explosion with an accelerant. The scald death perpetrators were the father, mother's boyfriend, and an aunt.

This retrospective study and review of the literature may reveal patterns useful for evaluation of manner of death. By recognizing scene characteristics, potential perpetrators, and children at risk we can better classify pediatric burn related fatalities.

Pediatric, Burns, Homicide

G6 Insect Succession Studies on Pig Carrion in Southwest Virginia and the Effects of Antemortem Ethanol Ingestion on Insect Succession and Development

Kimberly L. Tabor, BA, MS, Richard D. Fell, PhD, and Carlyle C. Brewster, PhD, Virginia Tech, 216 Price Hall, Blacksburg, VA 24061; Kevin Pelzer, DVM, Virginia Tech School of Veterinary Medicine, Blacksburg, VA 24061; George S. Behonick, PhD, Department of Criminal Justice Services, Division of Forensic Sciences, 6600 Northside High School Road, Roanoke, VA 24019*

The goal of this presentation is to present the results of the effects of antemortem ethanol ingestion on insect development patterns on pig

carrion; and to present the results of insect succession studies performed on pig carcasses during different seasons over a two year period.

This presentation will impact the forensic community and/or humanity by presenting research which describes an interdisciplinary animal model, incorporating the expertise of forensic entomology and forensic toxicology, in characterizing factors that may or may not influence the succession and development of insect taxa on postmortem remains. As a collateral forthcoming project, the model will provide the means to investigate the feasibility of using biochemical markers of ethanol consumption (fatty acid ethyl esters) in discerning antemortem ingestion of ethanol from postmortem neo-formation during decomposition.

Learning Objective: one method of estimating the postmortem interval (PMI) uses results from studies on the faunal progression or succession patterns of carrion arthropods. The pattern of insect succession is specific to the location and environmental conditions in which a carcass occurs. Because taxa can vary greatly with locale, particularly at the species level, it is important to identify the forensically important insects that are specific to an area. To date, no such data have been published for the southwest Virginia region. It is possible that factors such as antemortem ingestion of ethanol or drugs can affect succession patterns and insect development rates, thereby rendering a PMI estimation based on insect evidence inaccurate.

Succession studies were performed over three seasons for two years using untreated pig carrion. Over 57 insect taxa were collected and identified. An occurrence matrix showing dominant species on a seasonal basis is presented.

In an additional study, two pigs (weighing 57 and 66 kg) were intravenously dosed with a mixture of 95% ethanol and saline using an intravenous catheter inserted into an ear vein and by oral gavage. Two untreated pigs of similar weight (53 and 49 kg) were used as controls. Antemortem blood samples were colleced from both groups 15 minutes following delivery of ethanol to the treated animals. Euthanasia immediately followed the collection of blood samples. Loin meat was removed from each carcass to be used as a rearing medium for field development studies of the black blow fly, *Phormia regina.* The carcasses were placed under cages in a partially wooded field within one hour of death. Insects were collected and an occurrence matrix was developed. Results of the succession studies indicate no differences in the insect taxa collected from ethanol-treated versus control pigs. Decomposition rates were similar for all animals.

All four carcasses were necropsied in the field two days postmortem. Blood, tissue and maggot homogenate specimens were analyzed for ethanol by headspace gas chromatography (HSGC) utilizing a HP 7694 HS Sampler configured to an AgilentGC-6890 Plus™ with a flame ionization detector (FID). The column was a Restek Rtx-BAC1™ and the internal standard utilized was n-propanol. Total run time was four minutes. The limit of quantitation (LOQ) is 0.01%.

For the development studies, *P. regina* egg clusters were collected from carcasses and placed in rearing cups containing pieces of loin meat from either treated or control pigs (n=6 each). The rearing cups were kept outdoors to monitor development under natural conditions. Temperature and relative humidity were recorded at the site using HOBO® data loggers. Following egg hatch, six maggots were removed from each rearing cup every eight hours until pupation. Size and larval stage were recorded for each sample interval. The time from pupation until adult emergence was also determined. Preliminary data indicate no difference in development on meat from ethanol-treated versus control animals. However, the concentration of ethanol in the loin meat of treated animals (0.07%) was only slightly higher than that of controls (ND). Additional *in vitro* studies using meat fortified with higher concentrations of ethanol are being conducted to determine if alcohol can affect maggot development.

An ethanol vitreous humor concentration of 0.14% was obtained for one animal (No. 2) and the loin ethanol concentrations (No. 1 and 2) of 0.07% suggest distribution within the pig model similar to that encountered in the vitreous and skeletal muscle of humans. The experimental paradigm seems to provide a reasonably comparable model to human postmortem tissues and fluids for elucidating the influence or effect of antemortem ingestion of ethanol on insect succession and development. The postmortem blood ethanol determinations in animals 3 and 4 are consistent with postmortem neo-formation encountered in decomposition. Maggot specimens analyzed as homogenates obtained from animals 1 and 2 had higher ethanol concentrations when compared to the control, untreated animals (No. 3 and No. 4). The low ethanol concentrations observed in the control animal maggot specimens are possibly the result of postmortem neo-formation during decomposition or being a metabolic by-product attributed to maggot and bacterial interaction. Additional data from a second experiment, derived from serial collection of maggot masses over a period of five days, from ethanol-treated and control animals is provided in the poster.

ETHANOL RESULTS-% (WEIGHT BY VOLUME)

Animal No.	Antemortem Blood	Postmortem Blood	Loin	Maggots
1	0.14	0.11	0.07	0.06
2	0.16	0.10	0.07	0.04
3	ND	0.02	ND	0.02
4	ND	0.01	ND	0.02

Animals 1&2 ethanol-treated
Animals 3&4 non-treated controls
ND indicates not detected

The research describes an interdisciplinary animal model, incorporating the expertise of forensic entomology and forensic toxicology, in characterizing factors that may or may not influence the succession and development of insect taxa on postmortem remains. As a collateral forthcoming project, the model will provide the means to investigate the feasibility of using biochemical markers of ethanol consumption (fatty acid ethyl esters) in discerning antemortem ingestion of ethanol from postmortem neo-formation during decomposition. (The Virginia Tech Animal Care Committee approved this study).

Forensic Entomology, Ethanol, Maggots

G7 The Detection of Saliva: Factors Affecting the Phadebas® Press and Tube Tests

Melissa S Kell, BSc, Wendy Lalonde, BSc, Roger Frappier, MSc, and Jonathan Newman, BSc, Centre of Forensic Sciences, 25 Grosvenor Street, Toronto, ON M7A 2G8, Canada*

The goal of this paper is to present to the forensic community, the findings from a study conducted to assess a test employed to detect saliva in forensic casework samples.

Forensic biologists will learn of the relative merits of the Phadebas test for the detection of amylase applied quantitatively as a Tube Test and semi-quantitatively as a Press Test.

It is often necessary for a forensic biologist to locate and identify saliva stains in casework. Not only is saliva important as a source of DNA, its presence in various circumstances can corroborate aspects of an account of a crime. Unlike blood, which is usually evident by visible, red-brown staining, often saliva does not contain any visible components, making the "stains" difficult to observe. Therefore, chemical methods are used to locate saliva stains.

At the Centre of Forensic Sciences, the localization and identification of saliva is determined using the Phadebas® Amylase Test (Pharmacia and Upjohn Diagnostics AB, Uppsala, Sweden). This assay

is used to detect the digestive enzyme α-amylase, which is found in high quantities in saliva. The test can be performed in two ways: the press test (Willott and Griffiths, 1980) and the tube test (Willott, 1974). In this study, three variables were assessed to determine their effects on both the press and tube tests: 1) the quantity of amylase in a person's saliva, 2) the type of substrate on which saliva is deposited, and 3) the mixing of saliva with a second body fluid, either blood or semen. A second aim of the study was to evaluate the effectiveness of both tests to determine if the tube test is always necessary to perform in addition to the press test, and to determine the required duration of the press test.

Neat and diluted saliva from thirty individuals was used to stain cotton. Ninety percent of the neat saliva stains were detected in less than 10 minutes using the press test, and all neat saliva stains had amylase activities greater than 0.03 International Units (IU) (Willott, 1974) using the tube test. Overall, the tube test showed higher sensitivity. Press and tube tests were then performed on stains made from saliva from individuals covering a range of amylase levels on the following substrates: cotton, polyester, a blend of 95% acrylic 5% spandex, silk, satin, corduroy, denim, and white S & S #903 filter paper (Schleicher & Schuell Bioscience). The press test could detect saliva more readily on thinner, less absorbent fabrics, while higher amylase activities were obtained with thicker fabrics using the tube test. Experimentation was also done to determine how the deposition of saliva in the presence of semen and blood affects the press and tube tests. Stains were made of saliva and either blood or semen in three different ways: 1) mixing prior to deposition, 2) depositing saliva, letting it dry then depositing the other body fluid on top, and 3) depositing the other body fluid first, letting it dry then depositing saliva on top. Semen did not interfere with the detection of saliva using the press or tube tests, regardless of the method of deposition. Blood did not interfere with the detection of saliva using the tube test, but when the press test was performed there were some instances where the result took longer to appear or did not appear within the 20-minute test period.

Overall, the press test is sufficient for detecting saliva stains in most cases if administered for 40 minutes. The limitations discussed must be considered when blood is present on the sample to be tested, or if the substrate fabric is heavy / thick (e.g., denim).

Saliva, Phadebas, Amylase

G8 Places to Commit Suicide

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NO ABSTRACT PROVIDED.

Suicide, Place of Death, Methods of Suicides

G9 Dramatic Rise in Methadone-Related Deaths in Oklahoma 1990-2002

Ronalod F. Distefano, DO, Office of the Chief Medical Examiner, State of Oklahoma, 1115 West 17th Street, Tulsa, OK 74107*

After attending this presentation, attendees will have awareness of dramatic increase in methadone-related deaths and potential explanation of why they occur. This trend is evolving nationwide and there is every expectation that it will continue.

This presentation will impact the forensic community and/or humanity by making the forensic community aware of the emerging epidemic of deaths related to this drug and the reasons for it. Unique aspects of its pharmacology interacting with ignorance of this by physicians, patients, and substance abusers have resulted in an emerging tragedy. The forensic community needs to enlighten the broader community as part of its public health and public safety missions.

Deaths attributed to the toxic effects of methadone, alone or in combination with other drugs, have dramatically increased in the State of Oklahoma during the study period. Tabulation of these deaths on an annual basis from records of the Office of the Chief Medical Examiner of the State of Oklahoma demonstrates this trend. A comparison of deaths in the three-year period 1990–1992 versus 2000–2002 shows 7 versus 140 respectively. This parallels a dramatic rise in the prescribing of methadone in the state, particularly for the treatment of chronic pain. Possible rationales for this increase including unique aspects of the pharmacology of methadone are discussed.

Methadone, Deaths, Chronic Pain

G10 Fatal Botox®-Induced Anaphylaxis? A Case Report

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After attending this presentation, attendees will learn about autopsy findings and laboratory diagnosis of anaphylactic reactions and the history and uses of Botox®.

This presentation will impact the forensic community and/or humanity by reporting on the first case of Botox® associated death; describing what kind of conditions Botox® is currently used for, and that it can possibly be a cause for anaphylaxis; and describing how to support the diagnosis of anaphylaxis.

Introduction: adverse drug reactions can occur with any therapeutic drug, with anaphylaxis being the most serious event. Botox (botulinum type A, Allergan Inc, Irvine, CA) is a relatively new drug that is FDA-approved for blepharospasm, strabismus, cervical dystonia and glabellar wrinkles. It is also used 'off label' for a variety of disorders such as chronic pain syndromes, hyperhidrosis, cosmesis, and achalasia. It has been touted as extremely safe and effective. To date, no deaths associated with Botox have been reported. We report the first case of anaphylaxis and death in a woman who received a mixture of Botox and lidocaine injections.

Case History: a 43-year-old woman who had chronic upper back pain presented at a rehabilitation clinic for a repeat set of Botox and lidocaine injections. Fourteen months previously, she had received her first set of Botox injections and obtained relief from her pain for several months. However, over the last few months, her back pain returned. A 5 cc solution of 1% Lidocaine and 100 units of Botox was made and 1 cc was injected into each of the 5 trigger points located in her upper back. Immediately following the last injection, she experienced a vasovagal reaction, lost consciousness and exhibited seizure activity. She was transported to the local hospital emergency room, where despite all efforts, she died.

Autopsy and Toxicologic Findings: the most significant autopsy finding was pulmonary edema and hemorrhage. The hypopharynx, larynx and trachea showed no evidence of edema or hemorrhage. Postmortem blood toxicology demonstrated a lidocaine level of 1.1 ug/mL and a methadone level of 0.12 mg/L. Premortem serum demonstrated a tryptase level of 37.6 ug/ml (reference range 0.4-10.9 ug/ml) and an IgE level of 6.7 IU/mL (reference range 0.0-100.0 IU/mL).

Discussion: anaphylaxis can occur quite suddenly, and is often a clinical diagnosis or a diagnosis of exclusion. It commonly occurs with food allergies and insect stings. An elevated serum tryptase level can support the diagnosis of anaphylaxis. Tryptase is a mast cell specific enzyme that is released in allergic reactions. This patient demonstrated a greatly elevated tryptase level. Although IgE was not significantly ele-

vated, it does not exclude anaphylaxis, since some drugs may trigger mast cell degranulation directly. Because the mixture included lidocaine, the cause of the anaphylaxis cannot be definitively solely attributed to Botox, since rare anaphylactic reactions and death have been associated with lidocaine. The patient's previous injections of Botox may have been the time of sensitization.

Conclusion: both Botox and lidocaine have few reported adverse side effects. This is the first Botox associated anaphylactic reaction and death. Despite reports of safety and few complications, precautions should always be taken for an adverse reaction.

Botox®, Lidocaine, Anaphylaxis

G11 Significant Trends in Work-Related Deaths — United States

Gordon K. Murphy, MD, 814 Hathaway Road, Dayton, OH 45419-3555*

After attending this presentation, attendees will become familiar with work-related deaths and how to investigate them properly.

Both the general public and forensic scientists will realize that there are hazards inherent in every form of work, whether sedentary, or involving physical labor. Prevention of work-related deaths involves recognition of hazards; personal protective equipment; instilling proper work practices; and monitoring the workplace. It will be recognized that most important of all is a persistent commitment to safety by both management and labor. While there has been a significant decrease in work-related deaths over time, many still occur, and many of these are preventable.

In recent years, work-related deaths have ranked second only to motor vehicle accidents as a category of accidental deaths in the USA. It is vital that the forensic scientist be familiar with all aspects of work-related deaths because of their frequency; the often time-consuming and complex nature of a proper investigation; and because these deaths often have implications for the living as well, in the context of prevention. A significant number of these deaths result in litigation - civil, criminal, or both.

Investigation of work-related deaths involves thorough examination and documentation of the scene of death, with expert consultation when indicated; a complete autopsy, including toxicology; and clear statement of conclusions of the investigation as warranted by the evidence.

Four significant trends in work-related deaths in the USA are apparent from experience and review of the literature. 1 - A significant decrease in the number and incidence of work-related deaths particularly since the turn of the 20th century, as well as in the past 20 years 2 - Mining and quarrying; construction; and agriculture in that order were formerly the three industries in which the largest numbers of work-related deaths occurred. Due to significant improvements in safety in mining and quarrying, and in agriculture, the three leading industries are now construction, transportation, and manufacturing. 3 - Work-related deaths due to gunshot were formerly infrequent. Since 1990, however, homicide has been the second-leading cause of work-related deaths in the USA. Homicide is the leading cause for females. 4 - Deaths due to collapses of open-trench excavations in construction, although preventable, continue to rise.

Illustrative cases: Construction - a motor-vehicle accident, the leading cause of work-related death. Deaths at two construction sites, one presenting the coroner with an unusual responsibility Open-trench excavation - a death resulting in both a large fine stemming from OSHA citations, and a civil lawsuit. Homicide - While the great majority of work-related homicides are committed by fellow workers, each of these two cases is a law enforcement officer shot and killed by another because of mistaken identity during a crisis. Manufacturing - death in a chocolate candy factory Death from immersion in a vat at a paper mill Accidental death of a lawyer at work

Conclusions: The investigation of work-related deaths is challenging. It requires broad knowledge of various fields of work, and of the dangers inherent in each. Investigation must be both wide-ranging, yet focused. All findings must be rigorously documented.

Both the general public and forensic scientists will realize that there are hazards inherent in every form of work, whether sedentary, or involving physical labor. Prevention of work-related deaths involves recognition of hazards; personal protective equipment; instilling proper work practices; and monitoring the workplace. It will be recognized that most important of all is a persistent commitment to safety by both management and labor.

While there has been a significant decrease in work-related deaths over time, many still occur, and many of these are preventable.

Work-Related Death, Homicide, Investigation

G12 Over Diagnosis of Low Voltage Electrocution

Ronald K. Wright, BS, MD, JD, 2101 SW 29th Avenue, Fort Lauderdale, FL 33312*

After attending this presentation, attendees will understand the mechanisms of death in electrocution; be provided easily conducted analyses to prevent over diagnosis of electrocution; recognize that over diagnosis of electrocution is relatively common.

This presentation will impact the forensic community and/or humanity by understanding the pitfalls which can occur in investigation of low voltage electrocutions and techniques to employ to reduce over diagnosis.

The fact that electrical burns are the only significant finding in low voltage electrocutions is well known in the forensic pathology community. The fact that electrical burns are seen in only approximately 50% of low voltage electrocutions is also well known. Further, it is generally understood that a high index of suspicion is required if there is a possibility that an electrical circuit may have killed someone, as the autopsy will not identify the cause of death in approximately 50% of cases.

Unfortunately, the above works to create over diagnosis in some cases. The author has encountered eight cases of over diagnosis of low voltage electrocution in the past eight years in his consultative practice of forensic pathology. Of these cases, the author was a consultant to the defense in seven and to the plaintiff in one. The possibility of bias could thus be argued, but then again, the government-hired death investigator also has a bias to determine a cause of death, and in the majority of these cases, if electrocution was not diagnosed, the cause of death was certainly obscure. Invocation of electrocution made a tidy diagnosis in an otherwise puzzling case in the majority of cases.

The eight cases presented show variable circumstances, with varying degrees of certainty that the death could not have been electrocution.

In each case there was a possibility of electrocution because some source of electricity was available to the deceased prior to his or her demise.

In each case, the approach will be to show that for there to be an electrocution, there must be a circuit of more than 16 mamps through the person immediately prior to the death. 16 mamps is used a minimal figure as that is the average "no let go" value for alternating current passing from hand to hand. Further, it is necessary to show that the circuit of more than 16 mamps traversed the body through the chest or the head or both. With low voltage electrocution the mechanism of death is either asphyxia (rarely) or ventricular fibrillation (commonly.) Asphyxia is produced by prolonged exposure (minutes) of the chest causing tetanic contractions of the chest musculature during a through-the-chest circuit or by seizures induced by a through-the-head circuit. Ventricular fibrillation requires a through the chest circuit, of probably

more than 100 mamps of current flow, but of very brief duration, as little as 0.2 seconds.

For there to be a circuit of more than 16 mamps through a person there must be exposure to voltage sufficient to overcome the resistance to current flow which the human body presents. For contact through the skin, requiring the skin to be minimally keratinized, moist and flushed, the resistance is greater than 1000 ohms. Thus to achieve 16 mamps of current flow requires 16 volts as a minimal voltage to achieve "no let-go." As will be shown, one of the cases involved batteries have a voltage below 16 volts, thus making it a case of over diagnosis.

Further, low voltage direct current probably requires much higher current flows than seen with alternating current making the DC current case even more unlikely.

In one of the cases, the conduit through which wires passed caused the insulation to be cut, causing a short circuit which blew the fuse to the transformer. Upon replacement of the fuse, the cut wire arced periodically. As the conduit was grounded, it was never ever to have a voltage, and thus insufficient voltage provided a way to determine over diagnosis.

In another case, the possibility of ground leakage, producing a force field of varying voltages over distance was proposed as the mechanism of electrocution. Demonstration of shoes with high dielectric (resistance to the flow of electricity) made the over diagnosis unlikely.

In four of the eight cases the autopsy demonstrated causes of death from other causes than electricity. These included traumatic asphyxia, ruptured AV malformation of the lung, aortic stenosis with cardiomegaly and buried left anterior-descending coronary artery with ischemic changes new and old in the distribution of the LAD.

In two of the cases the deaths were witnessed. In both of these cases there was no involuntary movement produced by the flow of electricity. A circuit through a person sufficient to cause death causes involuntary contraction of the muscles in the circuit 0.2 seconds after the initiation of the circuit. This results in a scream or shouts if the current passes through the chest. In addition, if the circuit passes through the upper extremity there is involuntary flexion. If the circuit passes through the trunk and lower extremities there is involuntary extension. Both of these phenomena should be described by witnesses who could see and hear the soon to be deceased. In two the presented cases no such movements were heard or seen.

However, the most striking and uniform absence in all of the presented cases is the pathway to ground. In none of the presented cases was there a demonstrable pathway to ground. To have an electrical circuit there must be a source of electrons and something conductive to allow them to flow to a place with fewer electrons. In a low voltage electrocution there must be a circuit of more than 16 mamps from an energized source and the person must be grounded to complete the circuit. In all eight cases there is complete absence of pathway to ground, thus an analysis of pathway to ground which is simple and easy to do, is the most important criteria to employ in the investigation of a possible electrocution.

Autopsy, Electrocution, Cause of Death

G13 Accidental Parachuting Death Due to Equipment Failure

Martha J. Burt, MD and Matthew J. Bowes, MD, Miami-Dade County Medical Examiner Department, Number One on Bob Hope Road, Miami, FL 33136*

After attending this presentation, attendees will understand the importance of an integrated approach to determining cause and manner of death in skydiving related fatalities.

This presentation will impact the forensic community and/or humanity by emphasizing the importance of a multidisciplinary approach to death investigation.

The goals of this research project are to recognize the importance of a multidisciplinary approach to the investigation of parachute deaths, with an emphasis on the importance of scene investigation and equipment analysis.

Skydiving carries a low but significant risk of harm for participants. Between 1992 and 2002, there have been between 27 and 44 skydiving deaths per year in the United States, with an average of approximately 35 deaths per year. As compared with other high risk sports, skydiving has a relatively low mortality rate (25 deaths per 100,000 participants, versus SCUBA diving, 25 per 100,000 and boxing, 50 per 100,000 participants). Human error is the most important cause of mortality in skydiving. Equipment failure is considered rare.

Case Report: A 47-year-old male with no significant medical history began his dive at 13,000 feet. He deployed his main parachute at 5000 feet. The position of his body at the time of deployment of the parachute was head down. Witnesses observed the parachute deploy properly, but the subject did not steer. The subject began to spin, thus tangling his lines. The subject was not observed to make an attempt at cutting the lines and deploying the reserve parachute, which would have been the correct course of action. The subject fell to Earth in a grassy field some distance from his designated drop zone. At the time of his impact, his body was traveling at somewhat less than terminal velocity, since his parachute was deployed, but deployed imperfectly. Fire-rescue was called, but resuscitation was unsuccessful and he was pronounced at the scene.

External examination showed a mildly obese male with several abrasions, lacerations and contusions. In particular, the left neck had a transverse, linear, patterned mixed abrasion and contusion. Internal examination demonstrated scant subarachnoid hemorrhage without skull fractures or cerebral contusions. The organs of the neck underlying the transverse abrasion/contusion had extensive acute hemorrhage. The atlanto-occipital joint was several dislocated, without transection of the brainstem or proximal spinal cord, but with significant impingement on the brainstem and spinal cord structures. Several ribs were fractured. The heart had a full thickness laceration of the right ventricle with hemopericardium. The coronary arteries did not have any atherosclerosis. The lungs were contused but not lacerated. The liver and spleen were extensively lacerated.

Examination of the parachute harness demonstrated a torn vertical nylon strap on the left side, which connected the horizontal chest strap to the leg straps. The vertical strap doubles over through a metal ring to allow for adjustment to the harness length between the chest strap and the leg strap. The edges of the nylon strap were frayed in close proximity to the metal ring. The company owned several other similar harnesses of the same type, which showed significant wear pattern in the same location.

Integration of data collected from the scene, autopsy and analysis of the harness allowed us to surmise that the nylon strap had snapped when the parachute deployed, thus causing the freely mobile chest strap on the left to be violently pulled caudally by the deploying parachute, forcefully abrading and contusing the left side of the neck while snapping the head backward. This caused the atlanto-occipital dislocation, disabling the subject and making self-rescue impossible. The disturbed flight characteristics of the limp and unbalanced human form caused the parachute to spin and tangle, hastening the subject's descent. The death was ruled an accident.

Equipment failure as a cause of parachute death is rare, but potentially preventable. This case underscores the critical importance of equipment evaluation by a competent analyst.

Skydiving Death, Parachute Equipment, Scene Investigation

G14 The Richard Cory Phenomenon: Suicide and Socioeconomic Status in Kansas City, Missouri

Thomas W. Young, MD, Jackson County Medical Examiner, 660 East 24th Street, Kansas City, MO 64108; Suzanna Wooden, University of Missouri, Kansas City School of Medicine, 2411 Holmes, Kansas City, MO 64108; Jinwen Cai, MD and Gerald L. Hoff, PhD, Kansas City Missouri Health Department, 2400 Troost, Kansas City, MO 64108; Paul C. Dew, MD, MPh, University of Health Sciences, 1750 Independence Avenue, Kansas City, MO 64106*

The goal of this presentation is to present findings from a retrospective study demonstrating a positive association between suicide and socioeconomic status.

This presentation will impact the forensic community and/or humanity by enabling the design of more effective public health interventions for people at risk for suicide. The study also illustrates how data obtained from a coroner or medical examiner agency may be useful for the epidemiologic research of violent death.

Edwin Arlington Robinson's famous poem, "Richard Cory," tells how a man of refinement and wealth goes home "one calm summer night" and inexplicably puts "a bullet through his head." The poem leaves the reader surprised that a wealthy man with all one could seemingly desire in life kills himself. Is a suicide like his unexpected? Results of a retrospective study performed in Kansas City, Missouri, indicate that suicide actually occurs more frequently among those with more of life's finer things.

The Jackson County Medical Examiner receives reports of and investigates all deaths from injury and many natural deaths in Jackson County, Missouri, and maintains a database of information from these investigations. The information includes the home address of each victim. Jackson County Government performs house and personal property appraisals for taxation purposes. Appraisal values for real estate and personal property can be viewed from the Jackson County Government website (www.jacksongov.org) by the parcel address and by the name of each individual owning personal property subject to taxation. These government home and personal property appraisals tend to be lower than actual real market value.

The authors studied all suicides reported to the Medical Examiner from 1998 to 2002. They compared appraisals of houses where suicide victims used to live to appraisals of houses lived in by victims from a control group of non-suicidal deaths. Each non-suicide control victim was randomly selected from the Jackson County Medical Examiner database and matched by age, race, sex, and year of death with each suicide victim. Where available, appraisals for personal property owned by each victim, the victim's spouse, or the victim's parents were also obtained and compared for each group. Additionally, stressors for suicidal intent, such as financial strain, recent loss of a loved one, relationship difficulties, and health, mental or drug problems, were identified for each suicide from investigative reports.

The suicide and control groups each had 426 victims. Significantly more victims in the suicide group lived in houses than victims in the control group (suicide: 70% vs. control: 56.8%, $p < 0.001$ by chi square analysis). Appraisal values for the houses obtained for 277 members of the suicide group had a significantly higher mean and median compared to those of 227 members of the control group (mean: $70,143 for suicide vs. $61,513 for control, median: $62,316 for suicide vs. $50,580 for control, $p = 0.04$ for two means by two-tailed t-test). Personal property appraisals were available for only 93 members of the suicide group and 90 members of the control group. Although the mean and median appraisals were higher for the suicide group (mean: $3,666 for suicide vs. $3,054 for control, median: $2,750 for suicide vs. $2,045 for control), the differences were not statistically significant. Analysis of stressors within the suicide group identified mental health and relationship issues as the predominant stressors, but financial strain, identified in only 8% of victims, was the least frequent stressor. Those suicide victims identified with financial strain had even higher mean and median house values than the suicide or control groups (mean of financial strain group, $77,126; median, $74,050).

The data indicate that suicide victims are: 1) more likely to live in houses than other victims rather than in apartments or trailers, 2) more likely to live in more expensive houses than other victims, 3) more likely to kill themselves because of factors other than financial strain, and 4) if financial strain is a factor, more likely to kill themselves after becoming accustomed to a more affluent lifestyle.

Suicide, Socioeconomic Status, Retrospective Study

G15 Suicide: A Ten-Year Retrospective Review of Kentucky Medical Examiner Cases

Lisa B. Shields, MD, Donna M. Hunsaker, MD, and John M. Hunsaker III, MD, JD, Office of the Associate Chief Medical Examiner, 100 Sower Boulevard, Frankfort, KY 40601*

The goal of this presentation is to present a retrospective analysis of information gleaned from postmortem examinations of all suicides from the medical examiners' records in Kentucky between 1993 and 2002; and to correlate this data with national trends regarding suicides.

This comprehensive report aims to dispel the conventional image of the suicide victim as an elderly Caucasian male afflicted by physical disease and demonstrate how suicidal trends have been drastically altered over the years; and to delineate distinguishing characteristics present at the scene and revealed in the medical history that may aid investigators in ascribing the manner of death as suicide.

According to the Center for Disease Control's Monthly Vital Statistics Report in 2000, suicide ranks eleventh in the United States and accounts for approximately 30,000 deaths annually. A host of biological and psychosocial components interplay in the investigation of a suicide. Precipitating factors may include domestic quarrels, loss of employment, financial difficulties, substance abuse, chronic disease, or mental illness. The commonly held belief of the typical suicide victim includes either an elderly Caucasian male with a debilitating disease or a female dying from acute drug intoxication commonly referred to as an overdose. Men are more likely to commit suicide than women. Researchers attribute the lower number of female suicides to a larger number of women who may attempt, but fail to commit, suicide by drug overdose. Furthermore, women may be prone to ventilate emotional problems with others in an attempt to avert suicide whereas men are less likely to admit hardships and are more impulsive in their actions. Although a suicide note may illustrate suicidal intent, it is present in less than one third of cases reported by some authors.

This study presents all 2,866 medical examiner cases of suicide between 1993-2002 in Kentucky. The majority of victims were males (81.8%) and Caucasian (94.8%). Black females comprised the smallest group of decedents, consisting of only 0.59% of suicides. Individuals ranged between 11 and 96 years of age with an average age of 42.0 years. The greatest number of suicides occurred in the fourth decade of life followed by the fifth decade and then the third decade. The preferred mode of death was by gunshot (67.6%), followed by hanging (13.7%), overdose (10.0%), and carbon monoxide poisoning (4.6%). Of the 1,934 gunshot wound fatalities, 79.5% of the wounds involved the head, 18.3% the chest, and 2.6% the abdomen. Both males and females chose a firearm as their primary means of committing suicide, 71.4% and 50.5%, respectively. The head was the most likely target of the gunshot wound in all shooting victims, specifically, 80.4% of the men and 72.7% of the women. 65.5% of black victims utilized a firearm to commit suicide, and 83.8% of these were head wounds. In men, the second and third most common causes of death respectively were hanging (14.5%) and overdose (5.9%). Conversely, this pattern was reversed in women:

the second leading cause of death was overdose (28.1%) and the third, hanging (10.3%).

The review analyzes a myriad of factors that may have prompted an individual to commit suicide: medical and psychiatric history, domestic relationship problems, substance abuse, financial and legal difficulties, and seasonality. The presence of a suicide note, previous suicide attempts, family history of suicide, dyadic murder-suicide, and suicide by cop have also been documented. A discussion of "playing" with a gun known in Russian Roulette and issues related to schizophrenic patients who commit suicide will also be presented. Furthermore, this study inventories and discusses the variety of disease processes and toxicological findings uncovered at autopsy.

Forensic Science, Forensic Pathology, Suicide

G16 Homicidal Cerebral Artery Aneurysm Rupture

Joseph A. Prahlow, MD, c/o South Bend Medical Foundation and Indiana University School of Medicine, 530 North Lafayette Boulevard, South Bend, IN 46601*

After attending this presentation, attendees will understand that, in the correct setting, a natural disease cause/mechanism of death may be considered a homicide, and to learn a set of proposed criteria for such deaths involving ruptured cerebral artery aneurysms.

This presentation will impact the forensic community and/or humanity by addressing the difficult question of whether or not minor head trauma, or even the threat of trauma, can be implicated in a death due to ruptured cerebral artery aneurysm. If trauma (or threats of trauma) can be considered a contributory cause in such deaths, "homicide" may be a reasonable manner of death, given the proper circumstances. The paper proposes a set of criteria to help forensic pathologists determine whether or not a given case represents a "homicide by ruptured berry aneurysm."

In 1978, Davis published his classic work, "Can sudden cardiac death be murder?"[1] In Davis' paper, a logical, well-reasoned argument is made for certifying certain cardiac deaths as homicides, so long as a set of specific criteria are met. Using Davis' criteria, a mugging victim who suddenly collapses and dies from underlying severe coronary artery disease can be appropriately ruled a homicide. While some forensic pathologists may not agree with such a ruling, the phrase "homicide by heart attack" remains well-known to many within the forensic community.

Cardiac disease is not the only natural disease process that can be considered the underlying mechanism of death in homicide. Subarachnoid hemorrhage related to traumatic ruptured cerebral artery berry aneurysm or arteriovenous malformation has received some attention in the medical and forensic literature. In this paper, we present a case of "minor" head trauma causing the rupture of a cerebral artery aneurysm. The MOD was considered "homicide." The ensuing discussion will address this controversial topic and present a proposed set of criteria useful in making such a determination.

An intoxicated, 46-year-old man, his wife, and their female friend returned to the friend's home late one night, after having been out for dinner and drinks. The man was reportedly loud and boistrous. Upon hearing the commotion, the friend's adult daughter, who had been sleeping, got-up, came-out of the bedroom, and asked them to be quiet, since her live-in boyfriend needed to get-up early for work. She then stated that she was going back to bed. The 46-year-old man then proposed to the daughter that he might join her in bed. The daughter's live-in boyfriend then emerged from the bedroom and confronted the intoxicated man. A short verbal altercation ensued, followed by a single punch, thrown by the boyfriend, that landed on the other man's face. The man immediately collapsed to the floor, totally unresponsive. Emergency resuscitation was initiated by the owner of the home. Emergency medical services responded to a 911 call and transported the victim to the hospital, where work-up and imaging studies revealed diffuse basilar subarachnoid hemorrhage and a ruptured berry aneurysm in the basilar artery. He died approximately 36 hours after the initial collapse.

Autopsy confirmed the presence of diffuse, basilar subarachnoid hemorrhage, as well as a ruptured, 9 mm basilar artery aneurysm. Brain examination was consistent with global ischemia. The remainder of the autopsy was significant for cardiomegaly (500 gm), with concentric left ventricular hypertrophy, as well as mild to moderate atherosclerotic cardiovascular disease involving the aorta and coronary arteries. There were no facial injuries identified at autopsy. A blood ethanol level from the time of hospital admission was 153 mg/dL.

Police investigation confirmed the story as presented above. The victim's wife, the homeowner, her daughter, and the boyfriend all related similar scenarios as they recalled the events. The cause of death was ruled "subarachnoid hemorrhage due to ruptured basilar artery aneurysm following blunt head trauma." The manner of death was ruled "homicide."

Whether or not "minor" head trauma may cause the rupture of a cerebral artery aneurysm (or arteriovenous malformation) remains a controversial topic. Some claim that "significant" or "severe" head trauma is necessary, with concomitant skull fractures or brain contusions/lacerations. Others feel that minor head injury is sufficient, in certain instances, to cause aneurysm rupture. A careful review of the literature suggests that minor head trauma may, in fact, contribute to or cause the rupture of an intracerebral aneurysm or arteriovenous malformation. This appears to be true particularly when the traumatic event (or threatened traumatic event) is associated with intense emotion, with a rise in blood pressure. Another factor that increases a person's risk for cerebral aneurysm rupture (traumatic or spontaneous) is ethanol intoxication, due most probably to the considerable intracranial blood vessel dilatation known to occur in association with ethanol intoxication.

The following represent a proposed set of criteria for ruling a ruptured cerebral artery aneurysm (or arteriovenous malformation) as a homicide: 1) Head trauma (and/or extreme emotional stress) must immediately precede the onset of symptoms related to ruptured aneurysm (or arteriovenous malformation). 2) Autopsy findings must confirm the presence of a ruptured aneurysm (or arteriovenous malformation), with no findings indicating that the rupture occurred prior to the trauma/emotional stress. 3) When head trauma is implicated, autopsy evidence of physical injury of the face/head may or may not be present. 4) Head trauma (and/or extreme emotional stress) must have occurred during or as a result of an event that would normally be considered a form of criminal activity. 5) In order to implicate the emotional stress of an event as a cause or contributing cause of the intracranial hemorrhage, the victim should have realized that the threat to personal safety was implicit, and the circumstances should be of such a nature as to be commonly accepted as highly emotional.

It is important to remember that each case must be evaluated on its own. Death scene investigation and witness statements are often of paramount importance, particularly when attempting to address criteria #1, #4, and #5. If the criteria are not met, it is prudent *not* to rule such a death as a homicide. In such an instance, an "undetermined" ruling is acceptable, with or without a statement suggesting that the case may represent a homicide. As a corollary, a modified form of the criteria may be utilized in an attempt to determine whether accidental trauma can be implicated in deaths related to ruptured cerebral aneurysms or arteriovenous malformations; criteria #4 would not apply in such accidental trauma cases.

Reference: 1. J.H. Davis. Can sudden cardiac death be murder? *Journal of Forensic Sciences* 23(2):384-7,1978.

Homicide, Natural Disease, Cerebral Aneurysm

G17 Death by Defibrillator: A Unique Homicide by Electrocution

Kendall V. Crowns, MD and Adrienne Segovia, MD, Cook County Medical Examines Office, 2121 W. Harrison Street, Chicago, IL 60612*

This presentation will review a case in which an external defibrillator was used as a weapon, discuss the general features of defibrillators, and review the role of defibrillators in accidents and suicides.

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A 49-year-old mentally challenged black male worked as part of a cleaning crew in a suburban dialysis clinic. According to co-workers while he was mopping the floor he had a seizure and collapsed to the floor. Upon their arrival paramedics found the subject in ventricular fibrillation and despite full advanced cardiac life support measures including external defibrillation he was pronounced dead at a local emergency room.

The autopsy examination showed a well developed, well nourished black male weighing 189 pounds and measuring five feet nine inches in height. Externally there were two irregular burn marks: one on the upper left chest measuring 0.9 x 0.6 inches and the other on the upper right chest measuring 0.5 x 0.4 inches. Internal examination was remarkable for a 415 gram heart and 90% atherosclerotic occlusion of the right coronary artery. The remaining coronary arteries were free of atherosclerotic disease. The lungs and brain were remarkable only for the presence of edema. A scene investigation was performed which disclosed no irregularities or the presence of electrical equipment in the room in which the decedent had worked. The cause of death was attributed to coronary atherosclerosis and the manner of death was natural.

One week later a member of the cleaning crew came forward stating that the initial story had been a fabrication. The crew member revealed that an 18-year-old co-worker, who had tormented the mentally challenged decedent on multiple occasions, had turned on one of the clinics external defibrillators which had a preset energy level of 200 joules. The 18-year-old then coaxed the decedent over and discharged the defibrillator into his chest. Following this statement and police investigation, the cause of death was amended to electrocution and the manner of death was changed to homicide.

The first experiments using electricity to stop the heart were conducted in 1775 using chickens. It was not until 1956, however, that the first successful external defibrillation was performed on humans.

A defibrillator delivers 60,000 watts of electricity in four to five millisecond intervals with a resultant energy level of 300 joules. This level of energy is analogous to a bolt of lightning. A properly used defibrillator delivers a current through the chest wall and heart. This causes the heart to stop and allows the pacemaker cells of the heart to repolarize and re-establish a sinus rhythm.

There are two general types of defibrillators, external and internal. These can be further sub–divided into either manual or automatic/semiautomatic types depending on whether an individual or machine recognizes the ventricular fibrillation. Defibrillators can be further subdivided based on charge direction, monophasic or biphasic of the defibrillator. Defibrillator energy levels range from 0 to 360 joules for manual defibrillators and to a preset range of 200 to 350 joules with automatic/semiautomatic defibrillators.

Among paramedics accidents occur at a rate of 1 per 1,700 defibrillator shocks and 1 per 1,000 for EMTs trained in the use of defibrillators. The most commonly reported injuries in these groups are accidental shocks. In patients, the most common accidental injuries are skin burns, and occasionally myocardial muscle damage. Rarely, an automatic defibrillator may shock a patient with a normal rhythm and cause fatal arrhythmias.

Two cases have been reported in which defibrillators were used in suicide attempts. In one a male nurse discharged the defibrillator into his head. He survived and recovered fully. The second case involved a hospital employee who discharged a defibrillator into his chest. He was found in ventricular fibrillation and died despite resuscitative efforts.

No reported cases of the homicidal use of external defibrillators were found in a review of the literature. This case represents a unique and to date unreported form of homicidal electrocution.

Defibrillator, Electrocution, Homicide

G18 The Influence of Violence in the Media on Unusual Methods of Murder and Suicide

Karin A. Margolius, MD, LLB and Gerard A. Cadden, MD, PathCentre, Locked Bag 2009, Nedlands, Perth, WA 6009, Australia*

After attending this presentation, forensic pathologists and crime scene officers will learn about he difficulties in detecting hidden homicides and that knowledge of the latest media releases is vital in crime scene analysis.

This presentation will impact the forensic community and/or humanity by describing to the forensic community the subtleties in signs of murder; addressing the need to be aware of the latest film releases; and addressing the need for an integrated scene analysis team.

There is a wealth of research about the influence of the media on violence, particularly homicides. Most recent reports show little or no correlation between crime and viewing habits. This has not stopped the calls for censorship of the media which may restrict freedom of speech.

The cases to be presented have been linked to a film in which there was an unusual method of causing death. The film showed the perpetrator encasing the victims in a film of plastic wrap causing asphyxiation. He then removed the wrap and the murders remained unsolved for a long period of time. Similarly subsequent concealment of the homicide method occurred in one case so that crime scene analysis would have been difficult if the recent release of the film had noted been identified.

A teenage girl was found lying in an undisturbed bed in the bedroom of a house occupied by her boyfriend. She had two broken fingernails, a small bruise on the thigh and a few petechiae in her eyes. Not far from her head was a roll of unused plastic cling-type wrap while the remainder of the wrap was found in the garbage bin some distance away. At trial the perpetrator confirmed that he copied the method of murdering his victim after viewing the film.

In another case a woman was found with the plastic wrap around her head requiring intense crime investigation into the circumstances surrounding her death. After seeing the film, she used the method to kill herself. In a similar case suicide was thought to be the manner of death in a man who was found with wrap around his head and neck.

Each case will demonstrate the difficulty in scene analysis, the problems in excluding homicide and the need for an awareness of the latest film releases. There are features in each case that suggest that the deaths were due to homicide. Each case died after seeing the same film, utilizing the same method as shown in that film. The media has influenced the deaths in these cases.

Homicide, Media, Concealment

G19 Use of the Impact Baton or So-Called "Rubber Bullet" as Less Lethal Force in Air vs. Water

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After attending this presentation, attendees will be able to recognize and differentiate wounds associated with impact baton, versus gunshot wounds associated with handguns and/or high velocity projectiles. Comparison will be made between impact baton wounds occurring in air as opposed to water.

This is a case of an officer involved shooting with a local law enforcement SWAT Team intervention using "less lethal" force which recently occurred at our office. The decedent is a 34-year-old white Hispanic man measuring 69 inches in height and weighing 283 pounds. The decedent had barricaded himself inside his trailer and was armed with a weapon. He was apparently depressed over his mother's illness and had a history of drug abuse. Less lethal force was used to subdue the decedent in the form of a police dog as well as the use of the "Impact Baton" or so-called "Rubber Bullet." The Sage Control Ordnance KO1 ammunition in a 37 mm Arwen 37 Mark III was used. This is known as the Sage Less Lethal Launched Ammunition and Ordnance System (L3A0S). The less lethal means used to subdue this man were unsuccessful and he was ultimately subdued with the use of .223 high velocity rifle wounds. The Arwen round wounds observed in this case will be compared to a second case in which rubber bullets were used to subdue an armed man in the San Gabriel River in Los Angeles County. In the second case the impact batons were fired through water, thus altering the wound characteristics. No fatal bullet wounds were incurred and the man ultimately drowned.

Rubber Bullet, Impact Baton, Less Lethal

G20 Dissection, Preservation and Sexual Abuse of Bodies and Body Parts – An Exceptional Case of Necrophilia

Martin Bauer, MD and Thomas Tatschner, MD, University of Wuerzburg, Institute of Legal Medicine, Versbacher Str. 3, Wuerzburg 97078, Germany; Michael Roesler, MD, Institute of Forensic Psychology and Psychiatry, Saarland University, Kirrberger Straße, Homburg 66421, Germany; Dieter Patzelt, MD, Institute of Legal Medicine, University of Wuerzburg, Versbacher Str. 3, Wuerzburg 97078, Germany*

After attending this presentation, attendees will learn that necrophilia is a rare disorder which can reach extreme dimensions with long-term sexual abuse of dissected and partially preserved body parts. He will retain that cooperation between police, forensic pathology and forensic psychiatry is essential to deal with such cases.

Necrophilia is rare and only few cases have been published in the literature. The cases presented here are unique because the crimes were committed by one individual in a period of 20 years. The stolen bodies were dissected and the organs and body parts partially preserved. The offender abused the corpse and the dissected body parts in a way that is hard to imagine and he documented this abuse on thousands of digital images.

The objective of this presentation is to demonstrate a cases of necrophilia committed by a 40-year-old man with mutilation, dissection and sexual abuse of three bodies and with extensive sexual abuse of dissected body parts which, in the last case, was documented by the offender on thousands of digital images.

The Greek term necrophilia or necrophilism refers to a morbid fondness of being in the presence of dead bodies and, in a stricter sense, to the impulse to have sexual context or the act of such contact with a dead body, usually of males with female corpses (*Stedman's Medical Dictionary*, 24th ed.). Necrophilia is classified as psychiatric disorder (other disturbance of sexual preference) and the psychopathology of necrophiliacs is an interesting, but largely unknown field of forensic psychiatry based mainly on the work of Krafft-Ebing from 1886 (Psychopathia sexualis). However, since this disorder is directly associated with bodies and body parts, forensic pathologists play an important role in the investigation of such cases. The following case series demonstrates that the anatomical and pathological know-how of forensic pathology is indispensable for the police investigations and the psychiatric examination. Furthermore, forensic science is necessary to reunite body parts by morphological and molecular analysis thus ensuring that a dignified funeral finally can take place which is extremely important for the next-of-kin as they try to cope with this traumatizing event.

The chronologically last case of this series, which was the most spectacular, illustrates all features of necrophilia in an extreme dimension which, to our knowledge, never was reached in previous publications and case reports.

In October 1999, the body of a 14-year-old girl, who had been killed by a train accident, disappeared from a morgue at a small cemetery located in a rural area in Northern Bavaria, Germany. Extensive investigations were started but did not provide any results. Regional and national media reported on the case and considerable public pressure was exerted on the investigators.

Three months later, a forester observed a man who was taking photographs of intestines spread out in front of him. Although this observation was not reported to the police until 4 weeks later, the man could be identified and he immediately confessed having taken and sexually abused the body. Because of beginning putrefaction, the 40-year-old engineer had started to dissect the body after a few days, removing organs and body parts such as the intestines, liver, uterus, vagina and breasts. Using these specimens, he continued with sexual activities in his home bathroom and documented every detail with a digital camera. More than 7000 images were found on his computer hard disk showing extreme situations which are difficult to cope with even for experienced forensic pathologists.

The remains of the girl consisting of the trunk, parts of the extremities and the skull were found in a hole filled with mud on the property of the man. Some of the dissected specimens had been treated with an alcoholic solution to stop decomposition and could be recovered in his home. He also admitted having abused 2 other cadavers of young females: in 1985 he had opened a casket and mutilated a body by removing breasts, eyeballs and other body parts and in 1981 he had dismembered the corpse of a 21-year-old woman and further dissected and abused the torso at his home leaving the extremities in the casket. This body-snatching had not been noticed at that time. From this case there were still some specimens kept in his home such as a carefully prepared spine column with the pelvis attached by a Velcro fastening. He was suspected of being involved in more cases of body-snatching or body-stripping that had occurred in the region between 1985 and 2000 but no evidence could be found and he denied those accusations.

According to German criminal law he was convicted to two years and three months of prison because of disturbance of human remains. A psychiatric examination was ordered by the court and the diagnosis "necrophilia" (ICD 10: F65.8, other disorder of sexual preference) was made. According to the forensic psychiatrist, the criminal responsibility of the defendant was diminished and the probability of repeating similar crimes with corpses was high. The risk of committing homicides to satisfy his sexual urges in the future was considered to be significant and he was moved to a criminal mental hospital for an indefinite period of time.

Necrophilia, Sexual Abuse, Body Parts

G21 Too Many Causes of Death: What's the Manner?

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After attending this presentation, attendees will be able to evaluate the importance of competing causes of death discovered at autopsy. Rank causes of death in a hierarchical order depending on importance to the mechanism of death. Integrate scene information, gross autopsy discoveries, histologic findings, and toxicology results to determine the hierarchy of causes of death. Relate manner of death to the most important cause of death.

This presentation will impact the forensic community and/or humanity by recalling and reviewing the importance of integrating scene information, autopsy findings, histology, and toxicology into the determination of the most important cause of death, in order to determine an accurate manner of death. Understand the likelihood of multiple converging natural diseases in the homeless and alcoholic population. Increase awareness of recognizing significant and even predominating natural disease in persons with worrisome but nonfatal injuries, which may affect determination of manner of death.

A 53-year-old homeless man, familiar to local storeowners for about 15 years, had been living for the last three months beneath the trailer of an abandoned tractor-trailer behind a strip mall. Nearby storeowners said he appeared to be losing weight, and undergoing general health degeneration. He had no regular medical care. He had a history of admission to local hospitals for peptic ulcer disease and for chronic pancreatitis, with a splenic artery aneurysm recognized at one admission. The night before his death, children were observed throwing rocks in his direction. The children ran off when adults approached.

He was found dead beneath the trailer, surrounded by empty beer cans and vodka bottles. The scene investigators saw a bruise behind his left ear. At autopsy, he had numerous bruises of different ages on his shoulders, arms, chest, and legs, although no external bruise was appreciated in the livor behind his left ear. Small abrasions were noted on his elbow and hand; there was no other evidence of external injury.

The following lesions were found on internal examination: a small subgaleal hemorrhage behind the left ear, with a recent left-sided subdural hematoma; fresh injury to the left thoracic wall, without rib fracture; three separate ulcers or tears at the esophageo-gastric junction, one of which appeared to have perforated, but might have been postmortem; an ostium secundum defect of the heart, with right ventricular dilatation; slight coronary atherosclerosis, with a left predominance of the coronary system, and with a remote infarct of the posterior left ventricle, which was surrounded by a faint hyperemic area; micronodular cirrhosis of the liver, with diffuse, prominent fatty change; severe chronic pancreatitis, with a stented splenic artery aneurysm; three peptic ulcers in the first part of the duodenum, without frank bleeding; an intrahepatic aneurysmal dilatation of a large branch of the portal vein, with thrombosis; and moderately severe emphysema with chronic bronchitis. It was not possible to answer police inquiry, at gross autopsy, as to which of these had caused his death; or whether his manner of death was natural, accident, or homicide.

What do you do when you have too many causes of death, without a clear manner? The ramifications of multiple severe illnesses and injuries in a single case are discussed, particularly in a setting of homelessness and chronic alcoholism, with relevance to the manner of death.

Multiple Causes of Death, Manner of Death, Alcoholism

G22 Postmortem Analysis of Anastomotic Suture Line Disruption Following Carotid Endarterectomy

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The goal of this presentation is to describe a case report of a suture line disruption following surgery and how proper specimen handling and microscopic analysis allowed us to determine the cause of this therapeutic complication.

This presentation will impact the forensic community and/or humanity by providing this first report of its kind in which a postmortem analysis of suture material from a failed suture line implicated improper surgical technique in the death of a patient. In cases where an anastomotic failure is successfully repaired, a broken suture is often discarded along with any clot and blood-soaked gauze. The failure may be reported in the surgical literature or to the suture manufacturer but, without photography or an ultrastructural evaluation of the filament, it cannot be confirmed whether surgical technique or defective manufacturing was at fault.

In the forensic setting there is a singular opportunity to examine the sutures and resolve these issues. The findings can have both medicolegal and public health implications. In this study it was clear that tissue debris and formalin fixation did not significantly hinder such an analysis and we, therefore, recommend that in future death investigations of this nature, the medical examiner should refrain from handling the suture ends with dissecting implements, and preserve the anastomotic suture line with the surrounding tissue en-bloc so that a more detailed analysis can be performed.

The tensile strength of a surgical suture is essential in maintaining the integrity of vascular anastomoses. In the surgical literature, there have been several reports of suture line disruptions due to apparent fracture of polypropylene suture, including failure of an atrial septal defect repair, a proximal anastomosis of a coronary artery bypass, an aortic closure in a patent ductus arteriosus repair, a femoral-popliteal bypass repair, and a carotid endarterectomy. These previous case reports do not present a detailed analysis of the suture tips and there is no photography to document the findings.

While faulty operative technique and the loading strength of individual sutures have been implicated in spontaneous suture line disruptions, there has, to date, never been a published post-mortem analysis of a suture that has known to have failed. We present the case of suture line disruption leading to fatal exsanguination in a 77-year-old man following carotid endarterectomy with a facial vein patch. As part of the public health role performed by the medical examiner's office and in compliance with the requests of family, hospital and the suture manufacturer, we performed a detailed analysis to address the question of whether the suture or the surgical technique were at fault.

A 77-year-old white man with a history of hypertension, coronary artery disease and remote myocardial infarction underwent a carotid endarterectomy for high-grade stenosis of the right carotid artery. Under general anesthesia, the endarterectomy was performed and a right facial vein patch was placed using a double armed, #6-0 Prolene suture. He expired approximately 18 hours after surgery, following a sudden, fatal exsanguination from the surgical site. At autopsy, there was a 1 cm defect of the sutured anastomotic line. At the defect, two suture tips were identified: a straight cranial end and a tightly coiled caudal end. There was no knot on either side, nor were any loose suture fragments identified. The smooth edges of the vein graft and carotid artery confirmed that the tissue itself didn't fray or tear.

The carotid specimen was preserved en-bloc in 10% formalin and photographed using both dissecting and scanning electron microscopy. Examination of the specimen under a dissecting microscope demonstrated that other suture knots from the specimen, some involving vascular ligatures and others involving a distant line of interrupted sutures, were tied in stacked granny or half-hitch configurations. Several of these interrupted sutures were in various stages of untying, with one that had completely untied but had not yet pulled through the tissues.

For scanning electron microscopy, suture tips from the disrupted anastomotic line and from elsewhere on the specimen were carefully removed and oriented. For controls, several #6-0 Prolene control sutures were removed directly from the manufacturing package and were alternately cut with a scalpel blade, surgical scissors, or were manually broken and "popped off" the suture needle. Ultrastructural photography demonstrated that suture tips cut by a scalpel have a squared-off, straight edge while ones that have been cut by scissors are flattened or wedge-shaped with horizontal linear shear marks along the cut surface.

The microscopic shape and contour of the disrupted suture tips, and the complete absence of a knot or additional suture fragments, indicated that surgical technique (an untied knot) was the cause of the suture line disruption. The removal of a broken or untied suture at surgery or at autopsy should not preclude proper analysis of the failed suture, as the results can have both medico-legal and public health implications.

Forensic Science, Forensic Pathology, Anastomosis

G23 Advanced Flow Cytometric DNA Degradation Analysis: Utility in Postmortem Interval Estimation

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After attending this presentation, attendees will be able to determine if application of a statistical model and objective computer modeling to DNA degradation data will yield reproducible, accurate results, and help in post-mortem interval estimation.

This presentation will impact the forensic community and/or humanity by providing preliminary results which indicate that more advanced analysis, including statistical evaluation and computer modeling, of DNA degradation data is possible. These methodologies could be then be applied to forensic autopsy samples to assess their validity in estimating a post-mortem interval.

This poster will show data used to develop a mathematical model for PMI estimation as well as juxtapose two different flow cytometric computer models in an effort to select the most reliable methods of estimation.

Over the past decade, since the first proposal by Cina that flow cytometry might be useful in post-mortem interval estimation by monitoring DNA degradation, several papers have been published attempting to establish a link. Using flow cytometry, previous studies on splenic and hepatic tissue have suggested that cellular DNA degradation increases with time, and could thus potentially be used as a tool for post-mortem interval estimation. However, much of this previous work has been focused on selecting the best type of sample for analysis, rather than on perfecting the technique and analysis of the data obtained. In an attempt to delineate the best analytical method, this study involved the collection of easily obtainable blood samples, from normal living donors, which were stored at room temperature, then assayed for DNA content at varying times post collection (0-191.5 hrs) to determine the amount of DNA degradation. This amount of degraded DNA was quantified using two different computer programs: CellQuest™ v. 3.11 (Becton-Dickinson, San Jose, CA) and Modfit™ v. 3.0 (Verity Software, Topsham, ME, U.S.A). The first program allows for subjective analysis of the amount of DNA degradation, while the second program uses a computer model which can objectively assign the amount of DNA degradation, without user input.

After DNA degradation determination by both computer programs, the relationship of DNA degradation and sample age was plotted and further analyzed with a random coefficient statistical model to yield a population regression curve.

The validity of this curve was then tested using blood collected from another group of normal donors and analyzed at varying times in a blind study. In 20 of 28 samples, a correct 24 hour period was able to be assigned (71%). These preliminary results suggest that a mathematical model, combined with objective computer analysis, can be applied to the monitoring of DNA degradation of cellular material, and can potentially become a tool in determining post-mortem interval.

Post Mortem Interval, Flow Cytometry, DNA Degradation

G24 The Impact of Dermatologic Consultation in Autopsy Examination: A Case of Pseudoxanthoma Elasticum

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After attending this presentation, attendees will understand and realize the usefulness of dermatologic consultation in autopsy examinations through a case presentation of pseudoxanthoma elasticum.

This presentation will impact the forensic community and/or humanity by demonstrating that a dermatology consultation may be a very useful addition to forensic and hospital autopsies. We present an example of how this consultation may lead to the diagnosis of systemic disease and possible cause of death.

Dermatologic consultation in the autopsy examination may be very useful in many cases. We present a case of pseudoxanthoma elasticum, a genetic disease, that was diagnosed by a thorough external examination and histologic evaluation of the skin.

A forty-nine-year old white female was found unresponsive in an apartment fire and was taken to the local area hospital. On arrival, the patient was in asystole and had a carbon monoxide concentration of sixty percent. She was also found to have evidence of smoke inhalation and burns over approximately fourteen percent of the total body surface area. The patient was pronounced dead and was transferred to the Dallas County Medical Examiner's Office.

On skin examination, the patient had a large leathery, firm, dark brown plaque with surrounding erythema on her back and right flank. On the leading edge of the plaque, there were multiple bullae and skin sloughing. The leathery plaque was clinically consistent with the most severe burn site and was likely the area closest to the heat source given the intense drying of the skin. The bullae and skin sloughing was clinically consistent with a third degree, full thickness, burn. On the skin of her neck, anticubital fossa, and inguinal area, the patient had small yellow papules and a wrinkly appearance that resembled "plucked chicken skin." A biopsy was taken of the bullae on the right flank and the skin the inguinal area.

The biopsy of the bullae was consistent with a full thickness burn and showed a necrotic epidermis and polarization of the nuclei around the hair follicles. The biopsy of the skin taken from the inguinal area was characteristic of pseudoxanthoma elasticum and showed degeneration of the elastic fibers in the middle and lower dermis. On hematoxylin and eosin staining, the elastic fibers were basophilic, irregular, and widely dispersed among the collagen bundles. On von Kossa staining, these elastic fibers were highlighted in a dark brown color.

Pseudoxanthoma elasticum is an autosomal recessive disorder due to a mutation in the ABCC6 gene on chromosome 16. The patients have clumped, distorted, calcified elastic fibers which manifest as disease in many organ systems. The patients typically have flat, yellowish papules on the skin of flexural areas that sometimes coalesce to resemble "plucked chicken skin." Most patients also develop angioid streaks in the eye that may lead to blindness, and many develop progressive calcification of the medium sized arteries which leads to hypertension and myocardial infarctions at a much younger age. Patients may also have calcification of the cerebral and gastric vessels.

Upon further investigation into this patient's history, she was found to be blind and have severe hypertension. These findings, along with the characteristic histologic findings on skin biopsy, lead to a definitive diagnosis of pseudoxanthoma elasticum. This disease has tremendous implications for the family given that it is inheritable and may cause significant morbidity and mortality.

Dermatologic consultation was extremely useful in this case, given that the skin findings, combined with the knowledge of the patient's medical history, provided the diagnosis of a rare, genetic, and life threatening disease.

Dermatology, Consultation, Autopsy

G25 Homicidal Injury or Resuscitation Artifact?

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After attending this presentation, attendees will become aware of resuscitation artifact created by mechanical cardiopulmonary resuscitation systems.

Objectives: to present a case of resuscitation artifact from mechanical cardiopulmonary resuscitation system which could be potentially confused with homicidal injury and two additional cases involving the use of a mechanical cardiopulmonary resuscitation system; and, to discuss the mechanical cardiopulmonary resuscitation system used in the City and County of San Francisco.

Evaluation and correct identification of resuscitative artifact is critical in the diagnosis and determination of cause and manner of death in certain cases. Resuscitative artifact can emulate inflicted injuries and possibly be misinterpreted. Occasionally new technology and/or medical procedures will create original and distinctive artifact. This presentation discusses one new technology and its related artifact.

The decedent is a 69-year-old obese white man with a history of hypertension who is found dead on the floor of the bedroom/office in the home that he shared with his daughter and a downstairs tenant. On the evening of his death, his daughter was out with her fiancée. During the evening, the decedent reportedly engaged in a verbal altercation regarding the use of the oven in the kitchen with the downstairs tenant. The tenant reported that the landlord seemed very agitated, angry, and tense, which was unusual for him. The tenant called the decedent's daughter, who returned with her fiancée to the residence. While the daughter's fiancée was speaking with the tenant he noted an abrasion on the back of the tenant's right hand, which the tenant claimed was from striking a wall after the verbal altercation with the landlord. The daughter went upstairs and found her father lying on the floor, unresponsive. Hearing the daughter scream, her fiancée went upstairs. The daughter called 911 while the fiancée started cardiopulmonary resuscitation. When the paramedics arrived, they continued resuscitation using a mechanical cardiopulmonary resuscitation system. Despite all efforts, the decedent was pronounced dead at the scene.

External examination showed an abrasion on the top of the head, abrasions on the right side of the forehead, the right cheek, and the right side of the nose, and contusions of the lateral right eyebrow and left temple. There were petechial hemorrhages on skin of the forehead, the upper and lower eyelids, and cheeks. There were petechial and confluent hemorrhages of the conjunctivae and sclerae. There were large abrasions on the lateral left chest and abdomen. There was a contusion of the left knee. The decedent's doctor was contacted and reported that he considered this death sudden and unexpected.

This presentation will discuss the autopsy findings of this case and two additional cases in which a mechanical cardiopulmonary resuscitation system was used. The City and County of San Francisco Medical Examiner's Office participated in the development of prototypes of a mechanical cardiopulmonary resuscitation system (Revivant AutoPulse). Recently, the San Francisco Fire Department emergency personnel began using this mechanical cardiopulmonary resuscitation system in the field. This presentation will discuss the rationale and operation of mechanical cardiopulmonary resuscitation systems and associated findings at postmortem examination.

Forensic Pathology, Resuscitation Artifact, Mechanical Cardiopulmonary Resuscitation

G26 Screening Items of Evidence for the Presence of Body Fluids/DNA in Forensic Biology Casework — A Hypothesis-Driven Approach

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After attending this presentation, participants will learn how the implementation of various case screening strategies and initiatives developed in response to case hypotheses has assisted in addressing pertinent forensic questions in a timely and efficient manner.

This presentation will impact the forensic community and/or humanity by adapting processes and undertaking examinations specifically in response to hypotheses formulated by information in case histories has permitted us to work more efficiently while addressing the most pertinent questions in cases. Sharing these successes will assist other laboratories in implementing similar measures.

This poster will present specific examples of case screening strategies and initiatives adopted at the Centre of Forensic Sciences (CFS) designed to facilitate hypothesis-driven examinations. The aim is to promote the examination of relevant items only, in a manner that is timely and efficient.

Many forensic cases require a small number of items to be examined in order to address the pertinent questions at hand. On the other hand, larger and more complex cases require that decisions be made with respect to which items are to be examined, the order in which those items are examined, and, given a particular result, the necessity of additional examinations. Information provided though the case history and case conferencing as well as knowledge gained through experience and training can be used to formulate a hypothesis in accordance with the scientific method to address these decisions.

Recently, CFS case screening procedures were updated and further aligned with the principles of hypothesis testing. An increased emphasis was placed on assessing the relevance of an examination. The following statement from our DNA Case Screening Manual is one example:

"Scientists are required to evaluate the relevance of an examination using the principle of reasonable expectation and to be mindful of the limitations such an examination confers."

The approach is demonstrated through the following examples of classes of cases typically encountered at the CFS:

Sexual Assault Cases

Sex assaults comprise roughly two thirds of the workload of the Biology Section. Examples of initiatives undertaken to screen items more quickly in accordance with the case history provided include:

- The sexual assault examination kit (SAEK) provided to treatment centres throughout the province has been redesigned such that only relevant samples are collected. Furthermore, the design of the kit dovetails with our screening procedures in the laboratory, and provides samples that can be retained for independent testing.
- In sexual assault cases, relevancy of item examination is evaluated and hypothesis-based flowcharts govern the order in which selected items are examined. When vaginal intercourse is the only allegation, oral and rectal samples are not examined. Vaginal samples are examined beginning with the examination of the vaginal smear. If semen is identified, DNA testing of the vaginal swab is immediately initiated and case screening is terminated pending DNA results. In the absence of semen on the vaginal samples, underwear from the complainant is examined for the presence of semen and/or saliva only if vaginal penetration and/or cunnilingus is alleged, and if the underwear were worn shortly after the alleged assault. Clothing is examined for the presence of semen only if the case history indicates that external ejaculation is suspected or if the complainant cannot reliably describe the circumstances of the assault.
- A process was designed to expedite the examination of micro scope smears made from internal samples collected during the SAEK. The examination provides a rapid screen in order to expedite the processing of positive sexual assault cases while minimizing the consumption of related samples.
- A Cold Case Program was established through the joint efforts of the CFS and a major metropolitan police service. This initiative involves the examination/re-examination of unsolved cases by targeting only those cases and those items that are most likely, based on case history, to produce a DNA result attributable to the perpetrator. Strict criteria for submission as well as a hypothesis-based flowchart provided to investigators ensure submission of only relevant items, which leads to a timely examination and the highest chance of success.

Property Crime Cases

The CFS has initiated a "Break and Enter" program to accommodate the submission of evidence from break and enter cases where no suspect is known. The focus of this program is to produce DNA profiles, in a timely fashion, for upload to the National DNA Databank in cases where there are no other investigative leads. To control a potentially unmanageable influx of break and enter casework, strict guidelines were established to target the submission of one item per case that is most likely to be attributed to the perpetrator. Items that are accepted as per the guidelines include swabs of blood, cigarette butts, and swabs from drink containers. Items such as swabs of doorknobs, where there is a prior expectation of low levels of DNA having been deposited through innocuous means, are not accepted.

Blood Cases

The principle of hypothesis testing can also be applied in situations where the examination for the presence of blood is required. For example, when processing assault cases where the case history suggests only one bleeding person (complainant), and where a large number of items from the suspect are submitted, the examination of a single item is sufficient if in fact blood is detected. Item selection is based on the circumstances of the event (e.g., a shoe, if there was kicking involved, or the outermost upper garment if there was punching or an assault with a weapon).

Ultimately, the hypothesis-based approach promotes representative sampling over exhaustive sampling and leads to more meaningful results for clients in a timely fashion.

Case Screening, Forensic Biology, Hypothesis Testing

G27 Fatal Kawasaki Disease Associated With Cardiac Rhabdomyomas in an Infant

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The purpose of this report is three-fold: to present a hitherto undescribed association (Kawasaki disease and cardiac rhabdomyoma); to illustrate an extremely rare cause of sudden death in infants (cardiac tamponade due to a ruptured Kawasaki aneurysm); and to demonstrate the co-existence of two coronary complications of Kawasaki disease: proximal coronary aneurysm (common) and non-aneurysmal stenosis (rare).

This presentation will impact the forensic community and/or humanity by presenting a hitherto undescribed association in a rare cause of death (cardiac rhabdomyomas in fatal case of Kawasaki disease due to rupture of a coronary aneurysm in an infant).

The purpose of this report is three-fold: to present a hitherto undescribed association (Kawasaki disease and cardiac rhabdomyoma); to illustrate an extremely rare cause of sudden death in infants (cardiac tamponade due to a ruptured Kawasaki aneurysm); and to demonstrate the co-existence of two coronary complications of Kawasaki disease: proximal coronary aneurysm (common) and non-aneurysmal stenosis (rare).

Introduction: Kawasaki disease (KD), or mucocutaneous lymph node syndrome, is an inflammatory disease of infants and children that is often associated with a systemic vasculitis preferentially involving the coronary arteries. Although the acute illness usually resolves spontaneously, 15-30% of untreated children develop cardiovascular complications, including proximal coronary artery aneurysms and rarely coronary stenosis without aneurysm formation. Fatal complications are uncommon, occurring in an estimated 0.5% of cases. Sudden deaths are usually related to myocardial ischemia secondary to thrombosis of coronary aneurysms or coronary scarring. Among fatal cases of KD, coronary artery rupture has been reported in approximately 5% of those autopsied.

KD usually afflicts children under five years of age, and the diagnosis is based on a constellation of clinical features. The signs include fever unresponsive to antibiotics, cervical lymphadenopathy, bilateral conjunctival injection, labial and oropharyngeal mucosal erythema and fissuring, and cutaneous erythema and exanthema that often involves the palms and soles. Infants under six months of age can present with aggressive coronary vasculitis with aneurysms in the absence of the typical clinical signs.

The etiology of KD is unknown. Although a number of toxins and infectious agents have been implicated, acting as direct pathogens or via superantigen mediated autoimmunity, no constant associations have been identified. Moreover, case reports have described rare cases of KD occurring in association with other medical conditions, including congenital anomalies of the coronary arteries, Beckwith-Weidemann syndrome, and cystic fibrosis. To our knowledge, KD has not been previously reported in association with cardiac rhabdomyomas.

Cardiac rhabdomyomas are rare congenital hamartomatous tumors usually discovered in infants and children. Most are multiple, occurring anywhere in the myocardium. Rhabdomyomas of the heart are strongly associated with tuberous sclerosis. The clinical presentation and prognosis depend on the size and location of the tumors.

Clinical History: The decedent was a four-month-old white male infant who was the product of a 38 week gestation, delivered via cesarean section for maternal pre-ecclampsia. The early neonatal period was marked only by transient hyperbilirubinemia, which resolved spontaneously. The infant was healthy until approximately three months of age, when he developed a cough and intermittent fevers that reportedly responded to treatment with acetaminophen. He was seen by his primary pediatrician several times during the ensuing 2-3 weeks and diagnosed with otitis media. Despite treatment with antibiotics, fevers and cough persisted, prompting an emergency department visit. At the time, his temperature was recorded at 102.1. He had no lymphadenopathy, rash, or oral mucosal abnormalities, although redness of the eyes was noted. He was discharged home with continued antibiotics and symptomatic treatment. Ten days after being examined in the emergency department, the infant became suddenly unresponsive while being dressed by his mother. Resuscitative efforts were unsuccessful.

Autopsy Findings: The body was that of a well-developed, well-nourished white male infant who was large for the age of four months. The skin was pale and free of exanthema. The oral mucosa was free of lesions, and the conjunctivae were clear. There was no lymphadenopathy. The brain was free of tubers, and the kidneys had no masses. The pericardial sac was distended with 400 cubic centimeters of partially clotted, bright red blood. The heart was normally formed. The epicardial coronary arteries were markedly thickened and firm, most with a cord-like appearance. Focally (predominantly in the distal left obtuse marginal branches), the arteries had a beaded appearance, with areas of thickening alternating with thin, grossly normal-appearing segments. The proximal right coronary artery had a 0.8 x 0.8 x 0.7 centimeter thin walled aneurysm with a 0.1-0.2 centimeter rupture in the epicardial surface. Transverse sections of the thickened arterial segments demonstrated firm, yellow-white, circumferentially thickened arterial walls surrounding narrow, focally pinpoint residual lumina. The cardiac valves and chamber dimensions were normal. The myocardium was firm, red-brown, and free of gross abnormalities. A 0.2 x 0.2 x 0.2 centimeter smooth excrescent nodule was on the right ventricular aspect of the septum, just below the right ventricular outflow tract. The endocardial surfaces were otherwise unremarkable. The pulmonary artery, the aorta, and the major systemic arterial branches were free of thickening or other gross abnormalities.

Microscopic examination: Histologic sections of the coronary arteries demonstrated diffuse chronic and mixed inflammatory infiltrates involving the intima, media, and adventitia. Focally, the inflammation was accompanied by intimal hyperplasia and non-occlusive adherent luminal surface thrombi. The media was focally disrupted and obliterated. Both the media and the adventitia had large areas of sclerosis and neovascularization resembling granulation tissue. Sections of the right coronary aneurysm demonstrated attenuation of the arterial wall with destruction of the media and transmural mixed inflammation with eosinophils. The thin wall was focally disrupted, with transmural fibrin deposition at the rupture site. Myocardial histologic sections revealed multiple small subendocardial and intramural rhabdomyomas in the left and right ventricles, characterized by well demarcated foci of large, clear cells, some with spider cell morphology.

Discussion: Coronary artery aneurysm rupture due to KD and cardiac rhabdomyomas are both independently rare. To our knowledge, they have not been previously reported together. In addition, the coexistence of proximal aneurysm with diffuse non-aneurysmal stenosis in the acute phase of KD is described. The relationship, if any, between the these entities is not clear, and the rhabdomyomas may represent an incidental finding in this case of fatal KD.

Kawasaki Disease, Rhabdomyoma, Coronary Aneurysm

G28 Hmong Cultural Aversion to Forensic Autopsy: Bridging Communication and Cultural Barrier

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The goal of this presentation is to share with the forensic community practical experience in communication methods, including the use of community public radio broadcasting, to both increase understanding of the autopsy and to lessen cultural resistance to forensic autopsy among the Hmong cultural community in the USA.

This presentation will impact the forensic community and/or humanity by increasing understanding and acceptance of the forensic autopsy by Hmong people as an instrument of "good" for the entire community as well as greater sensitivity by the forensic community to the culture of the Hmong and their desired treatment of the dead.

This poster presents the work of the authors and a dedicated group of Hmong who addressed a series of cultural problems discovered during the course of a routine forensic autopsy performed on an Hmong elderly woman, a member of one of the five Hmong clans living in Butte County, located in northern California. After resolution of the cultural issues of this individual clan member, the scope of our work was expanded to examine cultural objections to autopsy by all eighteen clans which compose the some 300,000 Hmong currently residing in the United States. Over several months a series of meetings to identify Hmong cultural/religious objections to autopsy were held among members of the Hmong community, the Butte County Chief Deputy Coroner, and the county forensic pathologist. Given deeper insight, understanding, and sensitivity to the Hmong cultural aversion to autopsy examination, a number of mitigating steps were initiated by the Butte County Sheriff-Coroner and forensic pathologist which assured surviving Hmong relatives that the spirit of their deceased family member could enter the after-life with minimal negative cultural consequences for the decedent. The risk of the decedent's spirit returning to haunt surviving relatives because of the perceived failure of the relatives to prevent autopsy, a palpable fear among the relatives, was also eliminated. At the same time the requirements of the law necessitating forensic autopsy were also upheld.

Mitigating steps initiated included:

(1) Performing a full autopsy only when absolutely necessary.

(2) When a decedent coming to forensic autopsy was known, or suspected, to be Hmong, the next-of-kin was contacted by the forensic pathologist to inform them that an autopsy would be done and for what purpose. An offer for the family to elect a family member, or family representative, to 'talk' to the spirit of the dead person prior to autopsy in the presence of the body was proffered. Because of the Hmong belief that the spirit resides in the dead body, it is believed possible to communicate to the person's spirit after death. The purpose in talking to the dead body was to relate why an autopsy had to be done for which the family members bore no responsibility. Currently, a native Hmong-speaking liaison between the Hmong community and the Coroner's Office is being sought to replace the time consuming contact role of the forensic pathologist.

(3) Replace all organs back into the body after autopsy.

(4) Allow no metallic foreign items to be left in the body after autopsy.

Delay performing the autopsy until appropriate family ritual arrangements could be made.

Recognizing that the Hmong cultural aversion to autopsy affected not only the local community but also the broader Hmong community throughout the United States, a one hour long radio program titled, "Forensic autopsy and the Hmong" was carefully scripted employing very simple Hmong terms to explain medical terms totally foreign to the Hmong language. The radio program was broadcast over a local

northern California Community Public Radio station, FM 90.1 KZFR – Chico, with an estimated local listening audience of 4,000 Hmong. The radio program was recorded, burned to CD, and redistributed throughout the United States to numerous Hmong Cultural Centers as well as forensic pathologists who expressed an interest through the National Association of Medical Examiners (NAME) intenet-based computer listserve.

A conservative estimate is that tens of thousands of Hmong listeners will ultimately be exposed to this radio program.

Hmong Culture, Autopsy Resistance, Radio Broadcast

G29 Postmortem Diagnosis of Genetic Arrhythmia Syndromes

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After attending this presentation, attendees will understand current methods of postmortem diagnosis of genetic arrhythmia syndromes.

Genetic arrhythmia syndromes, which are almost certainly underdiagnosed by medical examiners, have been theorized to cause some deaths from Sudden Infant Death Syndrome and have been implicated in the development of fatal arrhythmias during exercise. A presentation by an M.E. about cases where genetic analysis supported an etiology for fatal arrhythmia may encourage others to increase their index of suspicion for these disorders and to support efforts to develop cost-effective screening methods.

Genetic disorders predisposing to sudden death from arrhythmia in the absence of cardiac anatomic abnormalities account for an unknown number of deaths presenting to the medical examiner. Two cases illustrate the importance of clinical history in such deaths and the methods by which postmortem diagnosis of these conditions can be accomplished.

A 15-year-old girl collapsed in front of witnesses while swimming and died despite immediate medical attention. Autopsy revealed no injuries, anomalies or acute disease process, and electrolyte analysis and toxicology were non-contributory. Medical history was significant for two fainting episodes in the past year under conditions of emotional stress. Review of antemortem EKG's showed mild prolongation of the Q-T interval and increased Q-T with increased heart rate. Molecular studies of frozen myocardium have shown a mutation in a cardiac ryanodine receptor gene associated with catecholaminergic polymorphic ventricular tachycardia. Also present was a polymorphism in the KCNE1 potassium subunit gene; mutations in that gene have been associated with Long Q-T Syndrome. The death has been classified as due to cardiac arrhythmia; further molecular studies are ongoing.

A 43-year-old woman was found dead where she had been shoveling snow. A complete autopsy revealed no cause of death. The information that her previously healthy sister had collapsed and died on hearing of her death prompted molecular analysis of a liver specimen archived for toxicology. A mutation was present in a cardiac potassium channel gene known to be associated with congenital Long Q-T Syndrome.

Genetic sequencing for mutations associated with sudden death from fatal arrhythmia is expensive, time-consuming and not widely available. Review of the circumstances of death, family history and medical records following a negative autopsy facilitates selection of the rare case appropriate for molecular testing. Frozen myocardium is currently the best specimen for analysis, and should be retained in suspected cases.

Simplification of screening for known mutations or abnormal gene products would enhance the ability of the medical examiner to determine that a genetic arrhythmia syndrome caused a death. These conditions are heritable and can often be managed by pharmacotherapy, avoidance of arrhythmia inducing substances and medications, and/or defibrillator placement. Surviving family members may therefore benefit from counseling and electrophysiologic screening. These interventions have the potential to save lives.

Long Q-T Syndrome, Molecular Diagnosis, Arrhythmia

G30 Is Hypertension a Risk Factor for Fatal Rupture of Intracranial Aneurysms?

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After attending this presentation, attendees will be able to describe detail of the characteristics of the subjects dying from ruptured berry aneurysms, including age, gender, and risk factors, detailed location, size, and anatomic extension of the subarachnoid hemorrhage depending on the location; and describe the risk factors for fatal rupture of berry aneurysms.

This presentation will impact the forensic community and/or humanity by demonstrating a better understanding of the epidemiology and risk factors of nontraumatic subarachnoid hemorrhage, specifically ruptured berry aneurysms

Background: Berry (saccular) aneurysms of the circle of Willis arteries are the most common cause of fatal subarachnoid hemorrhage in the absence of pre-existing trauma. The incidence of intracranial berry aneurysms increases with age, with a 1% prevalence in the overall population, 2% in middle age individuals and 5% in older people. The annual risk of rupture is estimated as 0.6%, with a very high fatality rate. Berry aneurysms have a multifactorial etiology. They are most commonly found at points of branching. An underlying defect in the wall of the vessel where the aneurysm subsequently forms is frequently found. They are familial in about 5% of the cases, and multiple in a similar percentage of cases. Besides age, other risk factors for the development and rupture of berry aneurysms are smoking, hypertension, heavy alcohol use or drugs. The role of hypertension in the development and rupture of aneurysms is controversial, and there are no previous studies correlating heart weight (raw or normalized) with the development or rupture of berry aneurysms.

Goals: To better define the population affected by fatal rupture of berry aneurysms and detect and characterize risk factors. A primary hypothesis of the study is that an increased heart weight represents a risk factor for aneurysmal rupture.

Subjects and Methods: We designed and performed a case-control study. **Cases** were all individuals autopsied at the Office of the Chief Medical Examiner for the State of Maryland in whom subarachnoid hemorrhage secondary to ruptured berry aneurysm was identified.

Two **controls** were selected per case in order to increase the power of the study. In order to minimize bias, controls were matched for age (within five years) and gender; we only selected individuals who died accidentally, and had an autopsy performed in our office, prior (one of the controls) or subsequent (the other control) to the matching case.

Antropometric parameters including age, gender, race, height and weight were recorded. We obtained clinical information including history of smoking, alcohol or drug use and hypertension. At autopsy, heart weight, presence and severity of coronary atherosclerosis, brain weight and toxicologic findings were tabulated. Heart weight is normalized for height, weight and body surface, as previously described. In addition, detailed information regarding the ruptured aneurysm was con-

sidered for the cases (side, location, size, distribution of the subarachnoid hemorrhage, presence of additional, unruptured aneurysms). Data was analyzed by multiple logistic regression, with case/control status as dependent variable and heart weight and other predictors as potential risk factors.

Results: A total of 145 cases (65 women [aged 47.5+/-12.7 years] and 80 men [aged 44+/-10.7 years]) and 290 controls (130 women [aged 47.5+/-13.2 years] and 160 men [aged 43.9+/-11.1 years]) were included in the study. Results of the multiple logistic regression analysis include odds ratios and confidence intervals for additional risk factors.

Berry Aneurysm, Hypertension, Fatal Rupture

G31 Fatal Acute Thrombosis of Anomalous Right Coronary Artery Arising From the Left Sinus of Valsalva

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Anomalous origin of coronary artery(s) may be an isolated cause of sudden death. Many different mechanisms have been suggested. The goal of this presentation is to illustrate a previously undescribed complication of this anomaly, namely fatal acute thrombosis occurring in an anomalous right coronary artery, otherwise free of atherosclerosis.

Previously postulated mechanisms of death in cases of isolated anomalous origin of coronary arteries have focused on functional insufficiency of the coronary vessel because of periodic compression, either between great vessels, or within the aortic wall. The present case suggests that another mechanism of death may be acute thrombosis of the anomalous artery. This mechanism may be related to other postulated mechanisms through intraluminal turbulence.

A 63-year-old Caucasian woman was found dead in her secure residence. She was of average height and weight with no external or internal injuries. The aorta and great veins were normally distributed; moderate atherosclerotic plaques were in the aorta. The 600-gram heart had concentric left ventricular hypertrophy, measuring up to 2.1 cm; the right ventricle was 0.5 cm; hypertensive changes were evident in the kidneys. The myocardium was uniform with no diffuse or discrete zones of fibrosis. The valves had a normal configuration, but the aortic valve cusps were partially calcified with no vegetations.

The left main coronary artery originated normally, from the left sinus of Valsalva; the left main coronary artery bifurcated to give rise to the anterior descending and circumflex branches. The right coronary artery also originated from the same ostium in the left sinus of Valsalva and traveled between the aorta and the pulmonary artery. The proximal 0.2-0.3 cm segment of the right coronary was intramural within the aorta and had an ovoid, narrow lumen. A 0.3 cm occlusive acute thrombus was within the lumen of the right coronary artery, 0.5 cm from its origin, extending for a length of 1 cm. The thrombus was in the portion of the right coronary artery interposed between the aorta and the pulmonary trunk, just distal of the intramural segment. The right coronary artery supplied the posterior apical myocardium. The coronary arteries were free of atherosclerosis.

Several mechanisms of death have been proposed in cases of isolated anomalous coronary origin. Because of the abnormal position with respect to the aorta, these vessels typically follow a course between the great vessels. One possible consequence is compression between the great vessels (a "scissors" mechanism). Since the aorta and pulmonary arteries are distended at different phases of the cardiac cycle, and because the coronaries are filled primarily during diastole, strenuous exercise, and consequent increased heart rate and shortening of the cardiac cycle, should present an increased risk of death for these patients. Indeed, most such deaths occur during strenuous exercise. Additionally, the proximal segment of the anomalous artery generally follows an intramural course; that is, it is within the aortic root, sharing tunica media with the aortic wall, without an intervening adventitia. This intramural segment typically has an ovoid cross section, and may well be further compromised with intra-aortic pressure. The latter mechanism is supported by clinical in situ intravascular ultrasound studies. In most cases the anomalous coronary emerges at an acute angle with the aortic wall, such that blood flow into the vessel would be less direct than in the "typical" arrangement. Other anatomic or functional features have been proposed, such as ostial ridges impeding flow into the vessel lumen. The present case indicates that another mechanism may occur in some patients, thrombosis of the anomalous origin. Turbulence of the intraluminal blood, perhaps caused by any (or a combination) of the other postulated mechanism(s) may lead to focal thrombosis. The absence of atherosclerosis in the thrombosed segment indicates that the anomalous origin was the likely cause of the thrombosis.

Anomalous Coronary Artery, Acute Thrombosis, Sudden Death

G32 Undiagnosed Cardiac Sarcoidosis and Sudden Death: Report of 14 Cases

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After attending this presentation, attendees will be able to recognize the significance of the postmortem diagnosis of sudden death due to undiagnosed cardiac sarcoidosis in the field of forensic medicine.

Cardiac sarcoidosis is often clinically silent. It has been reported that sudden death is the most common manifestation of myocardial sarcoidosis. Our study has demonstrated that it is important for forensic pathologists to consider cardiac sarcoidosis in sudden unexpected deaths and to perform a complete autopsy including histotological examination of the regional lymph nodes in addition to the major organs.

The Office of the Chief Medical Examiner (OCME) for the state of Maryland documented 37 deaths caused by sarcoidosis from 1993 through January 2003. Of the 37 cases, 14 (37%) carried no previous diagnosis of sarcoidosis. Five of the 14 cases (36%) were witnessed to suddenly collapse (including 1 case of collapse after a non-fatal assault). The remaining 9 cases (64%) were found unresponsive at home. All 14 cases had a complete autopsy with histological and toxicological studies. The mean age of the14 patients at death was 40 years (± 5.9, range 35-47 years). There was an equal distribution of sexes (7 males, 7 females) with a race distribution of 12 African Americans and 2 Caucasians. The majority of the cases (79%) were clinically silent. Only 3 (21%) of the cases had a prior cardiac history, including one who had biventricular hypertrophy with cardiac pacing, one with congestive heart failure and 1 case with non-specific cardiac complaints. Other known medical conditions included depression (2), obesity (2), diabetes mellitus (2), and asthma (1).

The diagnosis of cardiac sarcoidosis was based on microscopic findings of non-caseating granulomatous inflammation involving the heart and at least one other organ (lungs and/or regional lymph nodes), or with microscopic evidence of cardiac involvement and grossly enlarged regional lymph nodes in the absence of evidence of other infection or other granulomatous processes.

Mean heart weight for all 37 cases was 518 g (± 140, range 310-830 gm). Of the 14 cases of previously undiagnosed sarcoidosis, 13 (93%)

showed cardiac involvement. Five of the 13 (38%) cases had gross evidence of cardiac sarcoidosis that ranged from pericardial, epicardial or endocardial plaques to fibrosis of the ventricles and septum. However, the majority, 62% (8/13) of the cases showed no significant gross pathological changes in the heart and the diagnosis of cardiac sarcoidosis was made on histological examination. None of the 13 cases showed cardiac involvement alone. Three of the 13 (23%) cases had no gross evidence of disease in any organs. Of the 13 cases, non-caseating granulomatous inflammation was identified in the lung (13/13 cases), lymph nodes (5/5 cases with histological examination), liver (4/13 cases), spleen (3/13 cases), and kidney (2/13 cases). One patient died of extensive pulmonary sarcoidosis without cardiac involvement.

This report emphasizes the significance of the postmortem diagnosis of sudden death due to previously undiagnosed cardiac sarcoidosis. The implications of the medicolegal autopsy including histological examination are addressed.

Sarcoidosis, Sudden Death, Forensic Autopsy

G33 Accidental Insulin Overdose

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After attending this presentation, attendees will understand the postmortem laboratory tests required to make a diagnosis of insulin overdose.

This presentation will impact the forensic community and/or humanity by using a case of accidental insulin overdose which occurred in a hospital setting as an example, this paper addresses the difficult task of attempting to diagnose an insulin overdose after death. Guidelines are presented regarding the proper collection, storage, and evaluation of postmortem blood samples in cases of suspected insulin overdose.

Exogenous insulin has been used for many years to treat diabetes mellitus. Over the years there have been numerous accidental overdoses by these patients. However, in other instances insulin has been used as an agent for suicide and homicide in diabetics as well as non-diabetics. Presented here is a fatal case of accidental insulin overdose in a nondiabetic.

An 82-year-old white male, postoperative day 12 from incarcerated hernia repair, was transferred to the hospital's rehabilitation unit for care of continuing medical problems. A week after admission to the unit, the patient's nurse entered his room to check on him and to flush his PICC line. One hour later, the patient was noted to be in distress and a "Code Blue" was called. During the code a rapid blood sugar was found to be low and the physician ordered one ampule of D50 to be given. Blood glucose was 13 mg/dl initially and 33 mg/dl (normal range 64-105 mg/dl) eighty minutes later. During the code, it was noted that the PICC line was not usable, as it had "clotted-off." The patient's clinical course became substantially worse following this event and he died two days later.

Autopsy, limited by previous embalming, revealed severe hypertensive and atherosclerotic cardiovascular disease. Laboratory testing on a blood sample stored from the night of the hypoglycemic event included a C-peptide level of 0.9 ng/ml (normal range 1.1-4.6 ng/ml) and an insulin level of 297.5 (normal range 0-22.7 mIU). The cause of death was determined to be insulin overdose. Investigations were conducted to detect the cause of this incident. It was deemed that the patient mistakenly received from 100 units to 500 units of insulin. No reason or evidence of malicious administration could be found during investigation. Investigation concluded that nursing personnel accidentally flushed the PICC line with insulin, instead of heparinized saline. The containers for heparinized saline and insulin are of similar size and appearance.

Insulin is a major regulatory hormone that serves to lower the serum concentration of glucose. A proinsulin molecule, consisting of a two peptide chain molecule (insulin) linked by a connecting peptide (C-peptide), is synthesized in the beta cells of the pancreas. Rising serum glucose causes cleavage of the proinsulin molecule and yields the active insulin molecule and the inactive C-peptide in a 1:1 ratio. A major difference between commercial insulin and endogenous insulin is the absence of C-peptide in commercial preparations. With a large dose of exogenous insulin, the expected laboratory values include an elevated insulin level and a low C-peptide level.

Considering the difficulty of making a diagnosis of hypoglycemia postmortem, the interpretation of insulin and C-peptide levels becomes a crucial aspect of making a diagnosis of insulin overdose. In the case of a diabetic individual, postmortem anti-insulin antibody levels and free and total insulin levels also are appropriate tests. Peripheral blood is preferred as blood samples from the right heart have much higher insulin levels than peripheral blood. All samples should be placed in red-top serum separator tubes, spun down, and frozen as soon as possible. Samples for insulin and C-peptide levels are also valid in green-top plasma tubes, when spun down and frozen as above. Samples in purple-top EDTA tubes are not valid for analysis, nor are hemolyzed specimens. Anatomic autopsy findings in cases of insulin overdose are often unremarkable.

In any case of insulin overdose a comprehensive scene investigation to document the amount and type of insulin used, along with information revealing the source of the insulin is crucial. In addition, a complete autopsy, including appropriate laboratory studies, is needed to make a firm diagnosis in these cases. Special attention should be given to properly collecting and storing blood samples, as these specimens often yield the strongest evidence of insulin overdose.

Insulin Overdose, Accident, Complication of Therapy

G34 Unexplained Sudden Death and the Likelihood of Drug Abuse

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After attending this presentation, attendees will be able to define the relationship between drug abuse and deaths where neither anatomical nor toxicological cause for death is found.

This presentation will impact the forensic community and/or humanity by recognizing that a history of drug abuse may be sufficient to explain death in appropriate circumstances, just as chronic alcoholism can be accepted as a cause of death even in the absence of acute ethanol intoxication.

Rationale: Our office regularly receives cases of young adults with a history of drug abuse who have died suddenly and unexpectedly in whom neither anatomical nor toxicological cause for death is found at autopsy. In forensic pathology, these deaths are likely to be classified as undetermined in cause and manner. The common presence of a history of drug abuse, however, has led us to hypothesize that drug abuse induces some change that increases the risk of sudden death and that this change persists after the drug is no longer detectable in the body.

Methods: We conducted a retrospective case-control study of deaths investigated by the Jefferson County Coroner/Medical Examiner Office, Alabama between 1986 and 2002. The study group consisted of decedents between 10 and 70 years of age whose cause and manner of death remained undetermined following an autopsy and toxicological analysis for ethanol and drugs of abuse. The control group was chosen to most closely represent a random sampling of the population of Jefferson County, Alabama. The decedents chosen for the control group were either pedestrians or passengers in motor vehicle accidents, people

who died suddenly and unexpectedly while engaged in ordinary pursuits. Every decedent in the control group received an autopsy and toxicology analysis for ethanol and drugs of abuse. The control group was age matched to the study population within 5 years of the age of the study decedent and within 2 calendar years of the date of death of the study decedent (to keep social trends similar). The charts of all cases and controls were reviewed for the circumstances surrounding death, a documented history of drug abuse, and any compelling physical signs at autopsy that indicated drug use, i.e. needle track marks, nasal septum perforation, or polarizing particles in foreign body giant cells within the lungs. All toxicology results were noted including the presence of cocaine, any other drugs or medications, and ethanol. Decomposed remains were included in the study.

Results: The study group of undetermined deaths consisted of 62 decedents, 24 of whom had some evidence of drug abuse (history, physical signs, positive toxicology for cocaine or its metabolites in urine or bile, opiates, or methamphetamine). In the matched control population 9 decedents had a positive drug history or a drug of abuse detected by toxicology or both. These results are shown below.

	Evidence of drug abuse	**No evidence of drug abuse**	**Total**
Case study group (undetermined cause)	24	38	62
Control group (pedestrian or wreck)	9	53	62
Total	33	91	124

Analysis of these data shows that a decedent with a history of drug abuse has a risk odds ratio of 3.7 (95% confidence interval 1.59 8.69). In other words, an individual with an undetermined cause and manner of death is 3.7 times more likely to have evidence of drug abuse as is an individual who dies in a motor vehicle collision as either a pedestrian or passenger. For this study $p = 0.0015$, so chance is an unlikely explanation for these results. Nor is simple intoxication alone the explanation for death in the study group. Analysis revealed no statistically significant difference between the study group and the control group for the presence or absence of ethanol in the blood at the time of death.

Conclusion: A history of drug abuse is far more common in sudden, unexplained deaths than it is in a control group chosen to represent a random sample of the population, even in the absence of a level of drug sufficient to account for death at the time of death. Research suggests that cocaine use in particular induces chronic biochemical and physiological changes that persist beyond the presence of circulating cocaine in the blood, just as the induction of hepatic enzymes by alcohol persists beyond the presence of ethanol in the blood. These findings imply that a history of drug abuse may be sufficient to explain death in appropriate circumstances, just as chronic alcoholism can be accepted as a cause of death even in the absence of acute ethanol intoxication.

Sudden Death, Drug Abuse, Cocaine

G35 Acute Bacterial Meningitis With Predominance of Immature Granulocytes

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This presentation highlights three cases of acute meningitis with a predominance of immature granulocytes and compares these cases to a retrospective evaluation of cases diagnosed as "acute meningitis."

While a rare phenomenon, knowledge of the fact that immature granulocytes may constitute the principle cell type in the CSF and subarachnoid space of acute bacterial meningitis may prevent misclassification of these cells at the time of evaluation of CSF in the hematology and cytopathology laboratories and during surgical and autopsy pathology examinations.

Background: Bacterial meningitis, in its acute stage, is typically characterized by a "purulent" inflammatory cell infiltrate of abundant polymorphonuclear cells and necrotic debris. Intracellular or extracellular bacteria can be observed in some cases. The neutrophils seen are typically mature, or degenerating. As the process gains chronicity, neutrophils are eventually replaced by mononuclear cells. Recognition of neutrophils in the cerebrospinal fluid (CSF), as opposed to mononuclear cells (macrophages and lymphocytes), is a key clinical finding that guides therapy.

Case Reports: During a period of a year, at two institutions, a total of three fatal cases of acute bacterial meningitis were evaluated at autopsy in which the predominant cell type was immature granulocytes with only rare polymorphonuclear cells recognized.

Case 1: The first case involved a 12-year-old female with a history of morbid obesity and systemic lupus erythematosus, treated with corticosteroids. She was reported to have collapsed suddenly after a two day history of fever, diarrhea, and dark urine. Despite resuscitation efforts, the patient could not be revived and she was pronounced brain-dead the following day. Peripheral blood evaluation had demonstrated a marked left shift. CSF was not evaluated. She had been treated for 1.5 days with antibiotics prior to her demise. An autopsy revealed an inflammatory infiltrate composed of predominantly immature and mature granulocytes within the meninges, lungs, gastric mucosa, and adrenal glands. The bone marrow was normal, suggesting that these cells were the result of a left shift. Organisms were not initially identified by histology, histochemistry, or culture, but subsequent immunohistochemical testing performed at the Center for Disease Control was positive for *Neisseria meningitidis*.

Case 2: The second case involved a one day old female infant, born at 36 weeks estimated gestational age. At birth the infant was unresponsive with Apgar scores of 0, 1, and 5, requiring aggressive resuscitation. Blood cultures identified a *Listeria monocytogenes* bacteremia, and the patient died the following day. Development of a marked left shift occurred during a 20 hour period on a series of three peripheral blood smears. CSF was not evaluated. Antibiotics had been administered prior to death. An autopsy demonstrated miliary microabscesses involving the trachea, lungs, esophagus, stomach, intestine, liver, spleen, and adrenal glands. In addition, an inflammatory infiltrate within the leptomeninges showed a predominance of immature granulocytes rather than mature neutrophils. *Listeria monocytogenes* was cultured from lung and meningeal samples.

Case 3: The third case involved a 44-year-old male with a history of paranoid schizophrenia. He had no known history of immunosuppression and did not drink alcohol or abuse drugs. He had been in his usual state of health until one day prior to his demise when he had complained that he "felt bad." The next morning he was found unresponsive on the floor next to his bed. He was not taking antibiotics prior to his demise. At autopsy, histologic examination of the meninges revealed a dense inflammatory infiltrate of immature granulocytes. Postmortem cultures of cerebrospinal fluid were positive for *Neisseria meningitidis*.

Materials and Methods: Histologic sections were evaluated by hematoxylin and eosin and Gram stains and immunohistochemically for

CD68, CD20, CD3, and myeloperoxidase. Findings from these cases were compared to and contrasted with, by retrospective evaluation, all routinely diagnosed acute bacterial meningitis cases in our database.

Results: Myeloperoxidase positive immature granulocytes constituted the predominant cell type in each of the three cases; only very rare segmented forms were identified. Scattered admixed CD68 positive macrophages and CD3 positive T lymphocytes were identified; only rare CD20 positive B lymphocytes were identified. Gram stain failed to identify bacterial clusters in any of the three index cases.

Discussion: While a rare phenomenon, knowledge of the fact that immature granulocytes may constitute the principle cell type in the CSF and subarachnoid space of acute bacterial meningitis may prevent misclassification of these cells at the time of evaluation of CSF in the hematology and cytopathology laboratories and during surgical and autopsy pathology examinations. The organism, treatment, and host factors that may predispose toward manifestation of immature granulocytes in these patients remains unclear.

Acute Bacterial Meningitis, Autopsy, Forensic Science

G36 Coronary Artery Anomalies and Sudden Death: Two Case Reports in Young People

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The goal of this presentation is to present to the forensic community two cases of sudden death due to coronary artery anomalies by autoptic and clinicopathologic findings and histological studies.

This presentation will impact the forensic community and/or humanity by presenting to the forensic community two cases of sudden cardiac death due to rare coronary artery anomalies in young people. These two cases have been studied by means of autoptic and histological examinations. It would be an important contribute to the scientific community for the diagnosis of one of the possible causes of sudden death in infant and young people.

Coronary artery anomalies may cause sudden death. This presentation discusses the clinicopathologic features, the autoptic findings and microscopic features in two cases with different coronary anomalies.

Case 1: A 13-month-old infant, white male, was found unresponsive in his crib. The infant was transported to the hospital, where resuscitative efforts were unsuccessful, and the infant was pronounced dead. Previous clinical history: at the age of 6 months numerous episodes of apnea's crisis, cyanosis and convulsion and at the age of 7 months, the infant was diagnosed as epileptic. Cardiologic examinations (ECG, echocardiogram, Holter monitor evaluation) and chest X-Ray were normal.

The autopsy revealed a well developed and well nourished 13-month-old white male. All internal organs were in their normal anatomic relationship. The heart, in the fresh state, weighed 45 grams. Upon sectioning, the myocardium was reddish. Atrio-ventricular and semilunar valves were normal. The right coronary artery arose from the left sinus of Valsalva associated to a tunneled passage of the posterior interventricular coronary artery. The first section of this artery presented a take-off and a passage between the aortic and pulmonary root. The coronary circuit was dominant to the right.

The histological examination of the cardiac tissues revealed diffused and biventricular myocytolisis in contractile subendocardial bands characterized by altered, eosinophilic, hypercontracted myofiber. In many areas the myofiber appeared fragmented into irregular, partially acidophilic transverse bands. The immunohistochemical exams, effected on cardiac fragments, resulted positive to the anti - desmin and anti-actin antibodies, and negative to the anti C5 antibodies. Examination of the other organs were unremarkable except for pulmonary edema and polyvisceral stasis.

Case 2: A 22-year-old white male collapsed and died while exercising in a swimming pool; prompt medical assistance and attempted resuscitation were unsuccessful. At the age of 21, he was hospitalized in a Neurological Clinic, where instrumental and clinical data suggested the diagnosis of Friedreich's ataxia. The subject underwent molecular genetic analysis for the FA gene that revealed neither expansion nor point mutation of the FA gene. One year later, he was hospitalized at another Neurological Clinic where a general examination showed kyphoskoliosis, pes cavus, and a neurologic examination showed nystagmus, hypotonus, distal hypotrophy of the arms and legs, ataxia, areflexia, abnormalities in superficial and deep sensations. Ncv and EMG examinations were compatible with a severe axonal-myelinic sensory-motor neuropathy, while vitamin E, B12, folic acid, antigliadin antibodies, hexosaminidase, transferring isoforms, lactate and pyruvate were all normal. The diagnosis was spinocerebellar heredodegeneration, Friedreich's type. A treatment with idebenone, CoQ100 and Vitamin E associated with physiotherapy was suggested.

At autopsy the body was that of a well-developed young adult. Skin, ostia, oral and scleral mucosae were normal. On evisceration the heart had a normal intrathoracic position with the following diameters: longitudinal 11 cm, transversal 13 cm and antero-posterior 7 cm; the weight was 475 gr. On opening, the ventricular chamber was 30 mm wide, the wall and the inter-ventricular septum measured 28 mm each. The endocardium was white, smooth and bright, no trombi or vegetations were detected. Atrio-ventricular and semilunar valves were normal. The right coronary artery normally arose from the right ostium. In the left sinus of Valsalva two distinct ostia were detected instead of the left coronary artery ostium. The diameters of the two ostia measured 1,5 and 2,5 mm respectively and were separated by a septum that divided the stem determining a separate origin of the two left coronaries. Incannulation and a careful dissection demonstrated that the larger ostium was one of the circumflex branch, the smaller one the ostium of the anterior branch.

The histological examination of the sections revealed diffuse interstitial fibrosis due to the presence of thin fibrous septa dividing the muscle cells. Miocytes showed fragmentation of the fibers, nuclear enlargement, sometimes pyknosis and cytoplasmatic vacuolization. A section taken from the interventricular septum showed hemorrhagic infiltration of the wall with single erythrocytes between the single myocites and small blood extravasations. Examination of the other organs were unremarkable except for pulmonary edema and polyvisceral stasis.

The autoptic findings and the histological studies effected lead us to conclude that these are both cases of sudden cardiac death in subjects affected by coronary anomalies.

In the first case death was caused by cardiac arrhythmia sustained by myocardial hypoxia induced by an anomalous origin of the right coronary artery from the left Valsalva sinus.

In the second case death was caused by cardiac arrhythmia, sustained by myocardial hypoxia induced by an anomaly of the left Valsalva sinus, divided into two distinct ostium: one in the anterior intraventricular coronary and one in the circumflexed associated with myocardial hypertrophy, in subjects affected by Friedreich's ataxia.

Congenital coronary anomalies constitute a statistical incidence of 0,3-0,8% and represent 0,1-2% of all congenital cardiac conditions worldwide. If we consider the anomaly originating of the right coronary artery from the left Valsalva sinus, as revealed in one of the two cases examined, the prevalence from autoptic studies is reduced to 0.026%.

Congenital anomalies of the coronary arteries present great difficulties in diagnosis because these diseases can be absolutely asymptomatic and, although rarely, can manifest themselves with syncopal episodes or with a fading symptomatology leading to heart failure. However, the prognosis is influenced by the seriously of coronary anomaly.

The anomalous origin of the right coronary artery from the left Valsalva sinus has long been considered a mostly benign disease and only in 1982 three cases of sudden death are described whose cause depends on this type of congenital alteration.

In literature, the stenosis or coronary take-off in the initial tract are interpreted as causing ischemia and sudden death.

The origin of the right coronary artery from the left sinus may be an incidental observation during autopsy. Ischemia is usually precipitated by strenuous, prolonged effort, and this explains why a basal ECG or even a stress test ECG may be negative. Syncopal episodes are the only prodromal symptoms. Repetitive ischemic episodes may cause patchy myocardial necrosis and fibrosis as well as ventricular hypertrophy, which eventually can elicit arrhythmias because of the malignant combination of acute and chronic substrates. This may explain why sudden death, associated with an anomalous origin of a coronary artery from the wrong sinus, may occur in adults even though the anomaly has been present since birth.

An anomalous origin of the left circumflex artery from the left coronary sinus itself with a separate ostium, has also been described in victims of unexpected arrhythmic sudden death. This anomaly was considered a benign condition until cases were reported, both clinically and pathologically, with evidence of myocardial ischemia in the absence of obstructive coronary atherosclerosis or causes other than the malformation itself.

It should be noted that in cases of coronary anomalies sudden death, in children and young adults, often occurs during or following physical exertion. In the second case reported death occurred during physical activity and the anomaly of the left Valsalva sinus, divided into two distinct ostium: one for the anterior interventricular coronary and one for the circumflexed, was associated with cardiac hypertrophy, a pathology present very frequently in subjects affected with Friedreich's ataxia.

Sudden Death, Anomalous Origin Coronary Artery, Contraction Band Necrosis

G37 Neurofibromatosis Type 1 Associated With Hydrocephalus and Acute Cardiac Failure: A Fatal Case

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The goal of this presentation is to contribute to the diagnosis of the cause of death in a case of intracranial hypertension due to hydrocephalus and associated acute cardiac failure.

This presentation will impact the forensic community and/or humanity by providing a rare case of tetraventricular hydrocephalus associated with intracranial hypertension and acute cardiac failure in a young boy affected by neurofibromatosis type 1. Disturbance in central sympathetic control resulting in sympathetic hyperactivity has been suggested to be the most likely mechanism responsible for the cardiovascular complications during acute ICH. It would be an important contribute to the scientific community for the diagnosis of the cause of death in ICH.

Test: Neurofibromatosis type 1, also known as von Recklinghausen's disease, is an autosomal dominant genetic disorder, with an extremely wide range of manifestations, and a multisystemic involvement; its incidence is of 1 in 3.500 newborns, and its prevalence of 1 in 4.500 newborns, this makes it one of the most common inheritated diseases. It is caused by a mutation of the NF1 gene, located on the chromosome 17, whose product, the neurofibromin, is a GAP-protein which functions as a negative growth regulator, and is thought to be a tumor suppressor. NF1 is clinically characterized by its cutaneous manifestations, café au lait spots, axillary and inguinal freckling, Lish nodules, and multiple neurofibromas with a variable clinical expression, even in the affected members of the same family. The complications of this disease are numerous and can often be fatal. One severe complication is represented by the development of malignant tumors. The less known vascular lesions, in particular in the arterial tree, may also represent a potentially important complication of NF1, in fact they may be the cause, for example, of hypertension, aortic coarctation, cerebral and visceral infarcts, haemorrhage resulting from aneurysms rupture, etc. Moreover, also cardiovascular abnormalities may occur in NF1, in particular cardiovascular malformations (2.3% of patients) such as pulmonary stenosis, aortic coarctation, etc., hypertrophic cardiomyopathy, and other miscellaneous cardiac abnormalities (such as intracardiac tumors, mitral valve prolapse, aortic dilatation, etc.). Other severe complications are hydrocephalus, and osseous dysplasia, which causes severe scoliosis.

We have seen that patients with NF1 have an increased risk for a variety of cardiovascular disorders (vasculopathy, hypertension, congenital heart defect, etc.), but we want to underline that, in some cases, they are the direct complications of NF1 itself that may induce fatal cardiac disorders.

Case Report: A 12-year-old white male, affected by neurofibromatosis type 1 was admitted to our University Hospital with the suspected diagnosis of meningitis. He was diagnosed as having NF1 at the age of 4-years-old, on the basis of the clinical manifestations. His mother was also affected by NF1. The family history was negative for cardiovascular disease. On physical examination upon admission he measured 155 cm in height, and 48 Kg in weight. He presented dysmorphic features including coarse face with frontal bossing, flat nasal bridge, large nose with anteverted nostrils, large lips, prominent midface, numerous café au lait spots (> 1.5 cm) over the body, axillary and inguinal freckling, and multiple dermal and nodular neurofibromas over the trunk and limbs. Moreover he presented macrocephalia (head circumference 58,5 cm), neck stiffness, headache, and he had a temperature of 38°C with vomit for three days. On neurological examination the patient appeared conscious, but sleepy. The remaining physical examination was otherwise unremarkable. The laboratory analysis excluded signs of inflammation.

An urgent CT cranium revealed a tetraventricular hydrocephalus. In the meantime the clinical conditions got worse: the child presented a violent headache, agitation, cyanosis. So he underwent surgery for an emergency ventriculo-peritoneal shunt, 20 cc of clear fluid were drained, but during the operation he had a bradycardia, wich progressed to cardiac arrest, and then he died for a cardiocirculatory arrest. Death was attributed to acute cardiac arrest during intracranial hypertension resulting from tetraventricular hydrocephalus.

A complete autopsy was performed. External examination confirmed the clinically noted features of NF1. I nternal examination of the cranium revealed an edematous brain, which measured gm 1900 (normal 1400 gm) in weight, with tetraventricular hydrocephalus, a glioma of the left optic nerve, and vasal congestion. Both lungs were heavy and reddish (right 350 g, normal 210, left 300 g, normal 190). The heart weighed 140 g (124 norm), and was in appearance normal in all respects. The epicardial coronary arteries arose normally in a right dominance manner. The autopsy examination was otherwise normal. Microscopic sections of the brain showed a marked edema, cribrosis, little intraparenchymatous haemorrhages, vasal congestion. In the lung it was found edema, acute emphysema, acute stasis, endoalveolar haemorrhages, areas of fibrosis, while in the heart numerous foci of contraction band necrosis, acute stasis, and areas of disarray were found.

The cardiac histological findings require a careful investigation and an adequate interpretation. Contraction band necrosis is a specific morpho-functional entity. Histologically, this form of necrosis is characterised by irreversible hypercontraction of the myocell, extremely short sarcomeres, with markedly thickened Z-lines, paradiscal lesion which progresses to a breakdown of the whole contractile apparatus. This breakdown varies from irregular, pathological and eosinophilic cross-bands, consisting of segments hypercontracted or coagulated

sarcomeres, to a total disruption of myofibrils, the hole cell assuming a granular aspect without visible clear-cut pathological bands. CBN is observed in many human pathologies, it is not an ischemic change, but the expression of cathecolamine toxicity, as confirmed by experimental intravenous cathecolamine infusion, and by the equivalent human cases with pheochromocytoma. The excess of cathecolamines produces cardiotoxicity through two mechanisms: a) a direct cardiotoxicity, due to the binding of cathecolamines to adrenoceptors; b) an indirect cardiotoxicity, due to the formation, during the metabolisation of the cathecolamines, of highly toxic substances such as aminochromes (adrenochrome) and free radicals, which damage different types of heart membranes, causing intracellular Ca^{2+} overload and myocardial cell damage. The finding of CBN, even if microfocal, could be an important histological signal for interpreting the cause of death and the natural history of a disease in any single patient. It may represent a sign of adrenergic stress linked with malignant arrhythmia/ventricular fibrillation.

Now it only remains to clarify which has been the cause of such cathecolamine surge. The obstructive hydrocephalus related to NF1, generally results from a periaqueductal gliosis which may cause the stenosis of Sylvius's aqueduct, or the blockage of the IV ventricle, resulting in the block of the draining of the cerebro-spinal fluid, the hyperdistension of the upper ventricular cavities, and the increase of the intracranial pressure. In literature there is evidence of myocardial injury following acute intracranial hypertension. It is well established that traumatic head injury with intracranial hypertension (ICH) initiates a cascade of physiological but deleterious events that result in haemodynamic perturbations, electrocardiographic abnormalities. Recent clinical and experimental studies have demonstrated that the pressor and dynamic response of the heart to head injury with acute ICH is mediated by cathecolamine surge, which represents a stress response, mediated by medullary vasomotor centers, triggered by the increased circulatory needs consequent to the decreased cerebral perfusion that follows the sudden ICH. The transient hyperdynamic response of the heart following the excessive sympathetic nervous activation is short-lived and gives way to cardiovascular collapse. In failed hearts, there is histologic evidence of focal myocardial damage that is characteristic of cathecolamine-mediated cardiac necrosis.

The patients affected by NF1 have a reduced lifetime expectancy, because of an increased risk for a variety of fatal disorders, which may be the direct complications related to NF1, but also diseases due to the complications itselves. In the case we report, the obstructive hydrocephalus related to NF1 causes an acute ICH resulting in central sympathetic hyperactivity, that is responsible for the cardiovascular complications during acute ICH.

Neurofibromatosis 1, Hydrocephalus, Sympathetic Hyperactivity

G38 A Cluster of Child Deaths: A Medical Examiner System Participates in an Epidemiologic Investigation in Virginia

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After attending this presentation, attendees will learn how to recognize a developing cluster of deaths in children; how to cooperate with the Centers for Disease Control, local and national laboratories, and public health departments in analyzing the deaths of individuals involved in a cluster, allaying public fears, and meeting media demands; and to avoid mistakes previously made.

This presentation will impact the forensic community and/or humanity by increasing the ability to recognize a developing epidemiological cluster, and how to optimally communicate with all parties involved, including colleagues at a local and national level, parents and relatives of the decedents, the "worried well," and the media.

A two-year-old girl with a history of multiple upper respiratory infections, and a prodrome of a week of ear pain and fever, presented to an emergency room at 0300 in the morning with a fever of 102 degrees F. She was diagnosed with otitis media, and prescribed antibiotics. Five hours later, she was found dead in bed. Autopsy showed no evidence of bacterial infection; a viral infection was suspected. On the day of her autopsy, a three-year-old boy was diagnosed at a local military hospital clinic with a viral upper respiratory infection. He died in his sleep at home the next morning, after lying on the living room floor watching cartoons, with his mother asleep nearby on the couch. Within three days, two more children in the same geographic area had died at home after short febrile illnesses. When the four deaths were reported, media attention and public concern became intense.

The medical examiner system of the Commonwealth of Virginia was put on alert, and invited the Center for Disease Control to participate in analyzing the developing cluster, utilizing fluids and tissues obtained at autopsy. Two more children died in the following week, and three more in the next ten days. Early results were conflicting and noncontributory. Several weeks passed before it could be determined that this was a temporal cluster of unrelated childhood deaths, that there was no single pathogen responsible, and that the public had been protected.

This half hour discussion follows the experience of multiple medical examiners within a single statewide system coping with an unexplained cluster of child deaths. We review the recognition of the development of the cluster. We re-examine how we dealt with the issues of cooperation with public health colleagues, the CDC, and the laboratory, as well as communicating optimally with each other, the bereaved parents, the media, and the public. We revisit how we learned to utilize the CDC's expertise and resources, while performing optimal post mortem examinations within our medical examiner system. It was necessary to implement new methodologies that were foreign to our system, if well known to the CDC, and to develop new networks of communication as we relied upon colleagues in different states and many different institutions. The goal was to find answers for grieving families, bewildered colleagues, a hysterical public, and the voracious media. Special attention will be paid to the mistakes that were made, and how they could have been handled differently.

Child Death, Epidemiologic Cluster, Infectious Etiology

G39 Police Custody Deaths in the State of Maryland: Passing the Torch

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The goal of this presentation is to highlight and briefly discuss the major autopsy findings of deaths that occurred during police custody in the state of Maryland.

Medicolegal Investigation of police custody deaths has been a great challenge to our forensic investigators. It may be argued that much more information is needed on this subject. The establishment of a national database has been discussed. It should combine national statistics as well as grouping the information by state. It is hoped that recognizing more trends will perhaps establish criteria that may ease the difficulty of investigating and thus rendering a decision in these cases. Most impor-

tantly, established criteria may assuage the public's perception of police misconduct and ultimately save more lives.

This retrospective study was undertaken to enhance the academic examination of these potentially volatile cases. The Office of the Chief Medical Examiner (OCME) has jurisdiction over all municipalities in the state of Maryland, including twenty-three counties and the city of Baltimore. A total of twenty-five deaths that occurred during police custody were investigated by the OCME from 1993 through 2003. Examination of each case included the autopsy report, the police report, the investigative report and photographs. Highlighted characteristics included race, age and sex distribution, jurisdiction, nature of incident, type of restraint used, autopsy findings, toxicological findings and the cause and manner of death.

Nineteen of the cases involved African-American men, most of whom were in their thirties. Twenty-one of the incidents occurred in the major urban areas of Baltimore City (16) and Prince George's County (5). Cocaine use was found in twelve of the cases.

The reasons for police involvement and the use of restraints included physical assault against another person, irrational behavior and other aggressive actions. The primary methods of restraint involved handcuffing. Eight cases involved the use of handcuffs in the prone position. Four of the eight handcuffed cases had leg irons also. One subject was hog-tied and placed on his side.

Common autopsy findings included abrasions and contusions of the face and extremities. Petechial hemorrhages were found in three cases. Subgaleal hemorrhage was the most commonly documented internal injury. Cocaine intoxication contributed to the cause of death in twelve cases. The manner of death was concluded as undetermined in fourteen cases.

Literary review has recognized some common variables involved in these cases. Most notably, the risk of the prone restraint position and understanding the increased risk of death in individuals experiencing excited delirium caused by either illicit drug usage or psychiatric disorders.

Given the intense public scrutiny that surrounds these cases, it is the manner of death that requires the greatest objectivity when investigating these deaths. The circumstances of each case should stand independently of prior, similar incidents. A primary reason for the difficulty of custody death investigation is the paucity of evident, lethal physical injury. These cases exhaust the importance of the combined major facets of post-mortem examination, specifically the autopsy, the toxicology report and scene investigation. More than usual, heightened cooperation between law enforcement personnel and the medical examiner investigating the case is required.

Police Custody, Death Investigation, Autopsy

G40 Characterization of Recent Cocaine and Methadone-Related Death Trends in Caddo Parish, Louisiana, With Comparison to National Trends

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After attending this presentation, attendees will recognize recent trends in drug-related deaths, specifically cocaine and methadone-related.

Cocaine has dominated the picture in drug-related deaths presenting to the forensic pathologist. Recently, there has been a trend toward decreased cocaine-related deaths and increased methadone-related deaths. Unlike cocaine, methadone is not ordinarily considered an illicit drug, as it is regularly prescribed to heroin users (methadone maintenance programs) and to those with chronic pain. The forensic pathologist will become aware of the increase in methadone-related deaths in general, and the community-specific demographics with respect to each drug.

This study explored a local trend in cocaine and methadone-related deaths for years 2000 through 2002, with comparison to those seen in the major U.S. metropolitan areas. The general local trend in decreased cocaine-related deaths with concurrent increased methadone-related deaths paralleled that in many of the major metropolitan areas in which drug data was available. Discrete local trends were noted with respect to age, race, sex and marital status.

A recent increase in methadone-related deaths has been documented in medical and forensic literature, as well as in the mortality data from the Drug Abuse Warning Network (DAWN). A preliminary assessment of drug-related deaths presenting to the Caddo Parish Coroner's Office in Shreveport, LA, revealed a similar trend, therefore a comparison of local and national demographic data was performed to further characterize this trend.

We conducted a search of cases presenting to the Caddo Parish Coroner's Office between 2000 and 2002 in which death was attributed to drug use. Drugs found on toxicological analysis, as well as demographic information were documented. Finally, we compared our local demographic data with that provided in the most recent available (2000 and 2001) DAWN mortality analyses.

The search of local records yielded 22 cases, all listing either cocaine (13) or methadone (9) as contributing to death. Polypharmacy was documented in 2 of the cocaine-related deaths and in 5 of the methadone-related deaths; however, this was not pursued further as the cocaine/methadone-related mortality trend was the focus of this study. The results are listed in the table below.

Drug	Year	No. Cases	Mean Age (yrs)	Race B	Race W	Sex M	Sex F	Marital M	Status S
Cocaine	2000	7	34	5	2	5	2	0	7
	2001	4	57	3	1	3	1	2	1
	2002	2	51	1	1	1	1	1	unk
Methadone	2000	1	32	0	1	1	0	1	0
	2001	2	37	0	2	1	1	1	1
	2002	6	37	1	5	3	3	4	2

M=married S=single (never married, divorced, widowed)

These results show a gradual transition from greater cocaine-related deaths to greater methadone-related deaths in the years 2000 to 2002. Cocaine-related deaths were seen more often in a younger population of black males (mean 34 years) in 2000, with an increased age seen in subsequent years (mean age 57 and 51 years in 2001 and 2002, respectively). Methadone-related deaths were seen more often in a younger age group (mean age 35 years) and whites in all years. Another demographic trend that emerged and perhaps warrants further investigation was that of marital status. Eight (61%)of the cocaine-related deaths were single (never married, divorced, widowed), while 3 (23%) were married. Marital status of 2 decedents was not known. Three (33%), of the methadone-related deaths were single, while 6 (67%) were married.

A review of the most recent available DAWN mortality data (2000 and 2001) revealed that methadone was one of the top ten drugs reported in 25 of the 33 major metropolitan areas studied and cocaine was one of the top ten drugs reported in all areas. A comparison of the 2000-2001 data revealed an increase in methadone-related deaths by 7 to 72% (median 36.5%) in 17 of the 25 areas. Ten of the 17 experienced a concurrent decrease in cocaine-related deaths, similar to that observed in Caddo Parish, LA. Additionally, 9 of the 10 areas were located within the regions traditionally described as southern (4), midwestern (1), and western (4) United States.

These results indicate a recent trend toward fewer cocaine-related deaths, with concurrent increase in methadone-related deaths in both the region of study and in specific national regions. While local demographic trends were noted with respect to age, race, sex, and marital status, comparison of local trends to national trends was not possible, as the data provided by DAWN does not include specific drug-related demographic information. Additionally, since our study area has less population density than those included in the DAWN analyses, it would be desirable to compare our local data with that of similarly populated areas.

Cocaine, Methadone, Mortality

G41 Positional Asphyxia and Alcoholism: Review of Three Cases

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After attending this presentation, attendees will recall and consider the role of positional asphyxia in alcoholic deaths. Raise the index of suspicion of alcoholism in positional asphyxia deaths. Using case histories, consider the role of acute intoxication with ethanol, versus no intoxication, versus other agents. Be aware of issues in certification of manner of death in positional asphyxia deaths in alcoholics.

This presentation will impact the forensic community and/or humanity by creating awareness of possible role of alcoholism in positional asphyxia deaths, which has not received deserved consideration previously. Open the dialogue on how chronic alcoholism or acute intoxication in alcoholism is likely to affect positional asphyxia. Remind the forensic community that the manner of death deserves careful attention, as it may still be homicide, even in a person with scene evidence of positional asphyxia, and multiple intoxicants on board.

We report three cases in which positional asphyxia caused death, but was abetted or affected by alcoholism. In one of the cases, acute alcohol intoxication was present; in another, despite fatty liver, no alcohol was found on toxicology; in a third, homicidal assault may have been the instigating factor.

A 46-year-old woman, who had a history of a seizure disorder, was found dead at home. She had consumed a large quantity of beer and a half pint of Jack Daniels whiskey the evening before. She was found lying prone, with her neck hyperextended against the fabric of the foot of a couch. Scene photographs and autopsy findings both indicated that positional asphyxia was the cause of death. A faint bitemark on the tongue, and the absence of any seizure medication in the blood on toxicologic study, suggested that a seizure might have caused her to collapse in that position. However, the blood alcohol level was 0.43% weight per volume.

A 41-year-old man, with a history of probable chronic alcohol abuse and a known seizure disorder, was found dead at home, collapsed across the metal frame of a coffee table, which had had its glass top removed. Prominent pressure marks across his anterior neck and lower abdomen corresponded to the rails of the coffee table frame. The right cornu of the thyroid cartilage had fractured beneath the pressure mark, suggestive of a direct collapse onto the frame, possibly during a seizure; a probable tongue bitemark was present. Although fatty liver and micronodular cirrhosis were found at autopsy, the blood alcohol level was 0.0%. Toxicology did not reveal any anti-seizure medications.

The final case is more problematic. A 54-year-old woman, with a history of both chronic alcoholism and prescription drug abuse, was known to be unsteady on her feet; neighbors said she often had bruises. She was found dead at home, collapsed in her cluttered bedroom, with the head and neck extended into an awkward position. Autopsy showed a linear perimortem neck abrasion, with bruising over the anterior neck, and focal hemorrhage into the strap muscles. She had multiple bruises on the face, torso, and extremities, but no petechiae, and no fracture of the hyoid bone or thyroid cartilage. Postmortem toxicology showed an elevated amount of mirtazapine (0.6 mg/L), with no alcohol, street drugs, or anti-seizure medications. Death was attributed to asphyxia due to neck compression, due to positional asphyxia, with mirtazapine toxicity contributing. It was unclear whether some of the bruising or the linear abrasion might have been inflicted by an assailant.

These three deaths concern positional asphyxia in a setting of alcoholism. Although it is intuitively obvious that alcoholism should lend itself to deaths by positional asphyxia, there is a dearth of reports in the literature evaluating both. Reports in the popular media anecdotally mention alcoholism in a rare positional asphyxia death with homicidal intent, but the forensic literature has not addressed it. This report aims to open the forensic pathologic discussion on the effect of acute or chronic alcoholism on deaths by positional asphyxia

Positional Asphyxia, Alcoholism, Manner of Death

G42 Causes of Death in Chronic Alcoholics: A Comprehensive Retrospective Analysis of Medical Examiner Cases

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After attending this presentation, attendees will understand the necessity for complete autopsy examination, scene investigation and toxicology in the evaluation of individuals with chronic alcoholism. The spectrum of causes of death in individuals with chronic alcoholism.

This presentation will impact the forensic community and/or humanity by illustrating the spectrum of causes of death in chronic alcoholics and the need for complete death investigation in such deaths.

Acute and chronic alcohol abuse is a common issue faced by medical examiners and death investigators. The morbidity and mortality of chronic alcoholism is well-documented in the hospital population, but little data is available describing those who die outside of the hospital or without medical care. The teaching/dogma in the forensic pathology community is that chronic alcoholics suffer certain injuries, such as subdural hematoma, much more frequently than the general population, though little is published in the scientific literature to support these claims. This study was undertaken to assess the causes of death in chronic alcoholics in a large urban area over a seven year period.

The Miami-Dade County Medical Examiner Department case file computerized database was retrospectively searched, using the keywords “alcohol” and “heavy,” and “alcohol” and “abuse” in the history field, and “alcohol” or “ethanol” in the cause of death fields, for the years 1996 to 2002, inclusive. Inclusion criteria were: performance of a complete autopsy; a history of chronic alcohol abuse or scene evidence suggesting the same; acute alcohol use prior to death; and/or alcohol caused or contributed to the death after complete autopsy and toxicology examination. Case files were reviewed to ensure the cases met the inclusion criteria.

During this seven year period, 17,463 autopsies were performed at the Miami-Dade County Medical Examiner Department. 1,457 cases were identified that met the above inclusion criteria, and were broadly grouped into two categories, those with a history of chronic alcohol abuse and/or circumstances of chronic alcohol abuse or acute use (1297 cases, 89%), and those with no history of chronic alcohol abuse or circumstances to suggest alcohol abuse or acute use (160 cases, 11%). The cases were also categorized by the cause of death: blunt injuries (159, 11%), drowning (65, 4%), polydrug intoxication with alcohol present (149, 10%), polydrug intoxication without alcohol present (48, 3%), other single drug intoxication (58, 4%), other alcohol related causes, such as pancreatitis, bleeding varices, and liver failure (501, 34%), and

natural diseases with chronic alcohol abuse as a contributory condition (104, 7%). Gunshot wounds, stabbings and hangings each accounted for 1% or less of the cases. The most common cause of death in both those with and without history of alcoholism fell into the "other alcohol related deaths" category (438/1297, 34% in those with history; and 63/160, 39% in those with no history). Twenty-one percent of those with a history of chronic alcohol abuse died as a result of a natural disease unrelated to alcohol abuse. A total of 19 cases were identified where the cause of death was related to a subdural hematoma (3 in the group without a history of alcohol abuse and 16 in the group with a history of alcohol abuse), for an overall incidence of roughly 1% in our study population. Within the chronic alcohol abuse group, pedestrians struck by vehicles accounted for more than those killed in a motor vehicle crashes (23 versus 18).

This retrospective study of medical examiner cases shows that those who suffer from chronic alcohol abuse are more likely to die from a non-natural process, such as trauma, drug intoxication or drowning, than they are to die from a natural complication of abusing alcohol. A thorough death investigation, including scene investigation, autopsy and toxicology is necessary to clearly establish the cause and manner of death in individuals with a history of chronic alcohol abuse.

Cause of Death, Alcohol Abuse, Autopsy

G43 FluiDDB.com: A Model Database for Unidentified Bodies

Michael C. Britt, BS and Marta U. Coburn, MD, District Twenty Medical Examiner, 3838 Domestic Avenue, Naples, FL 34104*

The goal of this presentation is to highlight the importance for medical examiners to have a database where information about unidentified decedents can be kept and ultimately used as a central clearinghouse for interested parties searching for information about missing persons.

It is our hope that FLUIDDB.com will serve as a model for medical examiner's offices in all states and that it will be instrumental in identifying at least a portion of the unidentified bodies that previously established criminal databases have not been able to successfully identify. It is also our goal to encourage newfound interest in medical examiners and their staff to re-examine the case files that lay dormant in their offices of these "forgotten" bodies.

This presentation will highlight the reasons why there should exist an easily accessible website where information about unidentified bodies found may be readily accessed by family members, police, and any other interested party. Dr. Marta Coburn, Chief Medical Examiner of Collier County, Florida realized the need to create such a website and designed a simple, yet comprehensive, database. FLUIDDB.com, an acronym for Florida Unidentified Decedents Database, employs existing computer technology in a user-friendly format that engages the interested party in the search process, while maintaining the integrity of sensitive criminal data. This fact is instrumental in the success of the identification process because current criminal databases are not available for public use.

Identification of a body is often hampered for many reasons and the longer a body remains unidentified, the less likely it is that their identity will be discovered. To compound the problem, the majority of medical examiner's offices do not have the means to readily access all of their cases of unidentified bodies. Therefore, even the most cursory search cannot be executed when medical examiners receive requests for information from family members searching for missing loved ones. The database will serve to organize these cases into a format that permits medical examiner staff immediate retrieval of information. A complete list with information about all of the unidentified deaths is obtainable given the participation of each medical examiner's office in a given state. The searcher may then streamline their focus and pursue only those published cases that match the information about the missing person they seek. The website was also designed to allow each office to easily update or delete information as needed. The discussion will include insight about entering information into the various data fields from the medical examiner's perspective and how to retrieve information from the searcher's viewpoint.

This presentation also discusses future plans to link FLUIDDB.com to other websites that may contain purely scientific information such as dental records or anthropological data. Recommendations for medical examiners and their staff of the most effective methods for establishing identification of unidentified bodies will also be provided. These guidelines will hopefully serve as a checklist of steps that should be taken during the early part of an investigation in an effort to exhaust all means of conventional identification procedures.

The office of the District Twenty Medical Examiner is confident that this database will eliminate the need for families or police to write, call or fax each individual medical examiner's office or law enforcement agency and will instead utilize the website as a means to narrow their search.

Unidentified Bodies, Identification, Missing Persons

G44 Compressional Asphyxia Due to a Crowd Stampede: The E2 Nightclub Disaster

Adrienne Segovia, MD, Mitra B. Kalelkar, MD, Aldo J. Fusaro, DO, Scott Denton, MD, Edmund R. Donoghue, MD, Kendall V. Crowns, MD, Eupil Choi, MD, J. Lawrence Cogan, MD, Ronald Knoblock, MD, Cyndi D. Gardner, MD, and Barry D. Lifschultz, MD, Cook County Medical Examiners Office, 2121 West Harrison Street, Chicago, IL 60612*

After attending this presentation, attendees will be able to recognize the findings in cases of compressional asphyxia, understand the proposed pathophysiologic mechanism for their development, and become acquainted with models of crowd panic behavior.

This presentation will impact the forensic community and/or humanity by recognizing the findings in cases of compressional asphyxia in your daily forensic pathology practice, understand the proposed pathophysiologic mechanism for asphyxial deaths, and become acquainted with models of crowd panic behavior.

We present 21 deaths due to compressional asphyxia that occurred in a Chicago nightclub stairwell in February, 2003. For reasons that remain unclear approximately 500 persons fled down a long narrow 28 step stairwell. The alleged trigger for the event was an altercation between two women on the dance floor, and the use of pepper spray to control the situation.

The victims ranged in age from 19 to 43 years. Nine were male and twelve were female. At autopsy external evidence of injury, when present, consisted of abrasions and contusions. Petechial hemorrhages of the sclera and conjunctiva, face and neck region were present in 17 of the 21 victims. The remaining five showed scleral and conjunctival congestion without petechiae. Petechiae were also present on the shoulders and the mid back. Petechial hemorrhages of the larynx, oral mucosa, pleura, epicardium, epiglottis and scalp were also present in the majority of the victims. One victim had bite marks of the lips and two had bite marks of the tongue. When present, muscle hemorrhage involved the tempoarlis and sternocleidomastiod muscles. Hemorrhage was also present in the soft tissues overlaying the thyroid. The only bony injury present was a fracture the right second rib anteriorly. Petechial hemorrhages were not identified in the lower extremities of any of the victims. Hyperaeration of the lungs was present in four of the 21 victims. Toxicology studies revealed the presence of alcohol and the presence of an antidepressant in one victim.

Asphyxia due to crowd compression was first described by Ollivier d'Angers in 1837. Ollivier reported that twenty-three persons died when they were compressed by a crowd of approximately 300,000 exiting the

Champ de Mars in Paris following a re-enactment of the storming of the citadel of Antwerp. Ollivier used the term 'masque echymotique' to describe the physical findings consisting of subconjunctival hemorrhage, craniocervical cyanosis and cerebral vascular congestion. In 1900, Perthes described the clinical syndrome and included mental dullness, hyperpyrexia, tachypnea, hemoptysis and "contusion pneumonia" to the complex of findings. Since then the syndrome has been further defined and can include neurological complications, ophthalmic complications, petechiae of the mucosal membranes, epistaxis, hematemesis, microscopic hematuria and albuminuria. Associated traumatic injuries have been described. Of these, thoracic injuries are most common and include rib fractures, hemothorax, pneumothorax, pulmonary contusions, cardiac contusion, and clavicle fractures. Fractures the upper extremities, pelvis, lower extremities and spine are the second most commonly associated traumatic injury. More severe, crushing injuries may produce lacerations of the liver, rupture of the diaphragm, as well as injury to the small bowel and colon.

The majority of the victims demonstrated the classic findings of asphyxia by compression - petechial hemorrhages in the absence of associated fatal internal traumatic injuries. The etiology for the development of the classical findings is unclear. A "fear response" leading to closure of the glottis and contraction of the abdominal muscles was proposed in 1905 by Lejars. The work of Williams et. al., in 1968 supported this. Their study monitored blood flow and intrathoracic pressure in anesthetized dogs. They reported that blood flow through the jugular vein and carotid artery decreased with thoracic compression. To simulate closure of the glottis, Williams and co-workers occluded the endotracheal tubes of the dogs, which resulted in an increase in pressure of the jugular vein and the development of the classic findings. The classic findings, however, have been documented in situations when the glottis was not closed; for example, in entrapped victims who were screaming. Nontraumatic/compressional mechanisms can produce the classic findings such as paroxysmal coughing, which can only occur when the glottis is open. Closure of the glottis may be responsible for the hyperaeration of the lungs seen in some of the victims, but not necessarily in the development of subconjunctival, scleral or facial petechiae. The absence of petechial hemorrhages in the lower extremities has been shown to be the result of collapse of the inferior vena cava, which occurs with increasing levels of thoracoabdominal pressure. This protects the veins of the lower extremities.

The twenty-one deaths described above occurred when the crowd panicked and rushed into one of two available stairwells. The term panic will be used here to describe flight from a perceived danger. For panic to develop a specific threat to physical survival having immediate effects must exist. The behavior of panicking individuals in a crowd has been studied. Panicked flight is directed towards escaping imminent danger. The convergence of fleeing persons in a collective panic frequently occurs because individuals flee in one direction assuming that escape is possible in that direction while ignoring other exits. This behavior is called "herding." Herding behavior occurs when the crowd moves in the same direction and other exits are not efficiently used. Models show that this behavior pattern frustrates escape. Individual behavior occurs when each person finds an exit only by accident and is similarly ineffective in effecting escape. Models show that escape is best accomplished when there is a mixture of individual and herding behavior. Individual behavior allows some to detect the exit, while herding allows successful solutions to be imitated by others.

A review of the literature found few case reports which described compressional asphyxia caused by crowds, and also lacked traumatic injuries and presented the autopsy findings. Several articles emphasized the management of patients, discussed the implications for disaster planning, and emphasized that morbidity and mortality were the result of associated internal injuries. Little mention has been given to the duration of the compression, which we believe contributes significantly to mortality.

In summary, we describe twenty-one deaths from compressional asphyxia due to a crowd stampede. The majority demonstrated the classic findings first described in 1837 by Ollivier. Mortality resulted from chest compression inhibiting respiratory movement and was related to the duration and the amount of weight rather than internal or related traumatic injuries.

Compressional Asphyxia, Crowd Stampede, Petechiae

G45 Perspectives on the Variety of Mass Identification Projects

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The goal of this presentation is to relate considerations and strategies for identifying a large collection of corpses.

The incidence of mass identification efforts looks to increase in the future as it has in the past. The aim of this presentation is to encourage the use of experience from past identification efforts in solving new ones.

Experience with previous mass identification projects establishes a general framework to apply to such problems, but also teaches the lesson to expect novel challenges each time.

Airplane crashes (SwissAir 111 near Halifax in 1997, American 587 in Queens shortly after 9/11/2001), wars (Bosnian mass graves, Kuwaiti POWs), and the destruction of the World Trade Towers have in common a large number of deaths with most of the corpses damaged beyond recognition. Given the condition of the bodies, DNA is the most reliable modality for identification. Given the large numbers, sorting out the identities requires efficient and carefully-designed routines. A few general ideas seem to be always applicable; other kinds of ideas, the list of which grows with each new experience, are important for one disaster or another.

The first category, the generalities, includes: DNA profiles are obtained from the victims, and from references – family members and/or personal effects. Tentative or candidate identities are determined by a *screening* step in which every victim is rapidly compared with every reference sample, highlighting related-seeming pairs. The screening list should be prioritized by degree of similarity. Each candidate identity is then *tested* beginning with the easiest. The DNA part of the test consists in making appropriate kinship and/or DNA matching calculations taking into account all typing information. The result of the calculation is a number, a likelihood ratio that is usually either very large or very small – virtually ensuring or else contradicting the tentative match – but sometimes inconclusive. Common sense dictates that even when the likelihood ratio is very large, all available information must be carefully checked for any inconsistencies that might suggest a human error occurred. If all is well, the identity will be assumed.

Other ideas are sometimes critical but not universal. The DNA of victims from old graves or the smoldering ruins of the WTC (unlike that from plane crashes) is often of poor quality; analysis must cater to allelic dropout. Related victims are a salient feature of some tragedies, which needs to be appreciated lest a war victim be mistaken for his son or his brother. Moreover, in the airplane crashes, the relationships among victims were even an essential component of some of the identifications. For the WTC alone bodies are generally so fragmented that association of victim parts is an important preliminary to screening. One site or several? Where the victims are distributed among multiple graves, as in Bosnia and Kuwait, the criterion for a "very large" likelihood ratio varies with site and circumstances. One grave found in Iraq had about 150 bodies and there was a list, of unknown reliability, of mostly Kuwaitis claimed to be there. It turns out that tentative identifications reinforce each other as the pattern emerges that the list is largely accurate though it has some omissions. Large disasters of course magnify diffi-

culties, but also create a new problem in kind: For a plane crash a seeming parent-child or even sibling-sibling relationship between a victim and a reference person usually proves to be a correct relationship, but in the case of WTC or Bosnia it usually does not. When the number of victims is very large, the screening process needs to emphasize combinations of at least two family members both of whom match the same victim. Otherwise false leads in the candidate list swamp the good ones. If a project is ever mounted to identify a hundred thousand or more dead, such as the Kurds or Shiites killed in Iraq, it is a safe bet that previously unnoticed difficulties will come to light requiring some new ideas to solve.

The process of identifying a large number of victims using DNA is rapidly gaining maturity. Many mass identification projects have been attacked in isolation, as if each were a new problem. But now there is a sizeable body of experience. The ideas from past work provide useful lessons and tools for approaching new identification projects. One of these lessons is to keep an open mind. There is always something new.

Mass Disaster, DNA Identification, War Victims

G46 Investigation, Identification, and Repatriation of Contaminated Fatalities

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After attending this presentation, attendees will understand the complications involved in the investigation and identification of infectious remains and have a raised level of awareness of the potential complications involved with the transportation of contaminated remains from overseas into theater.

The presentation should alert and inform medical examiners, policymakers, investigators and others as to the complexities involved in investigation, identification and repatriation of contaminated fatalities.

The recent war in Iraq raised the specter that chemical, biological or radioactive agents would kill soldiers. Although most remains contaminated with most chemical or nuclear agents could be decontaminated, remains contaminated with smallpox, anthrax or other agents such as Ebola virus would remain hazardous and present a potential threat to if returned to the United States.

Current DoD policy and commitment is to return remains the remains of all fallen service members to the United States as expeditiously as possible. Cremation prior to return renders biological and chemically contaminated remains safe, but is contraindicated for radioactive remains. Unfortunately, involuntary cremation is specifically prohibited by U.S. military regulations. To date, the United States military did not have a good strategy to return of radioactive or potentially infectious remains to the United States.

For the occasional civilian case of contaminated remains being returned to the United States, the Centers for Disease Control (CDC) issues a permit allowing importation. To obtain this permit, the remains must be a hermetically sealed and remain sealed until buried. Such a hermetic seal would be adequate for transportation of biological, chemical and radioactive remains except for gamma emitters.

As this issue was addressed, there were two guiding principles. Paramount of these was protecting the health of mortuary affairs teams, medical personnel, other service members, and the American public. Protection of the living must take precedence over rapid repatriation of remains. There was also a commitment to fully and scientifically account for those who died in service to this country, even if the remains could not be returned.

A system was designed consisting of a commercially available "Zeigler casket" enclosing a "Ziegler case" that the manufacturer claimed to produce a hermetic seal. Inside the case the remains were to be contained within a "Bioseal" pouch. This triple seal containment system failed several tests conducted in early March 2003 in an altitude chamber. The Zeigler case leaked, even at sea level. The Batesville casket and Zeigler case warped and lost integrity under a drop of only four feet. The Bioseal system was hard to seal properly, even while testers were wearing normal clothes and in clean controlled conditions. It did maintain a seal to 67,000 feet when sealed properly. Small amounts of sand in the seam ruined the seal. Thus, we currently do not have a system that maintains a hermetic seal under testing.

Temporary interment was chosen as the next best option at that time (March, 2003), but was not deemed as a desirable. It would be done only when decontamination attempts were not successful. A tissue sample would be obtained prior to interment and shipped to Armed Forces DNA Identification Laboratory (AFDIL) for identification of the decedent and for possible identification of the pathogen.

Three other options are currently under study: a better containment system; irradiation in place; and voluntary cremation in theater. A better containment system is being developed. Irradiation in place requires that a mobile irradiator be developed. Mandatory cremation would also require a crematorium in theater. Although the end of the war meant that those options were not needed immediately, it is anticipated that future conflicts will produce the same issues.

Contamination, Identification, Repatriation

G47 When is SIDS Over-Laying?

W.P. Ryan, MBBS, PO Box 267, Nowra, NSW 2541, Australia*

The goal of this presentation is to acknowledge the powers of observation as perhaps the most important factor at a crime scene is vital.

This presentation will impact the forensic community and/or humanity by encouraging practitioners to be observant.

When called to a dwelling on the eastern aspect of our town, I was advised by the police officer in charge that "It looks like a SIDS." Observation at the scene, not only of the victim but of the domestic surrounds within the dwelling, made an indelible impression on my mind.

From the evidence gleaned from family members and, basing my opinion on my personal experience in such cases, I formed and opinion that the case was rather one of over-laying.

I will demonstrate by way of slides, the total scene.

SIDS, Over-Laying, Crime Scene

G48 Unexpected Death From Ureterocele in an Infant

Joyce L. de Jong, DO, Sparrow Hospital, Forensic Pathology, 1215 East Michigan Avenue, Lansing, MI 48909*

After attending this presentation, attendees will recognize ureteroceles as a possible cause of unexpected death in infants.

This presentation will impact the forensic community and/or humanity by creating awareness of a possible cause of unexpected death in infancy.

An infant died suddenly of an ectopic ureterocele which was undiagnosed in life. Ureteroceles are cystic dilatations of the submucosal portion of the terminal intravesical ureter. They are generally classified as intravesical (entirely within the bladder) or ectopic (some portion is situated permanently at the bladder neck or in the urethra). The incidence of this abnormality is about 1 in 5,000 to 12,000 births. In infants, the most common presentation is a urinary tract infection within the first few months of life. Other common presentations include a palpable abdominal mass from an obstructed renal unit or detection during an

antenatal maternal ultrasound. In the case presented, a 4-month-old white male died within minutes after his arrival at an emergency department. The parents reported the child had "not felt well" for about a week prior to his death. The autopsy revealed a right ectopic ureterocele with bilateral ureteral obstruction, urethral obstruction, and a urinary tract infection due to Escherichia coli. Sudden death in an infant caused by a previously undiagnosed ureterocele has not previously been reported.

Ureterocele, Infant Death, Genitourinary

G49 An Unusual Motorized Vehicle Fatality

Russell T. Alexander, MD, John Turner, MD, and Louis Dibernardo, MD, Duke University Medical Center, Department of Pathology, DUMC Box 3712, Durham, NC 27710*

After attending this presentation, attendees will understand the clinical features, classification, and pathogenesis of Osteogenesis Imperfecta. The high risk that these patients have for fatal intracranial injury after relatively minor trauma. The common causes of death of these patients. The possible diagnostic confusion of this disease with child abuse

This presentation will impact the forensic community and/or humanity by making the forensic community become aware of the disease Osteogenesis Imperfecta, its clinical features, and the likelyhood of these patients to die after what would normally be considered minor trauma. The forensic community will also become aware of the typical causes of death of these patients and the possible confusion of this disease with child abuse in young patients. The typical external features and radigraphic appearance of the disease will be shown so that the forensic community will be able to reocognize patients with Osteogenesis Imperfecta in the future.

The goals of this presentation are to present a case that summarizes the typical clinical features of osteogenesis imperfecta (OI) and that highlight the high risk that these patients have for fatal cranial injury following relatively minor trauma.

The decedent was a 20-year-old female with a past medical history of OI who was living independently at a local college. She was riding in her motorized wheelchair on a level concrete path at a unknown speed when it came to a sudden unexpected stop. She was unrestrained and was thrown forward out of the wheelchair. The left side of her head impacted the ground. There was no loss of consciousness or altered mental status at the time of the accident. She was transported to a local hospital where physical examination revealed a small scalp laceration and blood in her left external ear canal. Extreme body dysmorphism consistent with the history of OI was noted, but no new trauma to the extremities was identified. A computerized tomography (CT) scan of the brain revealed a large epidural hematoma and multiple fractures through the left side of the calvarium. Approximately 5 hours after the accident, her level of consciousness decreased. A repeat head CT confirmed a left sided epidural hematoma now with significant midline shift and subfalcine herniation. An emergent craniotomy was performed for evacuation of the epidural hematoma. She died soon after surgery.

Postmortem examination revealed the head to be disproportionately large for the body. Reflection of the scalp revealed a complex comminuted left temporal bone fracture status post repair. The bones of the skull were "egg shell" thin. A 10 x 6 cm temporal-parietal epidural blood clot compressed the underlying brain. A thin layer of subarachnoid hemorrhage overlay the cerebral convexities. Marked cerebral edema was associated with bilateral herniation of the parahippocampal gyri and cerebellar tonsils. Sectioning of the brain disclosed left to right midline shift and subfalcine herniation. Additionally, the sclera were blue and soft. The teeth were opalescent, brownish, and chipped. Both upper extremities were dysmorphic and tortuous. The lower extremities exhibited marked bowing and deformity. Radiographs revealed severe scoliosis of the spine with placement of a fixation rod. The legs contained internal fixation rods in both femurs and tibias. Representative samples of bone from the ribs and spine were soft and friable. Microscopic examination showed decreased amounts of bone that were disorganized and only focally calcified.

OI ("brittle bone disease") is a heterogeneous genetic disorder of type I collagen. Affected individuals have fragile bones and abnormalities in other tissues rich in type I collagen including teeth, sclera, and ligaments. The disease is due to mutations in the COL1A1 or COL1A2 genes that encode type I procollagen. The disease is divided into types 1 – 4 based on skeletal abnormalities, the extra-skeletal tissue affected, and the genetic defect present. Type I OI is a mild form of the disease characterized by less severe bone involvement, blue sclera, deafness, and variable involvement of teeth (dentinogenesis imperfecta). The most severe form of OI, type II, presents with extreme bone fragility, intrauterine fractures, crumpled long bones and ribs, severe deformity, blue sclera, and is usually fatal in the perinatal period. Type III OI is characterized by progressive bone deformities, frequent fractures, short stature, scoliosis, deafness, dentinogenesis imperfecta, variably hued sclera, and survival often into adolescence and young adulthood. Type IV OI is intermediate in severity between types I and III, and it is characterized by moderate bone fragility and deformity, deafness, variable dentinogenesis imperfecta, and normal sclera.

McAllion and Colin (1996) have reviewed the causes of death for non-type II OI patients. Patients with types I and IV OI had increased numbers of deaths due to respiratory complications of their disease, as well as compression of the brain due to basilar invagination of the skull. However, many type I and IV OI patients had a normal lifespan and died due to diseases that affect the community at large. The type III OI patients often died of respiratory complications of their disease. Five percent of the type III OI patients died due to cranial injury after falling out of a wheelchair.

A concern for the forensic community is the possible confusion of child abuse with OI since both can present with unexplained fractures. It has been estimated that up to 1% of infants presenting with fractures in the first year of life have OI (Byers, 2000). This highlights the need for accurate recognition of OI. The usual other signs of abuse including lacerations, burns, retinal and intracranial hemorrhages, and signs of sexual trauma should be sought. Laboratory evaluation of collagen, imaging studies of bone, and genetic analysis may provide support for a diagnosis of OI.

This case presentation highlights the increased risk that OI patients have for fatal intracranial trauma after relatively mild traumatic injury. Because of this risk, OI patients should always wear a seat belt when riding in a wheelchair.

Osteogenesis Imperfecta, Epidural Hematoma, Trauma

G50 Three Unusual Cases of Sudden Unexpected Death in Pregnancy Occurring in One Week in the State of Maryland

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After attending this presentation, attendees will become aware of relatively uncommon causes of death in the pregnant woman.

This presentation will impact the forensic community and/or humanity providing the opportunity for the forensic community to learn about relatively uncommon causes of sudden unexpected maternal death that they may see in their practice.

From June 24 through June 30, 2003, three cases of sudden unexpected death in pregnant women presented to the Office of the Chief Medical Examiner for the State of Maryland.

The first was a 40-year-old, previously healthy G7P6 female, carrying triplets as a surrogate mother for another couple. Her pregnancy history was significant for anemia during pregnancy, a previous large for gestation baby with shoulder dystocia and postpartum hemorrhage, and there was less than one year between the last delivery and the current in vitro fertilization and conception. She was being evaluated for possible pregnancy-induced hypertension (PIH) and it was recommended that she be admitted to the hospital for further care, but she refused. On the day of her death, she complained of shortness of breath, collapsed and was unable to be resuscitated. Emergency cesarean section delivered a stillborn male fetus. The other two fetuses were left inside her uterus. Autopsy was significant for focal 50% atherosclerotic narrowing of the left anterior descending coronary artery, left ventricular hypertrophy, and features of Hashimoto's thyroiditis, previously undiagnosed. The presumptive cause of death was a cardiac arrhythmia, most likely due to hypothyroidism. The second was a 39-year-old, previously healthy G2P1 female, who complained of abdominal fullness and cramping, then passed out while shopping. She was unable to be resuscitated and a stillborn male fetus was delivered by emergency cesarean section. Autopsy findings included diffuse hemorrhage into the retroperitoneal and peritoneal soft tissue originating from a lateral rupture of the spleen. There was no history of illness or trauma. Microscopy failed to indicate an infectious or malignant process underlying the rupture, and also identified prominent lymphocytic infiltration of the pituitary gland. The cause of death was determined to be spontaneous rupture of the spleen in pregnancy, with lymphocytic hypophysitis considered a contributory condition. The third case was a 28-year-old, previously healthy G1P0 female, who had a two week history of sporadic palpitations, occasional dizziness and shortness of breath. On the day of her death, she was diagnosed at the hospital with supraventricular tachycardia (SVT), became unresponsive, and was unable to be resuscitated. Autopsy findings were negative. The presumed cause of death was determined to be SVT.

These cases represent three relatively rare causes of death in pregnant women and are conditions of which the forensic community should be aware.

Spontaneous Rupture of Spleen, Hashimoto's Thyroiditis, Supraventricular Tachycardia

G51 Compressed Gas Cylinder Related Injuries: Case Report of a Fatality Associated With a Recreational Paintball Gun, Review of the Literature and Safety Recommendations

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By describing a fatality involving the pressurized canister of a paintball gun, this case report highlights the potentially serious hazards associated with these devices and reviews relevant safety guidelines in handling pressurized gas cylinders.

This presentation will impact the forensic community and/or humanity by underscoring the serious injury potential of gas powered paintball guns, the authors hope to: i) dispel the misconception that paintball markers are mere toys, ii) promote the safe use of compressed gas cylinder-powered devices, like paintball guns, by encouraging a healthy respect for their injury potential and emphasizing the need for adherence to age restrictions, game rules, and use of protection gear, and iii) prevent potentially avoidable paintball gun injuries by contributing to accident reporting and statistics and increasing public awareness.

The purpose of this paper is to draw attention to the potentially significant morbidity and mortality that may result from the recreational use of compressed gas cylinder-powered equipment, illustrated by a fatality involving a paintball marker/gun. Because such injuries are more common in a non-commercial setting lacking rigorous enforcement or consistent operator implementation of established paintball game rules, it is important to recognize the need for adherence to safety recommendations common to all devices employing pressurized gas cylinders, irrespective of the application involved.

Compressed gas cylinders, used in a variety of industrial, occupational and recreational devices and settings, present a substantial accident hazard due to the large amount of energy stored in the pressurized gas cylinder, which is released upon sudden decompression. Property damage and serious, or even fatal bodily injury may result from the careless or improper handling of gas cylinders, modification of equipment, or device malfunction.

This report describes a case of severe, fatal blunt force injury of the head sustained when a compressed carbon dioxide gas cylinder decompressed suddenly upon disconnection from a paintball gun. The gas cylinder was propelled from the gun, striking the head of the 15-year-old who was holding the gun. The impact resulted in craniocerebral injuries including depressed, comminuted skull fractures and cerebral contusions leading to death. Subsequent inspection of the device found that the gas cannister separated from its own coupling rather than from the connector attached to the device. The operator was apparently oblivious to the dangers inherent in handling pressurized cylinders when he unscrewed the cannister from the gun.

Although there have been numerous anecdotal and well documented reports of paintball equipment-related injuries, this appears to be the first report of a fatality involving a paintball gun. Previously, the most commonly reported injuries have involved ocular trauma resulting from paint pellets striking the eyes. Considering the current case report and previous reports of non-fatal injuries, it is apparent that failure to adhere to established safety standards accounts for the vast majority of serious injuries involving paintball guns.

Initially designed for the purpose of marking trees in the setting of forestry, the use of gas powered paintball markers/guns has gained increasing popularity over the last decade as a 'toy weapon' used in combat simulation or 'war games,' whether for sport or military training. As gas cylinder-powered devices, paintball guns are subject to the standard safety recommendations addressing the physical, chemical, mechanical, and inhalation hazards of compressed gas cylinders, tailored to the specific purposes of recreational combat simulation maneuvers. Users of compressed gas cylinders are strongly advised to follow the manufacturers' and suppliers' safety instructions with regard to proper storage, labeling, hazard designation, transport, inspection, handling, and maintenance of cylinders and their connections as well as operator age restrictions and recommended personal protective gear.

High pressure gas cylinders present a multitude of hazards including sudden decompression, flammability, inhalation toxicity, cryohazard, heavy object hazard, risk of explosion, and asphyxiation. For these reasons, pressurized gas powered devices are essentially accidents waiting to happen with potentially lethal outcome. The fatality reported herein illustrates the serious accident hazard of gas cylinders, particularly in a non-commercial recreational setting and emphasizes the need for awareness and strict adherence to relevant safety practices.

Paintball Marker/Gun, Compressed Gas Cylinder, Fatality

G52 Cerebral Air Embolism: An Uncommon Complication of a Common Procedure

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The goal of this presentation is to describe air embolism which is an uncommon but potentially fatal complication of esophagogastroscopy.

Forensic pathologists should be made aware of this uncommon complication as endoscopy is a commonly performed procedure. Cerebral air embolism can occur in the absence of an obvious right-to-left shunt. Careful review of imaging studies may be helpful in confirming the diagnosis and cause of death.

Esophagogastroscopy is routinely performed at most hospitals and is considered a very safe procedure. The two most common major and potentially life-threatening complications are perforation and bleeding. Another rare and potentially fatal complication of this procedure is cerebral air embolism. We present an example of cerebral air embolism following esophagogastroscopy eventuating in patient death.

The patient, a 71-year-old female, presented to hospital with a history of chronic abdominal and back pain. Investigations revealed a decreased hemoglobin level and her stool tested positive for occult blood. She underwent esophagogastroscopy to try to identify a bleeding source. Several abnormalities were identified including three small linear ulcers at the distal esophagus, a prepyloric ulcer, and an abnormal inflamed area within the duodenal cap. Biopsies of the stomach and duodenum revealed chronic active gastritis and duodenitis. Fragments of hepatic parenchyma were also present in the duodenal biopsy.

Immediately following the procedure, the patient develped an acute decline in her level of consciousness. She did not respond to verbal or painful stimuli. Her pupils were equal and pinpoint. She had a bilateral positive Babinski sign.

An emergency CT scan of her head demonstrated air within the arterial and venous cerebral vasculature. The cranial bones were normal. Bifrontal cortical infarcts involving the middle cerebral and the anterior cerebral artery territory were identified on a repeat CT scan performed 3 days later.

The patient's condition did not improve and she expired 6 days after endoscopy. Autopsy confirmed the presence of a 3 cm duodenal ulcer with penetration into the liver and associated peritonitis. Bilateral, hemorrhagic, frontal, recent infarcts were evident grossly and confirmed microscopically. Examination of the heart did not reveal a right-to-left shunt. Bilateral bronchopneumonia, involving all lung lobes, was identified in the lung tissue sections.

Given her large duodenal ulcer that penetrated into her liver, we suspect that air, introduced at endoscopy under insufflation pressure, entered into the venous circulation, either through an exposed vein or through dissection into the hepatic sinusoids. The air then likely ascended to the right atrium, followed by the right ventricle, the lungs, through an unidentifiable pulmonary shunt, the left atrium, the left ventricle, the cerebral arterial circulation with resultant infarcts in the territories of the middle and anterior cerebral arteries.

Only a few cases of cerebral artery air embolism following esophagogastroscopy have been previously documented. In the absence of an intracardiac shunt, proposed alternative mechanisms for paradoxical air embolism include intrapulmonary shunts and transcapillary routes, both of which will likely be unidentifiable at autopsy. As intravascular air is rapidly absorbed, the obtainment of emergency head CT images is critical to the diagnosis and, in this case, the determination of the proximate cause of death. Delays in imaging would likely result in a failure of diagnosis and possibly a wrong or undetermined cause of death.

Cerebral arterial air embolism is a rare, potentially fatal complication of esophagogastroscopy and can occur in the absence of intracardiac shunts. Keys to diagnosis are awareness of this complication and the early obtainment of good quality head CT images following symptom development.

Embolism, Esophagogastroscopy, Fatality

G53 Legal Outcome of Sexual Assault Cases, The County of Aarhus, Denmark

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After attending this presentation, attendees will become aware of medical findings and legal outcome of sexual assault cases examined by forensic pathologists.

Forensic pathologists are qualified to do clinical forensic examinations of victims experiencing sexual assault, due to their great experience in describing traumatic lesions during autopsies. Objectivity is easier maintained since the Forensic Pathologist does not take part in the following treatment of the victims. In this study the victims testimonies seemed to have had greater influence on the legal outcome than the findings at the clinical forensic examination.

Introduction: The medical examination of victims of sexual assault is in Aarhus, Denmark performed by forensic pathologists at the Rape Crisis Center, the County of Aarhus. This center has existed since the first of november 1999 and is open to all victims of sexual assault irrespective of police reporting or not. It is located in a hospital setting close to the Department of Forensic Medicine. The Rape Crisis Center covers an area with about 645.000 inhabitants.

Material and Methods: This is a study of all cases reported at the Rape Crisis Center or to the police in a fourteen-month period (Nov. 1, 2000 – Dec 31, 2001) from the County of Aarhus which has about 285,000 inhabitants. Police and court files were studied in the reported cases.

Results: 87 cases, all women, were included of which 73 reported to the police and 48 of these had a clinical forensic examination performed.

- 37 (77 %) had the examination performed within 24 hours of the assault, 30(62.5%) had injuries mostly caused by minor blunt trauma and 7 (14,6%) had minor injuries to the genitals.
- 39 (53.4%) women reported vaginal penetration and semen was found in six of these women.
- 18 (24.7%) of the reported sexual assault cases were "stranger rapes", 45 (61.6%) were "date rapes" and 10 (13.7%) "partner rapes."

Legal outcome: 11 were convicted and one acquitted in court, the charges were dropped in 25 cases because of lack of evidence. Eight were false allegations (seven date rapes and one stranger rape). No charges were made in 24 cases, in 12 of these no perpetrator was found, of which 11 were stranger rapes. Partner rape had the highest conviction rate (three (30%)), compared to date rape (seven (15,6%)) and stranger rape (one (5,6%)).

Injuries to the body were found in four convicted cases and to the genitals in one. In six of the convicted cases vaginal penetration was reported. Semen was not a finding in any of the convicted cases.

Conclusion: The presence of injuries, vaginal penetration or the findings of semen had, in this study, no influence on the legal outcome. Partner rape had the highest conviction rate compared to date rapes and stranger rapes. Reservations however have to be taken due to the small number of persons.

Sexual Assault, Legal Outcome, Clinical Forensic Medicine

G54 Boating People Pathology

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This presentation will impact the forensic community and/or humanity by describing unusual injuries and manner of death in forensic pathology about boating people.

The Authors describes the autopsy findings observed in foreign people died during the attempts of crossing the Adriatic sea to get Italy illegally. The crossings usually took place at night on board a rubber dinghy (8-10 mt long) with powerful outboard engines, driven by affiliate of criminal organization, full up to 40 illegal immigrants.

In the last five years we performed autopsy 57 bodies victims of these accidents.

The autopsy performed on corpses showed two kinds of injuries: some victims ha extensive amputations, produced by violent impact during collision between boats or caused by outboard-motor propeller on victims falling overboard; some others non injuries at all. Survivors, providing information about boating, told that someone of them, before to fall in water, already lost consciousness. In these cases we find blunt injuries on the head associated with focal or multifocal subaracnoid haemorrhages, consistent with trauma to the head. Although the above findings the cause of death in those victims was determined as drowning based on additional evidence (lungs large and bulky, white foam from trachea and bronchi, water in stomach, swollen brain and chemical finds of drowning in sea-water).

These findings are unusual in forensic pathology. The Authors were supposed that subaracnoid haemorrhages, following of trauma to the head, were responsible of lost consciousness and then made easier drowning when people fell in water-sea.

We found often traumatic head injuries made in people boating on rubber dinghy drived speedy and forced to make abrupt maneuvers to escape the guard boats; these injuries were produced accidentally against stiff parts of the boat (many people boating lying or with head rested on the side) or intentionally by others on the ship.

Sometimes victims presented wounds, localized especially on trunk and lower limbs, chemical burns, produced on the skin by oil flowing from breaking. The water-sea, in fact, compromise permeability of skin, allowing contact of derma with oil, so that it produced injuries seem to burns.

The cause and manner of these uncommon deaths and injuries will be also discussed.

Boating People, Subaracnoid Haemorrhages, Chemical Burns

G55 Do Centenarians Die Healthy? – An Autopsy Study

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The goal of this presentation is to assess the prevalence of common causes of death and demographic variables in a selected population of centenarians.

This presentation will impact the forensic community and/or humanity by underlining the need for more baseline data of the elderly which can be obtained only by more and well-performed autopsies.

There is a common conception that the very old die of old age, but the prevalent cause of death in this age group remains poorly studied.

Only few necropsies have been performed in patients dying after age 100 years and, little attention has been made on the clinical and morphologic features observed in these oldest old. For that reason we reviewed 34,858 consecutive autopsies done during a 15- year- period (1988 to 2002) at the Institute of Forensic Medicine, Vienna, Austria.

We focused on cases who met our working definition of sudden natural death in very old people: Unexpected or unexplained deaths of non-hospitalized persons over the age of 100 years, which are apparently due to natural causes". In particular, all persons who had not consulted a physician within 10 days before death were included and autopsied.

Of the 30 study corpses, 9 were men and 21 were women; all were Caucasian. The age of these out-of-hospital patients ranged from 100 to 108 years.

Nine persons lived alone in their homes without periodical care from relatives or welfare centers. Another 11 persons also lived alone, but were regularly cared for by neighbors, relatives or welfare workers, 10 lived with at least one family member.

Sudden natural death occurred in all cases in private homes, and in 35% of these cases while sleeping. Resuscitation was attempted in 53% of the cases. More than 63% (n = 19) of those who died were described as having been previously healthy.

About 30% had cardiac antecedents such as stable angina pectoris. Three persons had a history of myocardial infarction. Other pre-existing conditions were hypertension (16%), diabetes mellitus (10%), respiratory (10%) and gastrointestinal disorders (5%).

A total of 22% of the men and 29% of the women had a body mass index exceeding normal range.

Cardiovascular diseases accounted for almost three quarters of the deaths (n = 21); 23% (n = 7) of the centenarians died of respiratory illnesses, and 7% (n = 2) of gastrointestinal disorders.

Myocardial scars or focal myocardial fibrosis were detectable in 2/9 men and in 4/21 women, who died due to cardiac disorders; 3 men and 10 women had acute myocardial infarcts. Calcification of the mitral annulus and of the aortic valves were present in 80%; 15% of the calcified valves were anatomically stenotic.

All deceased had extensive aortic sclerosis, mainly focused in the abdominal part. In all 30 corpses the aorta was dilated in its transverse and longitudinal planes, with aneurysm formation in 5 cases, 2 resulted in fatal rupture.

Four cases of sudden death were caused by pulmonary embolism emerging from the left femoral veins, 3 patients died of bacterial pneumonia.

A gastric ulcer caused perforation with acute diffuse peritonitis in one 106- year old man, and in one 100- year old woman.

Centenarians succumb to disease, they do not die of old age. Undiagnosed conditions in the oldest old present a clinical challenge that increases with the patient's age. However, despite progress in diagnostic technology, confirmation rates of death causes have not changed much. Therefore, as the age of death rises, it is important to preserve and foster postmortem examinations, the most reliable source of medical evidence.

Centenarians, Autopsy, Cause of Death

G56 Degenerative Changes of the Conduction Tissue in Drug Addicts

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After attending this presentation, attendees will possibility of the influence of the degenerative findings in the cardiac conduction system in the pathophysiology of the death in chronic drug abusers.

This presentation will impact the forensic community and/or humanity by showing that degenerative changes of the cardiac con-

duction system are more often observed in drug addicts than in the control group.

The destructive effects of some drugs and especially of cocaine on the cardiovascular system are well known. The aim of this study was to evaluate if the degenerative changes concern also the cardiac conduction system and if these changes are more frequently observed in drug addicts.

The material included fatalities studied at the University Institute of Forensic Medicine in Lausanne for the period 1998-2001. The age of the patient ranged from 21 to 47 years (mean 32.4) for the drug addicts and from 21 to 50 in the control group (mean 32.5). In the group of the drug addicts we included 51 cases, all of them known by the police as drug users. Complete autopsy with histological examination were available for each case, and toxicological analyses in 50 cases. The toxicological analyses demonstrated the presence of one or more drugs in the blood in 43 cases, from which in 20 cases 3 or more drugs; cocaine or its metabolites were present in 18 cases. In the control group were included 52 cases not known as drug abuser. Complete autopsy with histological examination were available for each case and toxicological analyses in 40 cases. From 7 cases of intoxication which were included in this group, 4 were suicides by psychotropic drugs, one suicide by cyanide ingestion and 2 were consecutive to accidental monoxide intoxication. In 22 cases the toxicological analyses were negative. In 11 cases the therapeutic levels of different antidepressants were found. Cocaine or its metabolites were found in no case.

The degree of fibrosis and fatty infiltrations has been analysed using the semi-quantitative score evaluation. The changes were analysed in the following structures: the atrioventricular node (NAV), the penetrating part of the node (PB), the branching bundle (BB), the left and right branches (LBB and RBB) as well as the left and right part of the septum superior.

The mean scores for the degenerative changes were higher in the addicts group. The statistical analyses showed significant differences ($p<0.01$) for fibrosis in the atrioventricular node, in the penetrating part, in the left bundle branch, and in the septum superior as well as for fatty infiltration in the branching bundle and in the left bundle branch. No significant differences were found between the results in the group of cocaine-positive drug users and the results in the drug users without cocaine found in toxicological analyses.

The more frequent apparition of degenerative changes in the group of drug addicts, which are often cocaine users, can be explained by cardiotoxic effect of a chronic drug administration. On the other hand, it is evident that the pathomechanism of deaths in drug intoxication is multifactor, and that interpretation of deaths by overdose can be difficult because the range of drug concentration in fatal cases can be very large. Therefore, the possibility of the influence of the degenerative findings in the conduction system and in the septum superior in the pathophysiology of the death in chronic drug abusers should also be considered. Moreover, in some deaths pathological changes may be associated with the electrical instability of the heart and even contribute to the death, in particular in some unexplained cases of sudden death.

Drug Addiction, Heart, Conduction System

G57 Systemic Amyloidosis in an Intravenous Drug Abuser

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The goal of this presentation is present to the forensic community a case of systemic primary amyloidosis in an intravenous drug abuser.

Recognition of systemic amyloidosis and the subsequent microscopic examination of tissues is important during autopsy. Autopsy pathologists, residents, and pathologists' assistants should be aware of the correlation between systemic secondary amyloidosis and people with a history of illicit drug use/abuse, as well as the possibility of a chronic drug abuser having the primary form of amyloidosis. The type of amyloidosis can be further characterized through immunohistochemical staining of selected amyloid containing tissues.

This poster will present the incidental finding at autopsy of systemic amyloidosis in a 46-year-old African American male that was a former intravenous heroin abuser. Healed track marks were identified on the arms. The patient had cirrhosis and was Hepatitis B and C positive, underwent bimonthly serial paracentesis for refractory ascites, and had congestive heart failure, renal insufficiency, and dyslipidemia. The patient was noncompliant with treatment for his heart condition until 2000, which roughly correlates with the diagnosis of Hepatitis and his last illicit drug use. The patient's social history also includes a 15 pack/year smoking history, six 40-ounce beers per day for 6 years, and cocaine smoking. The patient was admitted to the hospital after paramedics arrived to a complaint at the patient's home of severe testicular edema, the last ascites tap having been performed two days prior. The patient's ascites did not resolve by the administration of albumin, and four litres of ascites fluid were drained three days after admission. The patient had a "seizure" the following early morning, witnessed by his roommate prior to the two attempting to sneak outside for a cigarette. The patient had no recollection of the event. An MRI revealed nothing of significance. Two days later, the patient was found to have a heart rate in the 60s, respirations of 8, and had no detectable blood pressure. Resuscitative efforts were continued for 35 minutes to no avail, and the patient was pronounced dead.

At autopsy, the cut surfaces of the heart and spleen had the typical heavy, waxy, glistening appearance of amyloid deposition. Microscopic sections of the heart, lung, spleen, liver, kidney, gastrointestinal tract, pancreas, thyroid, and prostate revealed amyloidosis, and were positive with Crystal Violet sensitivity and Congo Red specificity staining.

Amyloid is a pathologic proteinaceous deposit that collects in the tissues of persons having an immunologic disfunction. Amyloid has a distinct gross appearance and under the light microscope appears as an amorphous eosinophilic extracellular substance. It is unique that in staining with Congo Red and viewed under polarized light an apple-green birefringence is visible, and the stain has a dramatic appearance with fluorescent microscopy. There are three major biochemically distinct forms of amyloid; the AL (amyloid light chain) type that is derived from immunocyte dyscrasia and is termed primary amyloidosis, AA (amyloid-associated) type that is often associated with people who have chronic inflammatory conditions and is known as secondary amyloidosis, and A beta amyloid, found in the brain and associated with Alzheimer's disease.

Amyloidosis has been cited in the literature to be a major cause of nephropathy in living heroin abusers. A technique used to inject the drug, called "skin popping," is resorted to when there has been such overuse of the vasculature to cause venous thrombosis and scarring of venous access. Skin-popping leads to skin ulcerations from reaction to the injected drug as well as non-sterile technique. Secondary amyloidosis occurs as a complication of this underlying chronic inflammatory process. An extensive search of the literature contains abundant discussion of heroin abuser renal amyloidosis, but few cases discussing autopsy findings of widespread systemic amyloidosis. This patient has extensive manifestation of the disease in virtually every organ in his body. Is this a case of secondary amyloidosis, or rare primary disease in a drug abuser? Either way, the ultimate cause of this patient's death is most likely an arrhythmia due to cardiac amyloidosis.

The widespread distribution of amyloid in the organs did not quite fit with the diagnosis of secondary amyloidosis as seen in other chronic intravenous drug abusers. The amyloid was further characterized as the AL-type through immunohistochemical staining of selected tissues with a negative result for the Amyloid A stain. The classification of an AL-type amyloid diagnose this patient's disease as primary amyloidosis.

Careful consideration in the differentiation of either primary or secondary amyloidosis is important in this case, since secondary amyloidosis is the type most commonly associated with chronic drug abusers.

Systemic Amyloidosis, Illicit Drug Abuse, Autopsy Pathology

G58 Photographic Imaging of Handgun Gas Clouds Compared to Gunshot Residue Swabs

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After attending this presentation, the attendee will understand that a false negative result may be reported from gunshot residue analysis when ammunition with lead free primers are used.

This presentation will impact the forensic community and/or humanity by demonstrating why gunshot residue analysis is so non-specific when different ammunition is fired, even from the same weapon, and the possibility of a false negative result when lead free primer ammunition is used.

High speed photography is used to capture images of the gas/particle cloud emitted when firing full metal jacketed ammunition, hollow point ammunition and lead free primer ammunition from the same weapon, showing that similiar gas clouds are emitted. Gunshot residue analysis is performed by Scanning Electron Microscope and Induction Coupled Plasma screening (ICP).

Lead is typically one of three components reported in a GSR analysis. using ICP. When the type of ammunition primer is not known and lead free primer ammunition was used to fire the weapon, the results may represent a false negative.

This study calls attention to the fact that GSR analysis has many variables. The results may be skewed when lead free primer ammunition and full metal jacketed ammunition are used and false positives may result.

Handgun Gas Clouds, Gun Shot Residue Analysis, Lead Free Primers

G59 Who was Driving: A Case Report

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After attending this presentation the attendee will learn the power of DNA technology in solving problems concerning traffic accidents.

The forensic community will realize the importance of the application of DNA technology to traffic accidents.

The traffic accidents form one of the major sources of socioeconomic loss for almost all the countries. This loss figures as material as well as personal loss. One of the most important strategic approaches is the certainty with which the cause the accident can be established together with the responsible. The possibility of the determination of the responsible can be considered as the best method of prevention.

In case where the responsible is the driver the question is to identify him. The denial of driving is a very common phenomenon in traffic accidents. However the development in DNA technology the last decade made possible the personal identification in a very high accuracy.

Using this technology we have identified the driver of an accident with two deaths. Following the accident that took place in Izmir, a city in Aegean cost of Turkey, the Institute of Forensic Sciences of The University of Istanbul was asked to determine the driver performing a detailed crime scene investigation. There were two deaths and two survivors from whom the one had amnesia and the second accused the first to be the driver.

The car examination revealed biological material from the front seat and from the windshield that matched the DNA profile of the second survivor.

The success of the identification was not only because of the power of the technology used but also because of the careful and detailed car examination that was performed. It is true that to end up with a satisfactory result requires a correct crime scene investigation at first part.

Traffic Accidents, DNA Technology, Crime Scene Investigation

G60 The Contribution of Researching DNA Breaks to the Evaluation of Postmortem Delay

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After attending this presentation, attendees will understand the results of a study on intranuclear DNA breaks on skin in an animal model.

This presentation will impact the forensic community and/or humanity by demonstrating an initial approach to be followed by further study on human skin, in order to improve evaluation of PMD.

Introduction: Postmortem delay (PMD) evaluation remains a problem for the forensic pathologist. Although Professor KNIGHT recently resumed all the methods used in his last book, it still seemed worthwhile to test a pathological method as a first stage on an animal pattern.

Material and Methods: 2.1) Material: 30 adult male rats, sacrificed according to protocol.
Cutaneous samples 2 mm by 2 mm from the inner thigh every 3 hours up the 24th hour, then every 6 hours until the 48th hour.

2.2) Methods: TUNEL technique: a commercially available DNA end labelling kit, the TUNEL method was standardised, validated and used for this purpose. This TUNEL technique (apoptag oncor) has shown itself to be the most reliable (reference) in a previous work.

2.3) Statistical analysis: For each PMD the average and the standard variation in the number of marked cells was calculated. The comparisons between the different PMDs were analysed with the Fischer test. The estimated PMD from the number of marked cells was based on linear regression. All the statistics were treated with the SAS software and the threshold of 5% significance was retained.

Results: The statistic analysis allowed the establishment of the following regression based on the number of marked cutaneous cells and according to their topography:

Delay = 32.648 – 1.114 x basal – 6.886 x intensity + 0.209 x superficial + 0.434 x intermediate.

Interpretation of Results: From the statistical results it appears that before the 18th hour there is an intranuclear break in the DNA fragments particularly in the superficial layers mainly constituted of mature keratinocytes, that after the 18th hour whatever the layer these apoptotic phenomena diminish. This reduction in breaks thus presents an interest in the evaluation of post mortem delay since all the layers behave practically in the same way with almost parallel kinetics, up to about the 48th hour.

Conclusion: In the next stage of this work true apoptotic variations will be verified by immuno-histochemistry (detecting the expression of bcl2, P53, caspases 3/9) or simple post mortem DNA breaks related to apoptosis. But having said this the TUNEL technique retains all its relevance in the evaluation of post-mortem delay. If it is really a case of

apoptotic mechanisms, its evaluation in certain organs, taking into account an agonic phase such as brain death but with a heartbeat, the mechanisms leading to apoptosis, blocking some of the factors leading to it could be of interest in organ transplants. A second objective would be to study a human model by taking a sample from a skin fragment at the site where the corpse has been discovered, in order to study it very quickly.

PMD, DNA Breaks, Skin

G61 From VIRTOPSY to VIRTOBOT: Photogrammetry Based Optical Surface Scanning and Radiological Virtual Autopsy

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After attending this presentation, attendees will learn the newest cutting-edge technologies of 3D forensic documentation.

This presentation will impact the forensic community and/or humanity by demonstrating an upgrade of the newest techniques using 3D body surface documentation merged with radiological data sets.

Goal: 3D body-surface documentation and minimal-invasive, image-guided virtual autopsy utilizing optical and radiological scanning: Pushing low-tech documentation and autopsy procedures in a world of high-tech medicine to improve scientific value, to increase significance and quality.

Background: A main goal of forensic medicine is to document and to translate medical findings to a language and / or visualization, which is readable and understandable for judicial persons and for medical laymen. Therefore, in addition to classical methods, scientific cutting-edge technologies can and should be used.

The Institute of Forensic Medicine, University of Bern is, in collaboration with an internationally well selected research team, evaluating and validating several cutting- edge technologies such as 3D optical and photogrammetric surface scanning, Computed Tomography (CT), Magnetic Resonance Imaging (MRI), Magnetic Resonance (MR) Spectroscopy, Micro-CT, Micro-MR and synthetic body models (www.virtopsy.com).

Methods and Results: Through the use of the forensic, 3-D/CAD-supported photogrammetric and 3D body surface scanning method the documentation of so-called `morphologic fingerprints` has been realized. Forensic, 3-D/CAD-supported photogrammetry and and 3D body surface scanning create morphologic data models of the injury and of the suspected injury-causing instrument allowing the evaluation of a match between the injury and the instrument. In addition to the photogrammetric body surface registration and 3D body surface scanning, the radiological documentation provided by a volume scan (i.e., spiral, multi-detector CT, or MRI) registers the sub-surface injury, which is not visible to Photogrammetry and 3D body surface scanning. The new, combined method of merging photogrammetry/3D body surface scanning and radiology data sets creates the potential to perform many kinds of reconstructions and postprocessing of (patterned) injuries in the realm of forensic medical case work. Using this merging method of colored photogrammetric surface and gray-scale radiological internal documentation, a great step towards a new kind of reality based, high-tech wound documentation and visualization in forensic medicine is made.The combination of these methods has the advantage of being observer-independent, non-subjective, non-invasive, digitally storable over years or decades and even transferable over the web for second opinion.

Results: Body surface and radiological imaging techniques are particularly beneficial for reconstruction and visualization of forensic cases, allowing the opportunity to use the data for expert witness reports, teaching, quality control and telemedical consultation. The preliminary results based on the concept of 'Virtopsy' are promising enough to introduce and evaluate these techniques in forensic medicine. Documentation by these methods is observer-independent, objective and non-invasive. Digitally stored data may be recalled at will and provide fresh, intact topographical and anatomico-clinical reconstruction. Quality control and expert supervision becomes possible in a new manner, as well as image transmission and forensic "telemedicine" consultation. Image and data processing allows two- and three-dimensional views of forensic and anatomical findings. MR Spectroscopy has the possibility of metabolic-chemical analysis. In certain cultural circles where conventional autopsy is stigmatised or even forbidden, virtual autopsy would allow sound medico-legal practice and support for the judicial system without violating religious prohibitions or personal reservations. Also, in the post-mortem examination of highly infectious cadavers this technique could be of particular use (bio-terrorism). Minimally invasive autopsy would reduce the number of conventional autopsies, which are often difficult to bear for relatives. This development could be similar to that observed with the advent of minimally invasive percutaneous or laparoscopic surgery. Our results showed that we strive to lead forensic medicine to new horizons by utilizing the newest technologies.

Discussion and Perspectives: Based on our results, we hope that the combination of forensic-pathologic "know-how" (experience) with high-tech imaging will open new horizons in forensic medicine and other forensic sciences, leading towards a minimally-invasive virtual forensic autopsy (www.virtopsy.com). The automatisation of this process will lead to the development of a "Virtobot."

Forensic Radiology, Photogrammetry, 3D Body Surface Imaging

G62 Comparative Study of DNA Yield and STR Profile Quality Obtained From Various Tissue Types of a Decomposed Body

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The goal of this presentation is to present the forensic community with comparative DNA quantification and STR profiling results obtained following routine extraction of DNA from a variety of tissue types obtained during the autopsy of a decomposed body.

When DNA testing is necessary on bodies that have undergone decomposition, the pathologist may wish to focus collections on bone and nails prior to collection of hair or muscle for downstream typing purposes. Collection of the most appropriate samples for DNA typing will eliminate the need to repeat the extraction and profiling process and will ultimate expedite the identification process.

STR DNA profiling of decedents, either for identification purposes or for casework applications, is commonly used in the forensic setting. Obtaining DNA profiles from decedents where substantial decomposition has occurred presents a challenge to the DNA analyst due to the compromised nature of the cellular material housing nuclear DNA. The forensic pathologist is tasked with collecting tissue from the decomposed body that will most likely yield DNA of high quality and quantity such that nuclear DNA profiling will be possible. This presentation will describe the results of DNA quantification assays and STR DNA pro-

filing results obtained following the DNA extraction of a variety of tissue types collected from a decomposed body at autopsy. The results presented here are useful for predicting the most appropriate tissue types to collect during autopsy when subsequent DNA analysis will be required.

The study involved collecting a variety of tissue types from various areas of the body. Scalp hair, pubic hair, deep muscle tissue (psoas), nail material (toenails), and cross-sectioned vertebral bone were harvested from a body exhibiting moderate decomposition. According to investigative reports, the body was initially placed in a grassy field for two days. Suspects then returned to the scene and buried the body in a shallow grave, where it remained until exhumation eight days later. Temperatures during this period ranged from 48-88^{o} F, with a mean temperature of 67.5^{o} F and a total rainfall of 1.84 inches. The body exhibited mild to moderate postmortem insect larvae activity.

A general description of each tissue type was made prior to further processing for DNA extraction. The scalp hair was matted and evaluation of individual hairs and/or roots was not possible; approximately 36.7 mg of this material was collected for DNA extraction. Pubic hairs were separable, therefore root ends were identified macroscopically; approximately 7 mm of the root ends of ten hairs were collected for DNA extraction. The muscle obtained at autopsy was further sectioned prior to DNA extraction, yielding two visually different tissue samples. One was central to the mass submitted for testing and was pink in color (referred to as "deep" hereafter), while the second sampling was more superficial and gray in appearance (referred to as "superficial" hereafter). The muscle tissues collected for DNA extraction from these two visually distinct samples had a mass of 159.6 mg, and 147.9 mg, respectively. Toenails were selected as nail material that would least likely bear DNA from a foreign source (as compared to fingernails); 190.4 mg of nail material was cut for DNA extraction. Finally, 190.5 mg of bone matrix was shaved from the wedged aspect of the cross-sectioned vertebra for subsequent DNA extraction.

Resulting tissue cuttings were each extracted using organic extraction methods and by Microconâ (Millipore, Corp., Bedford, MA) concentration and purification of the DNA. Extracted DNA from all samples was quantified using 1% agarose yield gel analysis in conjunction with the QuantiBlot® (Applied Biosystems, Foster City, CA) human DNA quantification kit. The quantity of DNA detected for each tissue type using the agarose product gel and human specific quantification systems, as well as estimated overall human DNA yield, was calculated in terms of nanograms of DNA per milligram of tissue extracted.

Quantification results indicated that high molecular weight DNA was detected all tissue types, with the exception of the hairs. Also with the exception of the hair samples, human DNA was detected from all DNA samples using the QuantiBlot® system; the bone sample yielded the highest overall quantity (ng DNA/mg tissue). Although the superficial muscle appears to exhibit a slightly higher overall yield than the deep muscle sample, the slight difference may be due to the subjective nature of visual comparative determination employed when determining quantifications from slot blot. Nevertheless, it can be concluded that resulting muscle tissue yields were similar regardless of sample stratification.

Samples were then amplified using the PowerPlex™16 BIO System (Promega Corp., Madison WI) and amplified products were detected using the Hitachi FMBIO® II Fluorescent Imaging Device (MiraiBio Inc., Alameda, CA). A target template amount of 0.5 ng was incorporated into each amplification reaction based on the QuantiBlot® quantifications; since no DNA was detected for the hair samples, the sample retentates were consumed during amplification.

The DNA profiles obtained from the pubic hair and both muscle tissue samples were partial in nature, while the nail material and bone yielded complete DNA profiles. No profile was obtained from the scalp hair sample. Although high molecular weight DNA of human origin could be harvested from deep muscle tissue of various strata, nail material, and bone, the extracted DNA did not type with equal efficiency using common nuclear DNA typing techniques. While moderate results were obtained from pubic hairs that were separable upon extraction preparation, hairs submitted in bulky masses were not useful for typing using conventional methods. Deeper muscle tissue yielded a more complete profile than did the more superficial sample collected from the same muscle group. Although all were partial in nature, a more complete profile was generated from the pubic hair sampling than from either of the muscle cuttings. Nail material and bone both generated full DNA profiles and are were therefore determined most useful for nuclear DNA typing following decedent body decomposition.

It can be concluded that although the agarose product gel indicates the presence of quality DNA from these samples, the DNA may have undergone damage not explicitly detectable by this method. Furthermore, the presence of microbial DNA complicates the analyst's ability to accurately determine the quantity of amplifiable human DNA present. As expected, due to the relatively short nature of the probe primarily responsible for recognition of human DNA in the blotting quantification system, the presence of adequate quantities of human DNA using these conventional blotting techniques is not necessarily indicative of the quantity of amplifiable DNA. However, data from both the agarose gel and blotting system can be used to predict the amount of human DNA within the total observed high molecular weight DNA, which can be useful for predicting which sample will most likely generate a well-balanced DNA profile across all 16 loci. In summary, this study indicates that nail material and bone tissue collected from decomposed bodies are more likely to yield full DNA profiles than are hairs or muscle tissue when straightforward processing and DNA extraction techniques are employed. When DNA testing is necessary on bodies that have undergone decomposition, the pathologist may wish to focus collections on bone and nails prior to collection of hair or muscle for downstream typing purposes.

Decomposition, PCR DNA Profiling, DNA Extraction

G63 Experimental Evaluation of Rigor Mortis Nysten's Law: Does it Apply to Rats?

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The learning objective consists in presenting the development of the intensity of rigor mortis in the different parts of the body of rats.

In 1811, the French physician and chemist P.H. Nysten published the first scientific description of rigor mortis. The law named after him states that "Cadaveric rigidity affects successively the masticatory muscles, those of the face and the neck, those of the trunk and arms and finally those of the lower limbs." It is often added that resolution occurs in the same order. The development of rigor mortis is thus descending, a finding thought to be related to the varying distances between the different muscles and the central nervous system. However, Nysten himself noticed that the destruction of the CNS did not affect the order of the development of rigidity.

In 1917, Naumann confirmed the descending development of rigor mortis, but he also noticed that in some special cases (e.g., in weak individuals, or those diminished by illness), rigidity may show an ascending pattern.

However, in 1950 Shapiro contested Nysten's statement: "it is difficult to understand why a physico-chemical process which takes place in recently dead tissues should follow the sequence usually described. It appears more likely that, because we are dealing with a physico-chemical process in what is virtually a lump of clay, this will take place simultaneously in all the recently dead muscles."

Some years ago, we developed a method to increase our understanding of rigor mortis through the objective measurement of the intensity of cadaveric rigidity in rats. The principle of the method is to determine the force required to cause a movement of small amplitude (4 mm) in the limb under examination. Since the movement doesn't break rigor mortis, serial measurements can be conducted. Our apparatus measures the resistance caused by rigor mortis in the knee and hip joints of rats. This method has been used in the past to evaluate the influence of several pre-mortem and post-mortem factors (i.e., body weight, muscular mass, age, physical exercise, ambient temperature, various causes of death, electrocution) on the development of rigor mortis.

In our present investigation, we tried to determine the validity of Nysten's law in the case of rats. For this purpose, we adapted our method to perform parallel measurements in the masticatory muscles, the neck, the front limbs and the hind limbs in rats, respecting the same principles of measurements.

Experimentation:
Animals: male albino rats, weighing approx. 300 g.
Measurement time points: 10 min, 1h, 2h, 3h, 4h, 5h, 6h, 8h, 12h, 16h and 24 post-mortem.

Results:

Group No 1: hind limbs.
The maximal values of the intensity of rigor mortis were reached at 5 hours post-mortem with a plateau of the intensity between 5 and 8 hours post-mortem, followed by the resolution of rigor mortis.

Group No 2: front limbs.
The time course of the intensity of rigor mortis was practically the same as in the hind limbs in spite of the fact that the muscular mass of the hind limbs was 2.89 times greater than that of the front limbs.

Group No 3: neck.
The maximal values of the intensity of rigor mortis were reached at 3 hours post-mortem in the muscles of the neck. The resolution began at 6 hours postmortem.

Group No 4: masticatory muscles
In the masticatory muscles the maximal values were reached at 2 hours post-mortem. The resolution began at 8 hours postmortem.

Conclusion: The intensity of rigor mortis reaches maximal values significantly earlier in the masticatory muscles and in the muscles of the neck as compared to the front and hind limbs in rats. Consequently, Nysten's law seems to apply to rats as far the onset of rigor mortis is concerned.

Rigor Mortis, Nysten Law, Rats

G64 Microbial Processes in Soils Associated With Skeletal Muscle Tissue and Cadaver Decomposition at Different Temperatures

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After attending this presentation, attendees will understand that the examination of soil microbiological and biochemical processes can provide insight into how temperature can affect the decomposition of cadavers and cadaver components in soil.

This presentation will impact the forensic community and/or humanity by demonstrating the soil microbial community has the potential to provide a basis for the estimation of postmortem and/or post burial interval.

Forensic taphonomy, and forensic science in general, has benefited greatly from the application of biological sciences. For example, the use of entomological principles and practices has led to an increased understanding of cadaver decomposition while providing an efficient and effective means to estimate postmortem and/or postburial interval. Considering that the decomposition of most resources in terrestrial ecosystems is due to the activity of soil microorganisms (often acting in conjunction with a variety of invertebrates) microbial processes in soils have been given little consideration. The microbiota are responsible for the regulation of nutrient transformation and storage in soils. As a result, all organic matter placed in the soil is acted upon (eventually) by soil microorganisms prior to being recycled into the wider ecosystem. The soil microbial biomass is a dynamic population, which can respond rapidly to environmental conditions (e.g., temperature, moisture) and the introduction of fresh substrates. These stimuli may result in a population adapted for specific circumstances.

There are a number of well established microbiological and biochemical methods for studying structural and functional characteristics of soil microbial communities. For example, substrate-induced respiration (SIR) and chloroform-fumigation incubation can be used to estimate the soil microbial biomass while fatty acid methyl ester and DNA analysis can be used to identify the taxa that make up the soil microbial community. Functional processes may be examined through measurements of CO2 respiration, enzyme activity and nitrogen mineralization, among others. In this study we have applied a number of these methods (mass loss, microbial CO2 respiration, SIR, enzyme assays) to determine whether temperature affects microbially mediated decomposition of skeletal muscle tissue (Ovis aries) and cadavers (Rattus rattus) in soils.

In experiment 1, skeletal muscle tissue (Ovis aries: 1.5 g) was incubated in soil microcosms at 2 °C, 12 °C and 22 °C in a sandy loam soil (100 g) from Dorset, England. Tissue mass loss was measured gravimetrically at seven day intervals over a period of 42 days. Microbial CO2 respiration was measured every 24-48 hours using the alkali (0.3M NaOH) absorption method. Soil microbial biomass was estimated on day 21 using the SIR technique. Mass loss and SIR samples were collected using a destructive, sequential harvesting program.

In experiment 2, juvenile cadavers (Rattus rattus: ~20 g) were buried in a sandy loam soil (500 g) from tropical Queensland, Australia and incubated at 15 °C, 22 °C and 29 °C. Soil enzyme activities (arylsulphatase, dehydrogenase, phosphodiesterase, protease) were assayed on day 21 using standard soil enzymological techniques.

Experiment 1 demonstrated that each 10 °C increase resulted in an increase in the rate of tissue mass loss. These differences were maintained until day 42, when tissue incubated at 12 °C and 22 °C displayed similar levels of mass loss ($P = 0.266$). This may be due to the loss of readily available substrate (tissue) whereby the remaining tissue represents a more recalcitrant form of organic matter. The rapid utilisation of readily available nutrients was suggested by a flush of CO2 following burial at 12 °C and 22 °C. Microbial CO2 respiration gradually decreased following this flush. Test samples (soil with tissue) always demonstrated greater respiration rates than control samples (soil without tissue). Test samples incubated at 22 °C demonstrated greater levels of CO2 respiration than samples incubated at 12 °C until day 23 ($P = 0.267$). Microbial CO2 respiration at 2 °C was less than the other temperatures until day 42 ($P = 0.052$). A direct relationship was demonstrated between tissue mass loss and microbial CO2 respiration (22 °C: $r = 0.690$***, 12 °C: $r = 0.810$***, 02 °C: $r = 0.836$***). Thus, the measurement of microbially respired CO2 can provide a basis on which to accurately predict soft tissue decomposition in soil. This can be achieved by calculating the amount of CO2-C respired. Microbial biomass estimations demonstrated no differences between test and control samples incubated at 2 °C ($P = 0.139$) or 12 °C ($P = 0.088$). Test samples incubated at 22 °C demonstrated a greater microbial biomass than control samples incubated at the same temperature ($P = 0.002$). This suggests

that temperature is able to control growth of the soil microbial biomass even in the presence of a highly utilisable substrate.

In experiment 2 test samples always displayed greater protease and phosphodiesterase activity than control samples. Protease activity in test samples incubated at 15 °C were less than in test samples incubated at 22 °C ($P = 0.013$). Phosphodiesterase activity in test samples incubated at 15 °C was greater than in test samples incubated at 22 °C ($P = 0.010$). These results demonstrate that cadaver burial can bring about an increase in the activity of some enzymes commonly associated with soil microbial communities. The activity of these enzymes seems to be influenced by temperature. Arylsulphatase and dehydrogenase results did not respond to the presence of the cadaver.

The decomposition of the organic matter used in these experiments may be attributed to increased microbial biomass and/or enzyme activity. These decomposition processes can be greatly influenced by temperature. Soil microorganisms can play a rapid and substantial role in the decomposition of skeletal muscle tissue buried in soil. The decomposition of this relatively simple substrate can be accurately predicted through the estimation of C mineralization (CO2-C) and assimilation. This method may also assist in the study of the decomposition of amorphous materials such as blood and hair. The decomposition processes examined in the current work were most likely carried out by a diverse community of microorganisms. One particular feature of the taxa that comprise soil microbial communities is that they commonly exhibit a succession whereby a change in the composition of the community takes place over time as a result of change in environmental conditions or substrate. We believe that continued research into soil microbial succession in grave soils may possibly provide a basis for the estimation of postmortem and/or postburial interval.

Forensic Taphonomy, Temperature, Soil Microbial Community

G65 Does Carcass Enrichment Alter Community Structure of Predaceous and Parasitic Arthropods? A Second Test of the Arthropod Saturation Hypothesis at the Anthropology Research Facility in Knoxville, Tennessee

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The goal of this presentation is to present to the forensic sciences community the latest findings on the scientific usefulness of the Anthropology Research Facility (University of Tennessee, Knoxville) as a research and training site for forensic entomology.

This presentation will impact the forensic community and/or humanity by describing an application of probability and power testing of several key variables of arthropod community structure to test the scientific usefulness of the Anthropology Research Facility (University of Tennessee, Knoxville) as a research and training site for forensic entomology.

The on-campus Anthropology Research Facility (ARF) at the University of Tennessee, Knoxville, established by Professor William Bass in 1972, is an outdoor scientific laboratory devoted to the study of human decomposition. In a previous study, probability and power testing of several independent variables of decomposition rate and community structure showed that porcine remains in the ARF do not decompose faster, nor are they saturated with forensically-important (sarcosaprophagous) arthropods of reduced diversity, compared to remains in three non-enriched sites various distances away. In a second test of this 'arthropod saturation hypothesis,' we ask if the 30-yr history of carcass enrichment at the ARF has altered the community structure of predatory and parasitic arthropods that prey upon the sarcosaprophagous fauna. Over a 12-day period in 1998, using pitfall traps and sweep nets, we sampled over 81,000 invertebrates from freshly euthanized pigs (*Sus scrofa* L.) placed in the four sites: ARF: S2 (700 m away from ARF), S3 (6 km away), and S4 (40 km away). From these counts, we sorted 8,836 and 342 enemies of the sarcosaprophagous community (predators, parasitoids, and parasites) from pitfall and sweep-net counts, respectively, for a total enemy fauna of 9,178 individuals. The community structure of these organisms, measured by species and individuals' accumulation curves, rarefaction, and nonparametric correlation, was comparable in most paired-site tests with respect to colonization rates, ranked abundances, and colonization sequences of predatory/parasitic taxa on a per carcass basis. In the few exceptional cases, ARF differed from each of the three non-enriched sites in rarefaction-adjusted species richness (ARF pitfalls had more species). Spearman rank tests showed that correlations, although significantly positive between all site pairs, were stronger for sarcosaprophagous arthropods than for their natural enemies, confirming the tighter and more predictable relationship between carrion feeders and their carrion than between carrion feeders and their natural enemies. Overall, these findings parallel our earlier results on the sarcosaprophagous community, and except for species richness, bolster the conclusion that ARF is representative of surrounding sites with respect to the carrion-arthropod fauna.

Anthropology Research Facility (ARF), Forensic Entomology, Predatory and Parasitic Arthropods

G66 Trends in Forensic Entomology in the United States and Abroad

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The goal of this presentation is to provide those attending with an update on research trends in forensic entomology.

Due to the amount of forensic research conducted in general, it can be difficult for forensic specialists to remain up to date on research trends in their own field much less the countless other disciplines in the forensic sciences. We will provide those attending our presentation with a "snapshot" of current trends in forensic entomology research from around the world with an emphasis on research being conducted in the United States.

Initially, research on insects colonizing carrion was viewed as an attempt to better understand succession and nutrient recycling in terms of general ecology (Payne 1967). However, over the course of the past 20+ years, the aim and direction of such research has been largely focused on the use of insects as evidence in criminal investigations resulting in the development of the discipline of forensic entomology. Today, forensic entomology receives considerable attention from entomology and biology departments in universities throughout the United States and world.

The goal of this presentation is to provide those attending with an update on trends in forensic entomology. Published information on forensic entomology research was gathered through a search of the CAB database via Texas A&M University. Additional information on current research was gathered by contacting individuals from around the world who are known to have active forensic entomology programs. Articles located through the search were broken down into several categories;

research topic, locality of research, year published, and journal. Participants will be provided this information with special reference to states in the U.S. with ongoing programs in forensic entomology. Additional information will also be given on events occurring at the first North American Forensic Entomology Conference, which took place August 7-9, 2003, in Las Vegas, Nevada.

Articles with forensic entomology in the title or as a key word were located as far back as 1983. The number published gradually increased from 3 that year to 50 in 2001. A total of 22 countries published 101 articles on forensic entomology from 1999 through 2003. The top five countries during this period that produced articles in English according the CAB database search are the United States, France, Italy, Germany, and Australia. Other countries with significant contributions have been Thailand, Canada, and India.

Articles from 1999 through 2003 were grouped in one of seven research areas; insect biology (26%), review articles (16%), succession studies (15%), DNA (14%), case study (12%), entomotoxicology (10%), and morphology/taxonomy (7%). These articles were primarily published in three locations; *Forensic Science International* (31%), *Journal of Forensic Sciences* (14%), and the *Journal of Medical Entomology* (9%). Additionally, it was determined that forensic entomology research had been conducted in 18 states during this period: TX, AL, SC WV, CA, VA, NY, OH, GA, HI, MD, CO, LA, TN, MI, FL, MO, PA, and the District of Columbia. A summary of this survey and bibliography is located at: http://stephenville.tamu.edu/~jktomberlin/forensic.html

Entomology, Literature, Research

G67 Temperature-Dependent Development of the Blow Fly *Calliphora Vicina (Diptera: Calliphoridae)* and the Effects on the Estimation of the Postmortem Interval

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After attending this presentation, attendees will understand the importance of temperature on the development of the forensically important blow fly *Calliphora vicina* and present new research on the same.

This presentation will impact the forensic community and/or humanity by attempting to improve the quality, accuracy, and reliability of scientific data upon which estimates of the postmortem interval using insects are based. This will help strengthen the science of forensic entomology, but more importantly, serve to help investigators come closer to the truth when investigating the circumstances surrounding a death.

Forensic entomology deals largely with the estimation of the postmortem interval, or PMI, of the victim of a violent crime. There are several ways that entomological evidence may be used to calculate the PMI, but the most commonly used method involves using the developmental rates of blow fly (Diptera: Calliphoridae) and flesh fly (Diptera: Sarcophagidae) larvae. One forensically important blow fly is *Calliphora vicina* Robineau-Desvoidy, commonly known as the blue bottle fly. This species is nearly worldwide in distribution, and is commonly recovered on human remains through the course of forensic investigations.

Because insects are poikilothermic (cold-blooded), blow flies develop at rates which are largely dependant on the temperature of their surroundings. In general, development slows with cooler temperatures and accelerates with warmer temperatures. These developmental rates are of prime importance when calculating the PMI estimate. The temperatures experienced by the developing larvae must be taken into consideration when estimating the time it has taken for them to reach a given stage of development.

There have been a number of studies published on the developmental rates of blow flies at different temperatures. Because of variations in the experimental design, equipment, and sampling regime, there are some discrepancies in the literature regarding the accumulated degree-hours (ADH) and accumulated degree-days (ADD) needed for completion of the life cycle in these flies, as well as their developmental thresholds (those temperatures at which the larvae cease development). These discrepancies, when used to analyze evidence in a capital murder case, for example, can cause an exaggerated estimate of the PMI and cost an innocent person their freedom or help free a guilty person.

Our research has attempted to correct these problems and provides reliable data which forensic entomologists may use when estimating PMIs. Temperature trials over seven constant temperatures were conducted to determine developmental rates. Flies were reared on beef liver within plastic containers in environmental chambers. Thermocouples were placed within each container to accurately record the temperatures experienced by the developing larvae. Development times recorded to the nearest half-day were used to construct a degree-day model for each larval stage. The minimum temperature required for egg hatching within a five-day period was determined and ADH were calculated.

Forensic Entomology, Postmortem Interval, *Calliphoridae*

G68 Evidence for Neglect of Children and Elderly Persons by Use of Forensic Entomology

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After attending this presentation, attendees will recognize and collect evidence in severe cases of neglect, understand how to interpret the evidence, and the importance of the actual scene where the body was found, not only the state at the Institute of Legal Medicine.

This presentation will impact the forensic community and/or humanity by demonstrating forensic entomology in difficult cases: Insects on living persons — investigation however after death of persons.

Wounds of living persons are a potential target for the same flies that live, or feed early on corpses. This can lead both to complications in estimation of PMI (post mortem interval), or to additional information that might be valuable in a trial, or during the investigations. With forensic entomology, and forensic entomologists being more and more present, even lower profile cases like the neglect of elderly people (without violence being used against them (i.e., natural death), and neglect of children comes to our attention. Furthermore, much more people grow older than in the past years which leads to increased awareness of malpractice of caregivers in the professional, and personal environment.

Case 1: Elderly women found dead in October 2002 in her 3rd floor apartment in urban Cologne, Germany. Apartment was very clean except of the bathroom in which a bathtub had been filled with water, and clothing. Exclusively dead adult flies of the species *Muscina stabulans* FALLÉN were found spread on the floor; no blow flies in the zoological sense of the meaning were present in any live stage. Calculation of PMI led to an interval of around three weeks. This would have been a misconduct of the paid professional care giver who was supposed to check fort he women every week.

The caregiver claimed that she had called the women ca. two weeks ago to check on her; the now dead women allegedly rejected a visit. This possibility could not be ruled out since the old woman was known to be healthy, yet mentally unstable and behaving “difficult” against everybody.

In clear contrast to the entomological findings, it was assumed that the caregiver tried her best; no prosecution followed.

Case 2: In September 2002, an old woman was found dead in her apartment in an urbanized town in western Germany. Her foot was wrapped in a plastic bag; inside, numerous larvae of *Lucilia sericata* were found. The caregiver openly stated that "it was well possible that the foot of the person was wrapped in a plastic bag, and that maggots may have been present inside during the lifetime of the woman."

The age of the maggots was estimated as four days (4x 24 hrs). However, judging from the deep tissue loss at the foot, it was discussed that most likely, the maggots had been feeding on the living women for at least a week whilst she was still alive but then left the bag to pupate elsewhere. The apartment could not be checked for pupae, however.

Case 3: In March 2002, the corpse of an old woman found in her apartment in an urban apartment in a western German town. The apartment was not cleaned up, and on the actual corpse, the following insects were found: Larval *Fannia canicularis* flies, larval *Muscina stabulans* flies, and adult *Dermestes lardarius* beetles. These insects are known to build up populations inside of human housings but *Fannia* frequently hints towards the presence of feces, and urine in cases of neglect. In this case, further evidence for this possibility was found in the fact that the skin of the corpse was not fed on by the larvae. Pupae (of an unknown species) were reported but not collected. The son of the woman who was convicted of misconduct of taking care of his mother. It remained however unclear if the insects had inflicted pain on the woman or not.

Case 4: On the skin surface under the diaper (anal-genital area), third instar larvae of the false stable fly *Muscina stabulans* FALLEN, and the lesser house fly *Fannia canicularis* L. were found. *F. canicularis* adults are attracted to both feces and urine. From the face, larvae of the bluebottle fly *Calliphora vomitoria* L. were collected. *C. vomitoria* maggots are typical early inhabitants of corpses. From the developmental times of the flies, it was estimated that the anal-genital area of the child had not been cleaned for about 14 days (7-21 day range), and that death occurred only 6-8 days prior to discovery of the body.

Conclusion: From the actual case work, we get the impression that misconduct of elderly people currently becomes a severe problem in our aging societies. From a juridical standpoint, it is – and will be – very difficult to judge if the care giver is guilty of misconduct, or not. Forensic entomology can give important insights into the dynamics, the amount, and the final state of bodily care that was given to the neglected person.

At the same time, forensic entomology helps to excuse care givers who did actually do their duty whilst maggot infestation of a person's wounds occurred during a normal interval of non-visits.

Forensic Entomology, Child Neglect, Neglect of the Elderly

G69 DNA-Based Identification of Forensically Significant Blowflies of Australia and Southern Africa

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After attending this presentation, attendees will understand the DNA-based identification of flies; potential of improved identification of flies to increase the efficiency and accuracy of forensic entomology as an investigative technique; the importance of consideration of DNA variation between geographically isolated populations in estimating time since death; species status and implications for forensic entomology.

This presentation will impact the forensic community and/or humanity by demonstrating the potential of DNA for use in improving the accuracy of the estimation of time since death will be explored. This will aid scientists to incorporate DNA-based forensic entomology into investigations, increasing the efficiency and accuracy of the technique for aiding investigators to focus their investigations more effectively. These DNA-based techniques improve the performance of entomology in casework, an important facet of any science used in criminal investigation, as standards must constantly be improved.

Entomology is an important forensic investigative tool, commonly applied to the estimation of time since death, referred to as post mortem interval (PMI). Blowflies (*Diptera: Calliphoridae*) are commonly found in association with corpses and may be used to estimate PMI. A critical step in entomologically based PMI estimation is the identification of insects to species level. Many species display affinities with corpses in any given area, and all will develop at different rates. Blowflies, and particularly their immatures must therefore be accurately identified. Based on morphological characters this was generally problematic, but more recently DNA-based techniques have been utilised for identification.

In applying DNA-based techniques, careful consideration is required to ensure that DNA characters used are robust and thus present throughout the entire of a species. This requires not only study of many individuals of a species from a locality, but analysis of individuals from isolated populations of the species.

The majority of studies have addressed the corpse fauna of the United States, Europe, Britain and Australia, but generally neglected Africa. In southern Africa, forensic entomology is being incorporated increasingly into death investigations.

This study consequently focused on the molecular-based identification of flies from southern Africa and Australia, considering distinction between species as well as differences between geographically isolated populations. The cytochrome oxidase I (COI) encoding region of mitochondrial DNA (mtDNA) was sequenced over 1167 base pairs, and analysis performed using phylogenetic techniques to compute similarity and difference between individuals.

Results proved the region to be useful in species level identification, with robust characters present. Variation between species was consistently calculated at 3.0% or higher, while intraspecific variation did not exceed 0.8%. While the distinction between these two values indicates the ability to clearly distinguish between species, there is little scope for identifying the geographical provenance of insects considering the low variation between conspecific populations. Consequently, an alternate region is suggested for this purpose. In conclusion, many southern African and Australian species of blowflies can be successfully distinguished on the basis of DNA.

Entomology, DNA, Blowflies

G70 Fatal Pediatric Head Impact Biomechanics: Homicide vs. Accident

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After attending this presentation, attendees will develop skill in determining the head impact accident scenario and injury mechanisms responsible for fatal pediatric head injuries. In addition, attendees will develop skill in determining injury causation in possible homicide cases involving complex, interdisciplinary medical and biomechanical engineering concerns.

When handling death cases where issues involving occupant dynamics and impact injury biiomechanics have to be addressed, medical examiners should increasingly feel more comfortable seeking input and support from skilled biomechanical engineering colleagues.

A 14-month-old male in good health sustained a severe closed head injury at a babysitter's house, and he died in the hospital few hours later. Head CT Scan performed prior to his death demonstrated a large

occipital fracture, diffuse cerebral edema and tentorial subarachnoid hemorrhage with no midline shift. An autopsy was performed 27 hours post death. Autopsy findings are provided below, prior to addressing accident witness statements and reconstruction of the accident versus homocide scenario responsible for the death of this child.

Autopsy findings Summary:

1. Blunt Force Craniocerebral Injury:
   a. No lacerations, abrasions or contusions seen on skin of posterior scalp.
   b. A 15 x 11 cm area of subscapular and periosteal blood extravasation in occipital and posterior parietal regions.
   c. Extensive displaced fractures of occipital bones extending into the posterior aspect of both parietal bones.
   d. Film of epidural blood extravasation over skull fractures.
   e. An estimated 10 ml of liquid and partially clotted subdural blood extravasation, predominately over vertices of cerebral hemispheres, but also over base of skull.
   f. Moderate diffuse subarachnoid blood extravasation over entire brain with increased concentrations in left para sagittal/sagittal cortex and left temporal lobe.
   g. Apparent tear of falx cerebri anteriorly.
   h. A 2 x 1.5 cm contusion, right cerebellar hemisphere.
   i A 1 cm contusion, right parieto-occipital lobe.
   j. Blood extravasation surrounding each optic nerve.
   k. Retinal blood extravasation.
   l. Blood extravasation on the left nerve roots of C1 and C2 vertebrae.
   m. Subdural spinal cord blood extravasation.
2. Evidence of hypoxic-ischemic encephalopathy:
   a. Diffuse gyral flattening and sulcal narrowing.
   b. Cerebral tonsillar herniation.
   c. Cerebral edema and early neuronal degeneration on histology.
3. Small, scattered, circular areas of erythema with central dried punctures resembling insect bites on skin.

Witness Statement:

The babysitter, the only adult witness to this accident, provided accident scenario descriptions (a) during the 911 call post-accident, (b) to the EMS crew, (c) to the emergency room and hospital personnel, and (d) to investigating police officers; all of the accident scenario statements provided by the babysitter remained consistent. Namely, the 14-month-old boy was standing at rest, having just picked up a popular toy from a toy box, and he was facing two older children who were playing across the room. Suddenly, these two older children ran together fast towards the 14-month-old boy. As these two older boys approached this 14-month-old boy, still running fast, these older boys became entangled and they tripped and fell toward the 14-month-old boy. The 14-month-old boy was, in effect, gang-tackled by the two older boys, causing the 14-month-old boy to rotate backwards at a high rate of speed, pivoting about his feet, resulting in the back of his head violently impacting the bare, hardwood floor.

Impact Injury Biomechanics:

1. Analysis of all of the injuries sustained, and of the possible injury mechanisms responsible for each injury, led to the conclusion that one, single, violent, blunt blow, sustained by the back of the head of the 14-month-old boy, induced all of the injuries sustained. This injury biomechanics analysis included study of the pattern and extent of the skull fractures sustained and consideration of how this depressed skull fracture resulted in an increase in intracranial pressure sufficient to have induced hemorrhages in the region of the optic nerves and retinae.

2. Dynamic and impact biomechanic analyses were then performed to study (a) the kinematic consequences of collisions of the two older boys into the 14-month-old boy, along with (b) the magnitudes of the collision-induced increases in head-to-floor slam down velocities. These engineering analyses demonstrated that the collision of the two older boys into the 14-month-old boy standing at rest could have increased the 14-month-old boy's head-to-floor slam down velocity to a level more than capable of producing the severe skull fractures and fatal brain injuries sustained. In addition, these analyses demonstrated how unlikely it would have been for simple fall, starting at rest from a standing height and not involving a collision, to have caused these catastrophic head injuries.

Recommendations:

In an interdisciplinary case such as this one, whether or not the death of this 14-month child was caused by homicide would be difficult for most medical examiners to judge absent feedback and support from a team member skilled in biomechanical engineering. When the quest for accurately determining injury causation involves consideration of complex medical and biomechanical engineering issues, forensic pathologists should seek support from skilled biomechanical engineering colleagues.

Head Impact Injury Biomehchanics, Skull Fracture Mechanics, Occupant Kinematics

G71 The Enigma of SIDS: Variations in Diagnosis and Recommendations

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After attending this presentation, attendees will understand how SIDS is diagnosed differently by medical examiners and to discuss recommendations to enhance consistency in diagnosis and contribute to prevention efforts.

Consensus is needed on guidelines to diagnose SIDS and suffocation. These guidelines should be based on the definition of SIDS, autopsy data, death scene investigation, and pertinent medical and social history, as well as consistent decision making on whether these factors are positive or negative. The next phase of this effort will involve forensic pathologists, medical examiners and other interested parties forming a task force with the goal of developing a greater consensus regarding the diagnosis of SIDS. Forensic science should strive to produce the most accurate and truthful diagnosis of sudden unexpected infant deaths, both as a professional standard, and to benefit prevention. Since many prevention efforts are based on vital statistics data, the more accurate and consistent diagnosis of SIDS or other forms of sudden and unexpected deaths would serve to focus and enhance the reduction in preventable infant deaths.

Purpose: There is great debate about the diagnosis of SIDS in deference to other causes such as accidental asphyxia. In fact there is accumulating evidence that unsafe sleep environments are linked to many infant deaths although the diagnoses are controversial. Variations in diagnosis lead to inconsistency in vital statistics and confusion or misdirection of prevention efforts. The purpose of this session is 1) to present information on a study which investigated differences in the diagnosis of SIDS among medical examiners using case scenarios and 2) to use these study results as a starting point to discuss efforts and recommendations to increase consensus among forensic pathologists and medical examiners regarding the diagnosis of SIDS.

Methods: A mailed survey was obtained from Medical Examiners/Deputy Medical Examiners (ME) in Michigan. The survey included 28 case scenarios with varying diagnostic factors, questions about the diagnosis of SIDS, and demographics.

Results: A total of 53 surveys were returned for analysis representing a 59% return rate. Only 15% of MEs believe SIDS is a distinct

syndrome, 58% think SIDS is a catch-all diagnosis but includes actual SIDS cases, and 27% believe SIDS is a catch-all category and that SIDS does not exist. Among MEs, 21% say they would sometimes give SIDS as a comfort diagnosis so the parents would not feel guilty. In a case that classically meets the definition of SIDS, 80% called it SIDS, 11% indicated accidental asphyxia (AAX), and 9% would call it undetermined (UDTM). In a similar case with the only change being a 14-month-old baby, 32% of MEs would still call it SIDS, while 66% would call it UDTM. If a baby was found prone on a pillow, 17% call it SIDS and 73% AAX. When an infant was found alone on a waterbed or air mattress there was a fairly even split on SIDS vs. AAX. When bedsharing was involved, the diagnostic distribution was 42% SIDS, 39% AAX and 19% UDTM. As factors were added to cases which make suffocation more likely, AAX increased as a choice, but a substantial proportion of MEs continue to call these cases SIDS. When an intoxicated parent is bedsharing both AAX and homicidal asphyxia (HAX) increased as cause of death. (10% SIDS, 63% AAX, 8% HAX, 19% UDTM). Cases in which parents were sleeping with infant on couches elicited the highest rates of AAX (77-85%).

Conclusions: There is significant variation in the way that SIDS is diagnosed in Michigan. Even in cases that have accepted definitions of SIDS or AAX there are marked differences in diagnosis, in part based on beliefs of what SIDS actually is. This variance makes it difficult to use and interpret death certificate data concerning SIDS. These results will be used to stimulate discussions and recommendations toward a consensus on the diagnosis of infants suffering sudden and unexpected deaths.

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Sudden Infant Deaths Syndrome, SIDS, Infant Mortality

G72 Investigations and Eye Findings in Crush and Other Accidental Traumas in Lethally Injured Infants and Children

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After attending this presentation, attendees will understand the extent of systemic and ocular findings in a group of injured children as well as the histories and investigations leading to the conclusion that the children were accidentally injured as a basis for comparison with their cases. Crush injuries of the head are a subset of accidental trauma but in this group they did not have extensive ocular injuries.

Observations have been the basis of the scientific study of phenomena for many years. Presentation of these observations allows others to consider and compare the material with personal experience and the literature, validate the observations, use them as a basis for making determinations in their own cases. Our "cases" impact the family members of that part of humanity which is affected by our determinations. The more scientific they are, the better our determinations should be for the forensic sciences and humanity.

Attendee can know the extent of systemic and ocular findings in a group of injured children as well as the histories and investigations leading to the conclusion that the children were accidentally injured. Attendee can be aware that crush injuries of the head may be a subset of accidental trauma with more extensive ocular injuries.

Concerns are sometimes raised because infant and child deaths are attributed to abusive injuries when explanations of caretakers are not accepted as sufficient to cause death. The following is a review of 35 cases in which the explanations of the events leading to the fatal injuries were regarded as adequate. It was concluded that the children were accidentally injured.

A prospective ocular and systemic study of infants and children was undertaken at the Southwestern Institute of Forensic Sciences between 1981 and 1989. The study group included 169 infants and children. Death was attributed to accidental injuries in 35 of the children.

Most of the accident deaths were attributed to non-abusive head injury, 18 cases. Six children were unrestrained passengers involved in motor vehicle collisions. The heads of two of these six were partially out of the vehicles during rollovers. Four other children were run over by motor vehicles, two were ejected from the vehicles prior to being run over. The other two were upright pedestrians. Four children fell: one fell from a second story window to concrete, another from an unknown height to a conglomerate patio. Two others were standing, on a washing machine and a bed above concrete floors, and fell onto their heads. One was ejected from a motorcycle. One child was being carried on a bicycle by an adult who fell on top of her when the bike hit an obstacle. A child's stroller rolled downhill and collided with a wall; a respiratory tract infection contributed to that death. The eighteenth child suffered a gunshot wound of the head and the ipsilateral eye was examined.

Analyzing the pattern of autopsy findings by the mechanism of injuries allows the identification of a subset of children with crush injuries of the head. Crush injuries were defined by the presence of extensive skull fractures and head deformity. Five of the six passengers had such injuries including the two with heads out of the vehicles during rollovers. All four of the children who were run over by vehicles had crush injuries. None of the other nine children had such extensive head injuries ©© one of the passengers in a motor vehicle collision, the four children with falls, the child ejected from the motorcycle, the child on the bicycle, the child in the stroller, and the child with the gunshot wound.

However, only four of the children with crush injuries had ocular hemorrhages. Retinal hemorrhages were seen near the optic disk in one of the two children whose heads were partially out of the vehicle when it rolled. Impact was a significant component of the injury mechanism in this child. More extensive retinal hemorrhages were found in three children. The hemorrhages included the superficial retina under the internal limiting membrane and the macula in two children who were run over at relatively low speeds and one of the unrestrained back seat passengers. Impact probably contributed to the injuries in the two children who were run over. Impact was a more significant component of the injury mechanism in the back seat passenger.

Although extensive skull fractures and head deformity was not seen with falls, two of the four had retinal hemorrhages — the two who fell the greatest distance. One of these two had hemorrhages at the ora serrata and under the internal limiting membrane as well as the disk and macula. The other's retinal hemorrhage were limited to the optic disk and macula. Similar findings were seen in one of the unrestrained passengers. The child who was ejected from the motorcycle and the child who fell from the bicycle both had retinal hemorrhages limited to the optic disk. All of these children had significant impact components in the mechanisms of injury

The other seventeen accidental deaths were attributed to less traumatic but equally lethal injuries. Nine children had asphyxial deaths: four positional, three overlays, and two aspirations. Eight children drowned: three were unattended in bathtubs, two were in pools, and one each into a bucket, a creek, and a live birth into a commode. Not surprisingly, none of these children had ocular injuries, subdural hemorrhages, or skull fractures.

Conclusions: Thorough investigation of history and scene circumstances coupled with a complete autopsy including ocular examination will allow identification of patterns of accidental injury. In this group approximately half of the deaths (eighteen) were the result of head injuries. A subset of more severe head injuries with multiple fractures and deformity were seen in nine of the children involved in motor vehicle collisions as passengers and as pedestrians in this series. Retinal hemorrhages were found in four of these children. Impact as well as crush mechanism was involved in the injuries. Five of the other nine head injured children also had retinal hemorrhages and all of these had significant impact injuries. In this group impact injuries were a confounding variable.

Head and ocular injuries were not found in the other seventeen deaths in this series. The presence of such injuries would be inconsistent with the explanations of the traumatic mechanisms and would have required additional explanations before the deaths could be regarded as accidental.

Retinal Hemorrhages, Accidental Head Injury, Accidental Injury

G73 Meningitis Mimicking Inflicted Abusive Head Trauma

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After attending this presentation, attendees will be reminded to consider other etiologies for markers of inflicted abusive head trauma which may prevent misdiagnoses of shaken baby syndrome.

The main goal impact of this presentation is to prevent misdiagnoses of inflicted abusive head trauma and the resulting consequences.

The current consensus regarding the triad of retinal hemorrhages, cerebral edema, and subarachnoid or subdural hemorrhage in non-ambulating infants is that it is virtually pathognomonic for inflicted abusive head trauma (i.e., shaken baby/shaken-impact syndrome - SBS). This case illustrates that while these findings are highly sensitive for SBS they are not 100% specific.

The local forensic pathologists were contacted by the pediatric intensivist to evaluate an eight-week-old male infant under treatment in the hospital's intensive care unit. The child had been admitted to the unit two days prior. The history given by the mother was that the child had a rectal temperature of 104° F at home, for which she gave him an ice bath. She then took him to the local health clinic. He was noted at the clinic desk to be "acutely ill." The mother was instructed to immediately take the baby to the hospital emergency room. She complied. Upon admission to the hospital the infant had a rectal temperature of 100.2° F and a heart rate of 240 beats per minute. Very little additional information is documented regarding the initial physical exam. The HEENT exam record consists of, "flat anterior fontanelle and a clear nose." Medical treatment focused on evaluating and treating the baby's rapid heart rate, and the child was "pan-cultured." Approximately 12 hours after admission the child's anterior fontanelle was noted to be bulging. A neurosurgical consult and a CT scan of the head were ordered. These revealed, "diffuse bilateral retinal hemorrhage, cerebral edema, and possible subarachnoid hemorrhage." The diagnosis of SBS was made. Local law enforcement and child protective services personnel were notified. Based upon the clinical diagnosis, the infant's older sibling (15 months) was removed from the custody of his parents.

The consulting forensic pathologists requested the results of all microbiology cultures, with particular attention to the spinal fluid cultures. They were advised that no lumbar puncture or spinal fluid culture had been performed upon admission, or at any time during the hospitalization. The tracheal aspirate culture was positive for *Streptococcus pneumoniae*. Throughout the child's hospitalization the mother maintained her position that she had not harmed her child. Regarding events leading up to her child's hospitalization, the mother specifically described the baby as having fever, jumping-like movements, "eyes rolling up into the head," and the presence of a hard red lump on the infant's head. The story did not change upon repeated interviews. The infant was pronounced brain dead on the fourth hospital day, and life support was withdrawn. The body was transported to the morgue. A complete autopsy was performed approximately 18 hours after death.

The autopsy revealed no external evidence of injury. All markings were a result of therapeutic intervention. The internal examination of the torso and neck was also negative for injuries. Examination of the head revealed a markedly swollen brain with herniation, very scant subdural and subarachnoid hemorrhage, and very extensive bilateral retinal hemorrhages. The meninges were remarkable for multifocal dull gray-green discoloration. The dura and overlying scalp around the anterior fontanelle grossly exhibited thickening and discoloration, suggestive of granulation tissue/inflammation. The middle ears were opened revealing a cloudy green exudate on the left. Based on these findings, the case appeared to represent undiagnosed bacterial meningitis. A more definitive diagnosis required microscopic examination of the brain, meninges, and retinas. The "red lump" reported by the mother was a calcifying cephalohematoma of parietal skull. This was attributed to birth-related trauma. Upon these initial findings, the police and child protective services were notified, and the older sibling was returned to parental custody.

Thorough microscopic examination revealed severe acute meningitis with necrosis of the small to medium sized meningeal blood vessels. The inflammatory process completely encased the optic nerves. Microthrombi were noted in the blood vessels of the optic nerves and retinas. Sections of the eyes showed bilateral diffuse intraretinal hemorrhage. No optic nerve sheath hemorrhages were noted. Swabs of the middle ear fluid were remarkable for acute inflammation and cocciform bacterial organisms consistent with *Streptococcus pneumoniae*. The cause of death was ultimately attributed to acute bacterial meningitis.

Review of the literature reveals numerous papers on retinal hemorrhages, all of which state that the most common cause of retinal hemorrhages in infants is inflicted head trauma, particularly shaken baby syndrome. However, most papers also state that other rare causes, such as infection and bleeding disorders, must be ruled out. Only one case report was found documenting retinal hemorrhages in the setting of bacterial meningitis and without suspected abuse. The hemorrhage in this report was focal, and the patient recovered.[1] The meningitis did not result in massive cerebral edema and death, as was seen in this case.

This case should serve to remind the forensic pathologist and the clinician of the importance of investigating other potential causes of the "markers" of shaken baby syndrome, regardless of how unlikely they may be. The presenter will discuss possible explanations for misdiagnosis and recommendations for evaluating similar cases.

[1] Fraser SG, Horgan SE. Retinal hemorrhage in meningitis. Eye 1995;9:659-60.

Retinal Hemorrhage, Shaken Baby Syndrome, Meningitis

G74 Fatal Hyponatremia, Cerebral Edema and Seizures Associated With Bilateral Peripheral Retinal Hemorrhages in a 20-Month-Old Child Following Hypotonic Fluid Administration for Dehydration: Case Report with Critical Appraisal of the Current Literature

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After attending this presentation, attendees will understand that, based on the lack of evidence base within the current medical literature, peripheral retinal hemorrhages cannot be regarded as specific for non-accidental head injury in children.

The importance of critically reviewing the medical literature before ascertaining that certain ocular findings are specific for non-accidental head injury.

A 20-month-old child was parenterally rehydrated with 0.2% normal saline in 5% dextrose in water for mild dehydration from gastroenteritis. He received more than 750 mL of the hypotonic fluid intravenously during a four-hour period. He became severely hyponatremic and developed diffuse cerebral edema and seizures. Numerous bilateral intra-retinal hemorrhages extending to the periphery were noted and considered worrisome for nonaccidental head injury (NAHI) or Shaken Baby Syndrome (SBS). A forensic autopsy confirmed the intracerebral and intraocular findings and subsequent investigation by the medical

examiner, child protective services and law enforcement uncovered no evidence of child abuse. Retinal hemorrhages have been reported in cases of hyponatremia, cerebral edema and seizures although the pathogenesis has been disputed. No previous reported cases of retinal hemorrhages in infants or young children who died following intravenous hypotonic fluid administration were found following an electronic database search, although two articles described infants with nonfatal oral water intoxication who had retinal hemorrhages. The proximate cause of these ocular findings has been disputed. In one case the peripheral retinal hemorrhages, cerebral edema and seizures with hyponatremia were presumably due to Shaken Baby Syndrome, although the history of oral water intoxication could explain the infant's low serum sodium, cerebral edema and seizures. Subsequently, a Letter to the Editor described another infant with hyponatremia and seizures with posterior retinal hemorrhages due to water intoxication. The authors concluded that the infant had not been abused and questioned published studies of retinal hemorrhages and seizures pointing out that infants with hyponatremic seizures rarely receive an ophthalmologic examination. The initial authors responded that the distinguishing feature between the cases was the location of the retinal hemorrhages. They stated that localized posterior retinal hemorrhages could be attributed to unintentional head trauma and increased intracranial pressure, whereas peripheral and multilayered retinal hemorrhages are more often associated with abusive head trauma. Therefore, the background question became: Are peripheral retinal hemorrhages diagnostic of NAHI when observed in infants and young children? Using the National Institutes of Health National Library of Medicine MEDLINE (1966- 2002) electronic database a search was done on reported childhood deaths due to the administration of hypotonic fluids and articles discussing peripheral retinal hemorrhages and child abuse. One case-controlled study that exhibited selection bias discussed peripheral retinal hemorrhages and NAHI in children but none of the children in this study died from hyponatremia associated cerebral edema secondary to hypotonic fluid administration. The remaining articles consisted of case reports, non-comparative case series and unsystematic review articles. Based on the lack of objective scientific evidence, peripheral retinal hemorrhages cannot be regarded as diagnostic for NAHI or SBS.

Peripheral Retinal Hemorrhages, Hyponatremia, Shaken Baby Syndrome

G75 Delayed Jejunal Rupture in a Three-Year-Old Child After Minor Blunt Impact

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After attending this presentation, attendees will understand role of history, scene information, autopsy, and histologic examination in differentiating ischemic from traumatic lesions of the small bowel. Be aware of an infrequent cause of traumatic death in children (delayed jejunal rupture). Review what is known and what is controversial about aging lesions by histology. Be cognizant of the pitfalls and controversies in establishing accident versus homicide as manner in similar cases.

This presentation will impact the forensic community and/or humanity by reviewing an unusual cause of traumatic death in children. Invite the forensic community to consider a difficult question of manner of death in this case and similar cases, using the tools of scene investigation, autopsy findings, histology, and attempted dating of traumatic intra-abdominal lesions by histology.

Histologic examination of tissue from the intestinal wall, to determine whether ischemia or impact is the primary cause of necrosis, may allow differentiation between accidental death and child abuse. A healthy three-year-old girl arrived at an emergency department with a report of head injury. The child described to nurses and investigators how she tripped and fell down three concrete stairs while running after a ball. No significant head injury was found, and no evidence of abuse was detected at that time. Three days later, the child complained of gradually increasing nausea and abdominal pain, and died suddenly. Autopsy revealed ischemic small bowel with perforation. Microscopic findings showed inflammation with both fresh and remote hemorrhage. Possible etiologies included three-day-old child abuse with blunt impact to abdomen, fresh child abuse with blunt impact to abdomen, and delayed jejunal rupture due to ischemia after minor blunt impact to abdomen. The characteristics of ischemic versus traumatic lesions are discussed. Controversies in determining aging of lesions are reviewed, along with the issues for the examining pathologist.

Delayed Jejunal Rupture, Histologic Dating of Lesions, Forensic Pathology

G76 Virulence Factors in Neisserial Meningococcemia

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Attendees will review new research into factors that make neisserial meningitis fatal for one person, while subclinical for another. Virulence factors include microbial adaptations, such as adhesive pili, lipopolysaccharides, and opacity proteins (Opa); host factors include toll-like receptors, cytokines, mannose-binding proteins, and immunoglobulin G receptors.

All of pathologists deal with the impact of cases of fulminant neisserial meningitis on communities, but rarely do is there an opportunity to review the science which lies behind the current understanding of what makes one victim die, while another survives. This "snapshot" overview of what is understood about the genetics behind host and microbe virulence factors will update the medical community, and will allow physicians to go on following the science as results continue to come in, and perhaps point the way for tests in the future on meningitis cases.

A 13-year-old boy underwent a rapid progression, over a period of hours, from normal health to septic shock and death, while family members remained healthy and free of disease. At autopsy, despite grossly clear meninges, evidence of Waterhouse-Friderichsen syndrome led to the suspicion of meningitis. Microbial culture determined the agent to be Neisseria meningitidis. This child's extreme susceptibility to the devastating effects of neisserial infection, while his family remained well, was likely due to the interplay of microbial virulence factors, with newly understood host factors. Newly understood microbial factors, recently described by functional genomics and microbiology research, include genes that play essential roles in the pathogenesis of meningococcemia. These are neisserial genes involved with quorum sensing, and with variation of surface antigens, such as adhesive pili, lipopolysaccharides, and opacity proteins (Opas). Regulation of expression of these genes is likely to underlie incomplete virulence among close patient contacts. However, the development of sepsis rather than an innocuous commensal relationship is not only a function of the microbe, but also of increased susceptibility of the host. A variety of gene products implicated in a diminished immune response to Neisseria meningitidis

include genetic polymorphisms in toll-like receptors, cytokines, mannose-binding proteins, and immunoglobulin G receptors on neutrophils, monocytes, and macrophages. This affords us an opportunity to review the recent research into the critical determinants of meningoccemia, from the aspect of both host and microbe.

Neisserial Meningitis, Virulence Factors, Host

G77 SARS, Monkeypox, West Nile, Dengue, and Plague: Pitfalls of Globalization

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After attending this presentation, attendees will explore the ramifications of political, social, and economic forces that impact mortality, morbidity, and public health issues. They will learn about the global mechanisms that foster aberrations in traditional biological and scientific relationships, and how to utilize the knowledge gained to create solutions.

Participants will consider the challenges and positive implications of unexpected phenomena. The development of new methodologies and technologies, and the applications of these unexpected experiences offer the potential for predictive modeling processes to expedite future valid solutions.

Forensic specialists and experts must be well grounded in factual elements. For truth to prevail forensic scientists must bring to light the crucial and all related ancillary facts. These must include the limitations of the science employed and the extent to which the opinions generated represent subjectivity, causality, and validity.

Over the past few decades and especially in the last few years changing patterns relating to human infectious diseases have emerged. For example, with the encroachment of human living environments especially in the western United States, into traditional animal habitats, the Hanta viruses have crossed over from being infections solely carried by the deer mouse, to ones infecting humans. Lyme disease (named in 1977) has emerged and has become embedded in a geographic distribution (the northeast, mid-Atlantic, upper north-central regions, and northwestern California) with progressive infection of humans manifesting an acute and/or chronic form of the disease. This is an infectious disease transmitted by an arthropod (the deer tick) and causes more than 16,000 cases in the United States each year. An effective vaccine has been developed and produced, but has been abandoned. In addition, the re-emergence of known but thought to be controlled infectious diseases such as Smallpox and Anthrax has occurred, including the potential use of these biological agents as weapons of terrorism. Smallpox vaccine exists in sufficient quantities to protect all 280 million United States citizens. Phase I of a stepwise program that would initially vaccinate 500,000 healthcare workers has been placed on hold. A program which protects most of the U.S. population would render the Smallpox virus ineffective as a terrorism weapon and truly be the application of prevention.

The Ebola virus has caused disease periodically since 1976 when it was initially recognized in Africa. It produces a severe, acute disease in humans and non-human primates with a high death rate. The origin and natural reservoir of the virus remains unknown but is suspected to be animal-borne (zoonotic). Death occurs due to a hemorrhagic fever. Dengue fever is caused by four closely related, but antigenically distinct virus serotypes. Infection with one of the serotypes does not render cross-protective immunity. However, until the late 20th century each of the serotypes remained primarily in its endemic region. The introduction of additional serotypes and mosquito vectors into various regions has resulted in the human population now being at risk for two or more Dengue infections. Dengue has emerged as a major public health problem in the region consisting of the Americas. In 1997 it was determined that the geographic distribution of the mosquito vector has progressively widened. Dengue is presently the most important mosquito-borne viral disease affecting humans, with a case-fatality rate of 5%.

A number of human diseases are spread by mosquito vectors. In addition to Dengue, Malaria, Yellow fever, West Nile virus, and filariasis are included. Some mosquitoes are great travelers. However, much depends on the facilities for travel. The mosquito is, in fact, a hardy and enterprising colonist, ready to exploit any and every chance. The advent of the airplane in the 20th century provided the mosquito, including disease-bearing members of its family, with the opportunity to spread to the far reaches of the world. If the mosquito cannot get there as an adult, it sends an egg or a larva as a substitute.

Though West Nile virus was first found in Uganda in 1937, its progression in the United States, identified first in New York in 1999, has generated great interest and concern. In that year only four states were affected, with 62 cases and seven deaths. By 2002, West Nile was present in 40 states, resulting in 4156 cases and 284 deaths. West Nile has proven to be extremely aggressive and versatile and can affect more than 130 species of birds, and is carried by at least 36 types of mosquitoes. No medical treatment or vaccine presently exists. The rapid expansion of this disease in only three years raises significant questions and serious problems to be evaluated.

This past year, 2002-2003, brought the emergence of SARS (Severe Acute Respiratory Syndrome) caused by a corona virus and spread human-to-human via droplet infection. The world outbreak began in Guangdong Province of mainland China in November 2002. The four month silence about the existence of the epidemic by the Chinese government until February 2003 played a significant role in the uncontrolled spread of the disease. Open communication and cooperation with healthcare entities like the World Health Organization (WHO) would have proven successful in alleviating the ensuing consequences. Healthcare workers played a significant role in the spread of SARS throughout the world, and closing healthcare facilities helped bring the epidemic under control. SARS infected 8439 people in 30 countries on five continents with a death rate of 10% (812 people). No vaccine or specific treatment presently exists. The disease has primarily been controlled by isolating patients and quarantining those in close contact with them. Re-training of hospital doctors and healthcare workers in infection control measures (proper use of gloves, masks, face shields, barrier techniques, strict isolation) was necessary because hospital workers were exposing others. SARS may prove to be a seasonal disease that returns in the winter each year. There is a need to develop predictive models in preparation for its return should a reservoir exist as many experts believe. The application of techniques like forensic patterns would be most helpful. No rapid laboratory identification testing presently exists to help in the early identification of SARS. All present approaches are focused primarily on response while they should be equally focused on prevention. The SARS epidemic, its rapid progression and world-wide public health and economic impact, provide a unique opportunity to use the SARS experiences in developing models for the control of future disease epidemics, and even terrorism planning.

Globalization, Predictive Models, Forensic Patterns

G78 Pure Group A Beta Streptococcal Peritonitis in a Child With Inflammatory Bowel Disease

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After attending this presentation, attendees will be able to discuss the rare phenomenon of pure Group A Beta Streptococcal peritonitis, and to describe the possible relationship between this death, previous colonic biopsy, and childhood inflammatory bowel disease. Current surgical practice regarding colonoscopic perforation will be described.

The forensic community will be more familiar with the rare occurrence of pure Beta Streptococcus peritonitis, and of current practice related to bowel perforation during colonoscopy.

A seven-year-old child with a history of ulcerative colitis presented to the emergency department with increased abdominal pain and collapsed, expiring after prolonged resuscitative efforts. He underwent colonoscopy with biopsy 4 days prior to death. Peritonitis was diagnosed in the Emergency Department, and microbiologic culture subsequently yielded a pure culture of Group A, Beta Hemolytic Streptococcus.

Autopsy revealed peritonitis resulting from a perforation of the descending colon. Diffuse erythematous skin discoloration, typical of streptococcal infection, was observed. Changes of ulcerative colitis extended from the midtransverse colon to the anocutaneous line. Original biopsy slides were reviewed and were shallow mucosal specimens, without full-thickness extension.

Pure Group A, Beta Streptococcal peritonitis has rarely been reported, and has been described only in cases of primary peritonitis. In streptococcal primary peritonitis, toxic shock syndrome often accompanies the abdominal findings. Adults who present with streptococcal primary peritonitis often have chronic ascites, nephrotic syndrome, or immunosuppression.

The incidence of perforation from diagnostic colonoscopy ranges from 0.2 to 0.8%. Non-operative management in cases of known perforation is acceptable in some circumstances.

Perforation occurs in less then 5% of cases of childhood ulcerative colitis. Colonic perforation in ulcerative colitis usually occurs in association with toxic megacolon or severe fulminant disease.

Beta Streptococcal Peritonitis

G79 Acute Dissection of the Left Subclavian Artery in a Patient With Ehlers-Danlos Syndrome

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After attending this presentation, attendees will have reviewed of pathogenesis, complications, and the methods for the diagnosis of EDS as a cause of sudden death.

The presentation will help one recognize this unusual cause of internal hemorrhage, and will emphasize the need for communication with families about the genetic implications of EDS.

This presentation consists of a case study of a female who died from complications of Ehlers-Danlos Syndrome Type IV and includes a discussion of the pathogenesis, complications and diagnostic workup of Ehlers-Danlos syndrome with emphasis on EDS Type IV, the vascular type.

EDS is a heterogeneous group of connective tissue disorders characterized by the inability to produce sufficient amounts of collagen or by a defect in the structure of collagen. At least 10 variants of EDS have variable modes of inheritance. This paper reviews the syndrome as a whole but will emphasize the vascular type, or EDS Type IV. Affected patients usually have hyperextensible skin and hypermobile joints, hence the designation "rubber man." Patients have a predisposition for joint dislocations and fragility of the skin and soft tissues. The most serious complications include rupture of a viscus, or vascular rupture or dissection. Death may result from internal hemorrhage. Diagnosis is based upon physical and laboratory examination of a living patient or autopsy findings. The specific collagen defect can be elucidated through electrophoresis of collagen products produced by a fibroblast culture of the patient's skin, soft tissue or organs. DNA molecular studies of the fibroblast culture pinpoint the gene locus mutation.

A 33-year-old white female was admitted in asystole to an emergency department after awaking suddenly during the night stating that she "was passing out." Despite ACLS protocol she could not be resuscitated. She had been admitted to the hospital earlier that week with headache and gastrointestinal symptoms including nausea, vomiting and abdominal pain. Endoscopy revealed gastritis, chronic enteritis of the duodenum, and the colon grossly was significant for a small cluster of dark red polyps clinically suspicious for juvenile polyps or hamartoma. She was also found to have a microcytic hypochromic anemia. Treatment included red blood transfusion. Preliminary autopsy findings included thin, transparent skin of the trunk and extremities revealing the subcutaneous vasculature. Internal findings included unusual friability of vasculature, soft tissue, and viscera. The organs were extremely soft, and the skin tore upon restoration of the body after autopsy. The embalmers reported severe friability of the vasculature and difficulty in the embalming procedure. Grossly there was a dissection of the left subclavian artery with adventitial hemorrhage, which extended from its origin at the aorta to 10 cm distal in the upper arm. Significant sequelae included a left hemothorax of 1,050 ml and visceral pallor. Microscopic sections of the vessels revealed a dissection of the outer third of the muscle wall of the left subclavian artery and the left renal artery. Thrombus and rupture of the vascular wall involved the mesenteric arteries of the transverse colon with subsequent segmental early necrosis of the colon. Samples of lung, skin and kidney underwent fibroblast culture. Electrophoretic mobilities of collagen produced by cultured fibroblasts revealed diminished type III procollagen and intracellular storage of abnormal type III procollagen. cDNA responsible for encoding pro alpha 1 (III) chains of the type III procollagen was synthesized from RNA isolated from the patient's fibroblast culture. Normal c DNA and an abnormal cDNA that demonstrated a mutation of the gene COL3A1 were present. The mutation was a change in the second nucleotide of intron 14 (IVS14 + 2T->A). There was no family history of adverse vascular events. The final diagnosis in this case is left hemothorax due to dissection with rupture of the left subclavian artery due to Ehler's Danlos syndrome type IV.

Ehler's Danlos syndrome is an entity to be included in the differential diagnosis of sudden death in a patient with internal hemorrhage cause by spontaneous vascular rupture or dissection. The implications to the patient's family are serious, and genetic counseling follow up is required.

Ehlers-Danlos Syndrome, Arterial Dissection, Hemothorax

G80 A Case of Sudden Death in a 3-Year-Old Infant With Prader Willi Syndrome

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A case of sudden death of a 3-year-old infant affected by Prader Willi Syndrome is presented. The aim of the paper is to analyze the macro-microscopic findings in Prader Willi Syndrome and to focalize the forensic implication in sudden death cases.

To the best of our knowledge, this is a rare case of sudden cardiac death in infant with Prader Willi Syndrome. This datum is confirmed by means of histological study of cardiac tissues. It would be an important contribute to the scientific community for the diagnosis of the cause of death in Prader Willi Syndrome.

The Prader Willi Syndrome has a variable prevalence of 1:10000 – 25000.

The syndrome is a rare genetic disorder caused by a chromosomal aberration. Most common a deletion on chromosome 15q11-13 in the portion inherited from the father, less frequently the child has two chromosomes 15 from the mother and none from the father, rarely there is an

imprinting mutation on chromosome 15q11-q13. The Prader Willi Syndrome is characterized from a hypothalamic dysfunction that leads to hyperfagia and obesity and has secondary consequences of diabetes, heart disease, stroke and sleep apnea. It is also characterized by severe muscular hypotonia, short stature, cryptorchidism, learning disabilities, mental retardation.

We present a sudden death case in a 3 years old young male, affected by Prader Willi Syndrome diagnosed by means of DNA methylation. The infant was referred apparently unconsciousness by his mother to the Emergency Area. Pulse was absent, he was breathless and in fixed mydriasis. The cardiopulmonary resuscitation was unsuccessful. In the history, mother referred that her son suddenly collapsed while he was on bed.

The external examination was performed showing an uninhabited scrotum, a severe hypo tonic muscular body mass and an excessive accumulation of fat. At the post mortem examination the skull cup was uninjured, the brain was congested and edematous with convolutions reduced (microgyria) in correspondence of parietal and occipital lobes, but normal in size, volume and weight. It was fixed in formalin and later it was sectioned with coronal cuts according to the Pitres technique, showing hypoplasia of olive of medulla oblongata and haemorrhage on periventricular surface. Cervical and thoracic organs were removed "en block" according to the Ghon's technique, appeared edematous and congested but anatomically normal; tracheobronchial tree and lungs, were unremarkable except for white fluid in upper respiratory tract. Heart was fixed in formalin and a dissected according to "Four – Chamber" method was completed. Cardiac size was normal, with conical shape, the color of fresh subepicardial myocardium was reddish-brownish. Macroscopic study (cut in cross-section 3 mm intervals) of coronary arteries was unremarkable. Left ventricular thickness, measured 2 cm below mitral anulus, was cm 1; ventricular septum 1.2 cm; right ventricular thickness 0.4 cm. Histological cardiac findings were represented by spotty area of fibrosis; myocells showed eosinophilic cross-bands consisting of segments of hyper contracted or coagulated sarcomeres, to a total disruption of myofibrils and cells with granular aspect. In particular, the contraction band necrosis were variously distributed in multiple foci, formed by few myocells. Sarcomeres appear shorter than their normal length and this finding was associated with marked thickening of the Z-lines. Granular destruction of myofibrils were also associated with a paradiscal lesion (paradiscal contraction band) without rhexis of the myofibrillar apparatus. Adjacent normal myocells show a typical "wavy" disposition, possibly induced by the hyper contracted myocells. Myocardial fibers appear also stretched and broken. (A quantitative morphometric analysis has been conducted). In the lung mild pulmonary oedema was observed; a limited bronchial phlogistic infiltration, and large areas of atelectasia were also observed.

The histological findings lead to the definition of a cardiac death with a typical picture of contraction band necrosis (CBN). The cardiac findings should be judged sufficient to explain the cause of death. Pulmonary hypoxic alteration is frequently reported as primary cause of death in PWS cases. The chronic hypoxic stimuli should trigger a fatal cardiac arrhythmia, as demonstrated by typical myocardial damage (Contraction Band Necrosis).

In conclusion, this case contributes to a better definition of morphological findings in sudden death related to Prader Willi Syndrome.

Prader Willi Syndrome, Sudden Cardiac Death, Histological Findings

G81 Pediatric Asthma Mortality in the Cook County Medical Examiner's Office, 1 to 14 Years: 1998 - 2002

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After attending this presentation, attendees will understand trends and patterns of pediatric asthma death and how to diagnose pediatric asthma at an early age.

The management of pediatric asthma should take optimal treatment with current therapies and continued public education for available care. Asthma mortality can be reversed.

The purpose of this presentation is to provide pediatric asthma death data between 1 and 14 years of age in the Cook County Medical Examiner's cases. This report has the following goals: 1. To describe trends and patterns of pediatric asthma death. 2. To identify the prevalence of risk factors. 3. To understand how to diagnose of the condition in children younger than 5 years of age. We examined case records of the Cook County Medical Examiner's Office (CCMEO) over the five year period from January 1, 1998 through December 31, 2002. The number of deaths investigated by CCMEO between 1 to 14 years of age totaled 42 cases in the five year period. Twenty-two cases involved males and twenty involved females. Blacks were predominate in 79% (33/42) of the cases. The highest incident occurred at the age of 10. This report highlights pediatric asthma mortality in an early age. Three cases involved under 2 years of age. Asthma is a chronic inflammatory disease of the airways clinically characterized by recurrent episodes of wheezing, breathlessness, and chest tightness. It is associated with variable airflow limitation that is at least partly reversible, either spontaneously or with treatment. In recent years, the prevalence and severity of asthma is noted to be increasing. In the United States, current estimates indicate that the number of children with asthma has increased by about 100% in the past 20 years. Between 1980 and 1995, the number of U.S. children with asthma rose from 2.3 million to 5.5 million, and this rise now seems continuing. The number of deaths from asthma increased gradually during 1980 to 1995, from 2891 to 5637 in all ages and from 94 to 185 in ages 0 to 14. Although without certainty, data for 1996-1998 indicate that mortality rates are starting to plateau or decrease. Asthma is a worldwide problem. The prevalence of asthma in adults is between 5% and 10% in the industrialized countries, and about 10% of these patients have a severe disease that is not optimally treated with currently available therapies. One-third of asthmatics are pediatric asthma. Asthma runs in families and has heritability. The hallmark in its pathogenesis is the development of chronic airway inflammation leading to bronchial hyper-responsiveness and airway remodeling. Exposure to inhalant allergen results in inflammatory mediators. The principal effector cells are eosinophils, mast cells and others. Diagnosis of pediatric asthma relies on a combination of meticulous history and the objective evidence of airway liability.

Pediatric Asthma, Mortality, Diagnosis

G82 Fatal Accidental Intravascular Injection of Air in Infants

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After attending this presentation, attendees will have reviewed cases of fatal accidental intravascular injection of air in infants. The importance of a thorough scene investigation, review of medical records, and complete postmortem examination in sudden death will be highlighted – even those occurring in the hospital.

This presentation will remind the forensic pathologist to consider this type of event in sudden death of hospitalized infants.

Air embolism may be difficult to diagnose in any age group. A review of the literature indicates that air embolism in infants may occur as a complication of ventilator therapy in hyaline membrane disease, during neurosurgical procedures, and as a complication of nasal continuous positive airway pressure (CPAP). To our knowledge, there are no reported cases of fatal accidental intravascular injection of air in infants. We report three such cases.

Case 1: A 29-week estimated gestational age baby boy was admitted to the neonatal intensive care unit (NICU) with a diagnosis of prematurity. At eleven hours of age he suffered a cardiac arrest. A chest radiograph during the unsuccessful resuscitation effort was suggestive of intracardiac and portal air. The nurse stated that she had mistakenly injected 10 ml of air into the arterial line as she attempted to "clear" the nasogatric gavage tube. A postmortem examination revealed intracardiac and intravascular air.

Case 2: A 30-day-old, former premature infant boy was admitted for observation for difficulty breathing. Shortly after the placement of an IV line, he developed facial cyanosis followed by respiratory arrest and a full code, from which he could not be resuscitated. Postmortem examination revealed no cause of death. Following up on information obtained through unsolicited telephone calls to the OCME, additional historical information obtained via deposition indicated that the intravenous (IV) line tubing had not been flushed prior to initiating the IV line. An "air bubble" was subsequently noted in the tubing, and the tubing was flushed. Immediately after re-initiation of IV fluids through the flushed line, the baby decompensated and died. The autopsy findings, historical information, and temporal sequence of events were consistent with death arising from an air embolus introduced through the IV tubing.

Case 3: A 31 week gestational age infant boy was admitted to the NICU for prematurity. At 43 days of age, in a time sequence shortly after receiving a "routine" replacement transfusion of red blood cells and a scheduled gavage feeding, the baby suffered an acute decompensation, with bradycardia and abdominal distension. Chest radiographs performed during the code revealed massive intracardiac air. An autopsy provided no significant, potentially lethal, pathologic process. The clinical presentation, radiographic findings, and pathologic findings were consistent with an exogenous source of air being introduced into the vascular system. The exact source of the exogenous air has not been clearly elucidated to date.

Air embolism presents a diagnostic challenge in adults, and is even more difficult to diagnose in infants. A thorough review of case information including specific nursing activities around the time of decompensation may suggest air embolism as a possibility. Review of radiographs taken during resuscitation may document the air embolus. Extensive follow-up may elucidate possible sources of exogenous air. These cases highlight the importance of a thorough scene investigation, review of medical records, and complete postmortem examination in sudden death – even those occurring in the hospital.

Air Embolus, Infants, Accident

G83 Lucid Interval Revisited: Delayed Onset of Unconsciousness in an Impacted Child

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After attending this presentation, attendees will understand the timing of inflicted childhood head trauma, depending on the mechanisms, and clarification and definition of the term "lucid interval."

The impact of the mechanisms of injury, interplay of the primary and secondary cerebral injury and age of the injured child on the timing of injuries.

The timing of injuries and existence of a lucid interval in non-accidental head trauma are among the most controversial issues in child abuse investigation. These issues are of paramount importance when it comes to prosecuting certain individuals who cared for the child. The current, widely held belief is that if the injured child becomes unresponsive while cared for by a certain individual then that particular caretaker must invariably be the perpetrator. This tenet, although recently challenged, is still being equally applied to impacted and "shaken baby" cases. In the present case report we discuss and correlate investigative information and court testimonies with autopsy findings in an impacted five-week-old infant. Our emphasis is on the importance of distinguishing different mechanisms of injury as well as the significance of primary and secondary cerebral injury, which have considerable impact on the clinical presentation and pathological findings in child abuse cases.

Non-Accidental Head Trauma, Craniocerebral Injuries, Subdural Hemorrhage

H1 Skeletons in the Medical Examiner's Closet: Realities and Merits of Investigating Human Skeletal Remains Undergoing Long Term Curation in the Medical Examiner's Office

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The goal of this presentation is to illustrate the scientific and educational value of studying the "cold" case in forensic anthropology.

This presentation will impact the forensic community and/or humanity by encouraging qualified forensic anthropologists to inventory and study (in some cases, restudy) "cold" cases undergoing long-term curation in Medical Examiner's offices or other such facilities.

Miscellaneous collections of forensically significant unidentified human skeletal remains are commonly curated over a substantial period of time in Medical Examiner's offices and other such facilities across the nation. Many of these are considered "cold" cases due to the absence of significant leads in these cases in several years. Others may be donated or unclaimed remains or those transferred from other facilities (e.g., Sheriff's offices, Police department closets). It is paradoxical that while the general public may perceive these cases as intriguing (with considerable potential for being "solved"), many professionals may see them as scientifically uninformative due to the inherent problems plaguing them. These problems often include an absence of contextual information concerning the derivation of the remains. It may not be known when, where, or even under what circumstances the remains were found, for example. In addition, key evidence may have deteriorated or been compromised in the intervening years—witnesses, relatives, and perpetrators may no longer be available, and linking evidence between each of these lost. Finally, the longer the period of curation, the greater the effect of physical deterioration on the remains themselves; there is also a greater chance of compromising their remaining contextual integrity.

Given these limitations, it is not surprising that these cases may be treated as lower priority. While it is true that the odds of resolving many of these older cases are significantly lower than more recent ones, the value of these "cold" cases is more subtle and far-reaching.

The objective of this presentation is the documentation of both national and regional difficulties and benefits of inventorying and studying these types of cases. The prevalence of these "cold" cases as well as their status is assessed nationally through a cross-sectional survey of medical examiners and forensic anthropologists across the country. On a regional level, the Virginia State Office of the Chief Medical Examiner, Western District, in Roanoke, Virginia, serves as a model for the kinds of cases which may be present in other such facilities. A survey of the collections housed within this office reveals a wide range of case types, histories, and degrees of contextual integrity. Systematic study of these cases over the past four years has resulted in the compilation of data with significant scientific and educational merit in at least three ways. First, forensic case reports (detailing basic vital statistical information for each case) have been completed and placed on file at the Roanoke Medical Examiner's office for future reference in the event that these cases become active again. This can, in fact, stimulate renewed interest and investigation of these cases. Second, these cases have scientific research value in that they expand the known range of human skeletal variation—they represent males and females of diverse ages, races, and pathological states and as such may aid the development and testing of new methods of forensic skeletal analysis and the validation of existing ones. Intensive study of the antemortem and perimortem pathologies which are manifested on these cases (including trauma and anomalies) give insight into the identification and differentiation of these conditions as well as the processes responsible for them. Likewise, observation of postdepositional effects on these remains enhances our understanding of the taphonomic pathways which they and other skeletonized remains endure. Finally, a third benefit derived from these cases is in the realm of education. These bones have been used as "practice" forensic cases for students enrolled in osteology and forensic anthropology courses at Radford University and can be an invaluable hands-on teaching tool for the young forensic scientist seeking to gain on-the-job experience. In sum, the oft-abandoned "cold" curated forensic case has much to offer in terms of its educational and scientific value and warrants further investigation.

Forensic Anthropology, Cold Cases, Education

H2 Nonmetric Characteristics of the Skull for Determining Race in Blacks and Whites

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This presentation has two objectives: to demonstrate the reliability of nonmetric morphological observations of the human skull for race attribution; and to illustrate secular trends found in frequency differences between the temporally divergent samples.

The results of this study are useful for forensic anthropology by showing the relative reliability of seven nonmetric traits used for attribution of race in the skull. A forensic anthropologist often uses nonmetric morphological characteristics for race assessment in the field. This study confirms that this method is still applicable. The results of this study should also be of interest to bioanthropologists by the resulting quantification of morphological change in the facial and cranial form due to secular trends.

Physical anthropologists have used morphological traits in the cranium, dentition, and mandible as a means of assessing race from the skull. Variance in reliability of these nonmetric traits are thought to be due to social and genetic group change, making racial identification much more difficult in modern cases. But does admixture inhibit nonmetric morphological characteristics as a means for identifying race in the skeleton? An evaluation of a group of these traits and influences from secular change in these traits needs to be determined.

Three different temporal samples were evaluated from collections at the Smithsonian Institution, totaling 324 crania. Morphological criteria were assessed from Hooton's 1949 "Harvard List" and Gill's 1986 Craniofacial Criteria in Forensic Race Identification, and seven traits were selected. Six assess facial features and one describes braincase form. The facial region was emphasized because previous research has shown this region to be the most accurate for race attribution.

The Terry Collection was initially used (100 Blacks and 107 Whites) to test the nonmetric criteria for accuracy and repeatability. Reliability testing of the traits was conducted using two sets of 25 crania blindly selected from the Terry Collection evaluated by the author and a second test independently evaluated by an intern. Each test obtained 84% accuracy in correctly attributing race from the cranium. These results indicate the reliability of these traits to attribute biological race without significant inter-observer error.

Four American Colonial sites were then evaluated: The Armor and Drummond Harris Sites, Governor's Landing, Virginia (nine Whites); Cliffs Plantation, Westmoreland County, Virginia (nine Blacks, five Whites); Catoctin Furnace, Thurmont, Maryland (nine Blacks) and a Colonial Cemetery from Deep River, Maryland (one Black, three Whites). An assortment of West African and Caribbean crania from the collections were also selected in order to obtain an originating "African" population from which to compare and assess admixture to later American Black groups.

Results from the research found that the Terry Blacks exhibited typical Negroid characteristics in orbital shape (oblong), nasal bridge (wide 50% of the sample), cranial form (long, 65% of the sample), nasal spine (small, 46% of the sample), and nasal sill (dull to no sill for 84% of the population). Alveolar prognathism was not a strong characteristic in the Black population with only 32.5% having pronounced and 38.6% having slight prognathism. Total nasal form was also not as expected, with only 44% having a broad nasal form.

Whites in the Terry Collection, exhibited strong typical Caucasoid characteristics for each of the traits. There was no alveolar prognathism, the orbits were rhomboid with a narrow nasal bridge large nasal spine and sharp nasal sill, the total nasal from being narrow and cranial form is high. Terry Whites also tended to exhibit a much more prominent chin than Blacks as well as greater brow ridging in the medial orbital region than Blacks. This most likely due to the pinched nasal bridge morphology.

Race attribution accuracy in the Terry Collection overall identified Blacks at 90% while Whites were correctly classified at 94.4%. When divided sex, Black females yielded 90% correct, White females yielded 88% accuracy and White males had 100% accuracy while Black males were lower at 90% correct.

The American Colonial Blacks displayed higher frequencies for alveolar prognathism, wide nasal bridge, long cranial form, insipient nasal spine, lack of nasal sill, and total nasal form. As such, this group presents more strongly "typical" Negroid features than the Terry Blacks. Orbital shape was exactly 50/50, indicating that this trait is not as useful as a racial criterion for this group. The White Colonial population was decidedly more difficult to identify. Colonial Whites tend to have elongated crania, which make their faces appear more rectangular. This gives the suggestion of African origins. Subsequently, accuracy for the Colonial Whites was only 50% while for the Colonial Blacks it was 100%.

The African and Caribbean skeletal material overall gave the strongest typical Negroid results, as was expected. Alveolar prognathism was clearly present, along with a wide nasal bridge, long cranial form, small to absent nasal spine, absent to dull nasal sill, and a broad nasal form. As was found before, orbital shape was not a distinctive feature.

Frequency comparisons of the three sample clearly show differences in facial form between these groups, illustrating the secular trends present due to significant admixture in the American Black sample, especially after the American Civil War. The Terry Blacks displays morphological form that is much more intermediate to the frequencies in the Colonial Blacks and certainly divergent from the frequencies of the African Blacks. Conversely, the American Terry Whites are not as distinctly different from their temporally earlier counterparts, other than in facial height, as discussed above.

Nonmetric Traits, Race Attribution, Cranial Morphology

H3 3-Dimensional Morphometric Analysis of the Zygomatic as Used in Ancestral Identification

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This poster will demonstrate a technique which in capturing the form of a craniofacial trait, lends increased accuracy to ancestry assessment.

This presentation will impact the forensic community and/or humanity by serving to increase scientific knowledge of new technologies and methods available to the forensic community that augment traditional methods and may ultimately increase precision in human identification. Ancestral identification, although often shrouded in controversy, continues to be an integral component of the biological profile. By adopting new technologies and methods, forensic scientists enhance their likelihood of successfully identifying unknown individuals.

The purpose of this poster is to investigate the potential of 3-D geometric morphometric landmark data to determine ancestry using the zygomatic region of the skull.

The determination of ancestry is often a critical component in the forensic identification of human skeletal remains. Ancestral classification is usually measured by examining a suite of metric and non-metric traits whose grouping tendencies have been extensively researched. For example, traditional metric morphological measurements have shown that ancestry can be determined from the skull 85-90 percent of the time (Krogman & Iscan 1986:296; Sauer 1992). However, an overwhelming number of these traits are non-metric in nature and cannot be measured with traditional osteological tools (Rhine 1990). The ability to predict the ancestral group or groups with which an individual is associated is based solely on the observer's experience. While many non-metric traits are recorded as present or absent (e.g., inion hook, metopic suture, wormian bones, etc.), others leave a tremendous amount of room for interpretation and, consequently, observer error. While traditional methods of ancestral analysis have proven their usefulness in forensic identification, new technologies are providing the opportunity to reevaluate current methods and create new techniques for analysis, like geometric morphometrics, which should help forensic and physical anthropologists to increase the accuracy of their results.

Over the past 20 years, the frequency of geometric morphometric studies has increased in physical anthropology. The applicability of such studies is now being explored by individuals in the field of forensics (e.g., Ousley 2003). Geometric morphometrics, the study of biological size and shape variation, is based on the analysis of 3-D coordinate data of anatomical landmarks (Bookstein 1991). These studies have increased precision and control error in the interpretation of biological data over those using traditional metric measurements. The coordinate data of geometric morphometric analyses, in particular, use the relationships between the landmarks to give a more comprehensive depiction of an object. Landmarks must be clearly defined and be able to be reproduced with certain accuracy by different observers. While many of these correspond with accepted anatomical landmarks like ectoconchion, zygion, and jugale, they often do not give the most complete picture of the object being studied. However, additional craniometric landmarks can be designed to complete this gap and better represent the form of the trait being studied.

This study examines the geometric morphological form of the zygomatic since it is a bone of particular interest to those attempting to identify ancestry of an individual. According to Rhine (1990), the angle of the zygomatic, in relation to the entire craniofacial region, can vary between Caucasoid (retreating), Mongoloid (projecting), and Negroid (vertical) skulls. The distinction between these populations is often made by placing a pencil across the nasal aperture and by attempting to insert a finger between the zygomatic and pencil in order to determine the angle (Bass 1995). While "eye balling" methods are beneficial in the field or for a quick assessment, there are times when more accurate methods are needed, especially in today's often hostile judicial climate.

The purpose of this pilot study was to transform a non-metric ancestral trait into a metric one by quantifying or 'metricizing' it. A Microscribe G2X 3-D digitizer was used to collect data from a variety of landmarks to help capture the size and shape of the zygomatic. The software package *Morphologika* (O'Higgins) helped with the visualization of form and the statistical analyses used to assess the variation of form within and between populations to isolate discriminating factors.

The sample was comprised of individuals of known origin, both male and female, representing each traditional ancestral group, Caucasoid, Mongoloid, and Negroid. The preliminary results confirm the distinctiveness of the zygomatic region yet also reveal interesting patterns of variation within each of these traditional ancestral groups.

This study serves to increase scientific knowledge of new technologies and methods available to forensic anthropology that augment traditional osteological methods and may ultimately increase precision in human identification. Ancestral identification, although often shrouded in controversy, continues to be an integral component of the biological profile. By adopting new technologies and methods, forensic anthropologists enhance their likelihood of successfully identifying unknown individuals.

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Ancestry, 3D Geometric Morphometrics, Human Identification

H4 Sex Determination of Infants and Juveniles From the Clavicle

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The goal of this presentation is to present the forensic community with rates of accuracy obtained by using the clavicle to sex sub-adults from a modern sample.

This presentation will impact the forensic community and/or humanity by directing attention to an underutilized skeletal element that may have potential in sexing subadults.

This poster will give the results of a test of the clavicle's accuracy in determining sex in subadults. This study was conducted because of the difficulty of accurately sexing subadult skeletons. Much of the research done up to this point focuses on the pelvis and the teeth. Unfortunately, the number of studies done on subadult sexing is somewhat sparse, largely due to a lack of sizable skeletal samples of known sex and age.

The present study uses a modern autopsy sample of infant and juvenile clavicles housed at the University of Tennessee in Knoxville. The McCormick clavicles were collected between 1986 and 1997 by Dr. William F. McCormick from individuals of known sex, age and ancestry. The sample available for this study consists of mainly Caucasian children, and, consequently, the results presented here should not be generalized to all ethnic backgrounds. Furthermore, there were no children between the ages of four and six from which data could be obtained. Future research and the inclusion of additional samples will eliminate this gap.

The sample consists of 86 individuals: 36 females and 50 males. The left clavicle was absent in seven individuals, but all others had both clavicles. For purposes of statistical analysis, the sample was divided into infants (0-3 years) and juveniles (7-17 years). Statistical analysis was done with SAS version 8.2. Three measurements were taken from each clavicle: (1) maximum length, (2) sagittal diameter at midshaft, and (3) vertical diameter at midshaft. Separate accuracy rates were obtained for each measurement.

Maximum length of the clavicle yielded accuracy rates of about 62% for both age groups and sexes: infant females=62%; infant males=59%; juvenile females=62%; juvenile males=63%. Vertical diameter at midshaft gave slightly better rates overall: infant females=60%; infant males=63%; juvenile females=69%; juvenile males=73%. The results for sagittal diameter at midshaft differed vastly between age groups: infant females=51%; infant males=53%; juvenile females=85%; juvenile males=77%.

The best rate obtained for the infant group was 63%, which suggests that, although the clavicle is sexually dimorphic at birth (or even before then), it is not a reliable indicator of sex in infants for forensic or archaeological purposes. Likewise, maximum length is not a reliable indicator of sex in juveniles. However, the measures of diameter proved fairly reliable for sex determination in juveniles (69-85%).

These results suggest that measures of robusticity may be more sexually dimorphic in juveniles than measures of length. Indeed, in an 1998 American Journal of Physical Anthropology article titled Growth Patterns in the Modern Human Skeleton (105(1):57-72), Humphrey states that sexual dimorphism in long bone length is attained at adolescence, whereas sexual dimorphism in long bone diameters develops between birth and five years. Specifically, Humphrey maintains that sexual differences in all dimensions of the clavicle are already present at birth. The present research suggests that sexual dimorphism in long bone diameter is greater in the juvenile group than in infants. These results warrant further investigation into this area, and the authors are working to increase the sample size and eliminate the information gap for 4-6-year-old children.

Sexing, Sub-Adults, Clavicle

H5 Sexual Dimorphism in the Distal Humerus

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This presentation provides the results of a metric analysis of six measurements on the distal humerus to determine their accuracy in discriminating the sex of the individual. The results indicate the most accurate measurements to be the articular width and biepicondylar width.

This presentation will impact the forensic community and/or humanity by showing that the distal left humerus can provide an alternative to sex identification in a forensic setting when other elements are missing. Occupational stress or habitual stress on the elbow may be the influential variable affecting the accuracy of some of the measurements for sex identification. This can be seen in the disparity of the articular width versus the biepicondylar width measurement results. Further refinement in measuring techniques of the distal humerus may provide better quantification of the sexual dimorphism in this bone.

Fragmentary remains in a forensic setting often do not include the most obvious elements used to measure or make morphological assessment of the sex for the individual. With the exclusion of elements such as the cranium, pelvis, or femora, sex identification becomes increasingly difficult to undertake. This becomes even more difficult when only isolated bones or partial remains are found. To assist in the determination of sex from fragmentary remains, this study focuses on

measurements of the distal humerus to evaluate the differences present in this morphology by statistical means. The object of this study is to identify metric differentiation between males and females in a modern population for use in determining sex from the distal humerus.

This study evaluated 268 adult left humerii from 141 males and 127 females from the Robert J. Terry Anatomical Collection. Humerii exhibiting abnormalities, severe arthritic wear, and fragmentation were excluded from this study. Elements were randomly chosen to avoid any selection biasing. However, equal numbers of Blacks and Whites and males and females were obtained from the collection to provide balanced sample sets for statistical comparison. Morgue records of the individuals in the Terry Collection were utilized to obtain reported cause of death, age, sex, and race.

Discriminant analysis was applied to assess the metric variables' ability to accurately assign sex using SYSTAT 10.2 software. Variables were analyzed independently and their accuracy determined. The two variables with highest ability to attribute sex were then combined to test for their ability as a combined set. All six measurements were also analyzed as one combined set with the races pooled, the only discretionary variable being between males and females, since race cannot be identified in fragmentary remains.

From the results of the statistical analysis, the combined six variable set provided a total correct sex attribution rate of 94%, with a 97% accuracy rating in the females (120 females correctly classified, 4 females misclassified) and the male sample producing a 91% accuracy rate (128 males accurately classified, 13 males misclassified). The two most valuable independent variables for sex attribution were articular width, with a total accuracy of 93% (97% correct for females and 89% for males) and biepicondylar width, correctly identifying sex at 85% correct (86% for females and 85% for males). These two measurements combined had a total accuracy rating of 93%, correctly classifying 120 females and misclassifying 4 females (97%) and 127 males were classified correctly with 14 males misclassified (90%).

Either articular width or biepicondylar width can be used independently as a defining measurement to accurately attribute sex to an individual. The combination of the two measurements provides a high degree of accuracy in determining sex. Articular width is the most reliable single measurement to correctly sex individuals. These few measurements can prove valuable when uncovering partial remains and can consequently give possible evidence to determine the identity of the individual.

The results of this investigation have shown that the distal left humerus can provide an alternative to sex identification in a forensic setting where other elements, such as the pelvis and cranium, are missing. Occupational stress or habitual stress on the elbow may be the influential variable affecting the accuracy of some of the measurements for sex identification. This can be seen in the disparity of the articular width versus the biepicondylar width measurement results. Further refinement in measuring techniques of the distal humerus may provide better quantification of the sexual dimorphism in this bone. Additional studies should also be conducted to substantiate this study's results.

Humerus, Forensic Anthropology, Sexual Dimorphism

H6 Sex vs. Gender: Does it Really Matter?

Frank P. Saul, PhD and Julie M. Saul, BA, Consultants, Lucas County Coroner's Office and Wayne County Medical Examiner's Office, 3518 East Lincolnshire Boulevard, Toledo, OH 43-1203*

After viewing this presentation, participants should have a better understanding of the terms "sex" and "gender" and the practical and research implications of their usage.

In these days of increasing awareness, if not increasing frequency, of unintentional as well as intentional cross dressing and similar practices, it is increasingly important to maintain the distinction between the terms "sex" (biologic identity) and "gender" (social identity). The authors believe that it is potentially confusing to refer to "gender identification of dried blood stains" as has occurred in the *Journal of Forensic Sciences*. The individual whose biological remains are one sex may have been "passing" as the other.

Walker and Cook (1999), speaking primarily to anthropologists, eloquently expressed their concern about the increasing use of the terms sex and gender as synonyms. They reviewed the usage and etymology of the two terms, but basically, sex refers to an individual's biologic identity and gender refers to an individuals social identity (which may, or may not, coincide with that individuals sex or biologic identity). Sex is determined by the presence or absence of the Y chromosome but gender may be assumed or chosen by the individual.

One of the most interesting examples of gender assumption may be found in the Sioux Indians of the past in the American Great Plains. The Sioux epitomized the stereotypical Indian warrior on horseback who sought out hand-to-hand combat with the enemy. Less well known is the fact that Sioux culture made provision for males who did not wish to become warriors to declare instead that they were berdaches and assume female gender clothing and roles such as food preparation and camp chores. Apparently they did this without stigmatization and homosexual orientation was not necessarily involved.

History also records individual females who donned male clothing so that they could assume a male gender role and serve as soldiers during the American Civil and other past wars.

In an otherwise excellent text, Steele and Bramblett (1988) matter of factly (and with no explanation) refer to "The Estimation of Gender" and continue to do so in contexts where the term sex had previously been used in similar publications.

However, the seemingly academic distinction between sex and gender has profound significance for both archaeological and forensic applications of osteological analysis.

The authors were unaware of the extent of the problem until several years ago when they were asked to assist a graduate student about to undertake archaeologic field research on gender as revealed by cultural associations and context in ancient Maya burials (Geller 1998). It was at that time that they learned how influential (and obfuscating) Steele and Bramblett's text had been in helping to train a generation or so of anthropologists.

In addition, a number of presumably well-meaning non-anthropologists apparently have come to believe that gender is a more politically correct way of referring to sex and this inappropriate term now shows up on official forms and in similar contexts. (For a discussion of some of the ramifications of this usage, see Jennifer Mather Saul (2003)).

The authors' research on the ancient Maya involves assigning male or female sex to skeletons using standards based preferably on the proportions and contours of the human pelvis, which has been designed by natural selection for successful birthing in females. As indicated above, some of their archaeologist colleagues are attempting to learn about the gender/sociocultural roles played by these individuals in life, using the artifacts/grave goods encountered within the burial. Some of the artifacts used to denote female gender/roles include the problematic spindle whorls that appear to be associated with weaving. Unfortunately, when skeletal remains are fragmentary and pelvic sex indicators have not been available (and in some instances even when appropriate pelvic remains were available) assumptions of biologic sex of burials have been made using such artifacts, or, even more misleading - the dictum that only males are buried in tombs. The authors have previously demonstrated the fallacy of the latter at Altar de Sacrificios (1972) and Rio Azul (2000) using pelvic remains that indicated the occupants were females. In fact, both females within the Altar tomb also possessed the pre-auricular sulci that denote the changes that occur in late pregnancy due to the release of the hormone relaxin.

Fortunately, mistakes have been avoided in their forensic practices at the Wayne County Medical Examiners Office (WCMEO) in Detroit,

Michigan, and the Lucas County Coroners Office (LCCO) in Toledo, Ohio, by proceeding cautiously. It is always tempting to use clothing to jump to conclusions when confronted with otherwise immediately unidentifiable remains, but obviously clothing (and jewelry) are transferable and should not be used for sexing or positive identifications. A recent WCMEO case involved the mostly skeletonized remains of a probable black child. The authors' biographic profile estimated the age at 4-6 years and although they are always hesitant to sex an immature individual they noted: Sex Uncertain, but *possibly* male based on the left ilium and mandible. An accompanying T-ball league T-shirt later led to a girls T-ball team and a young female whose black father had passed her outgrown shirt on to a male relative who passed it on to his 5-year-old son, who turned out to be the victim in this case.

In an LCCO case, as reported in the first news broadcasts, involved the discovery of an apparent black female at the foot of the stairs in the home of an apparently missing white male golf professional. The apparent black female was fully clothed in a dramatic dress, jewelry, hose and high heels and wrapped from head to ankles in a plastic bag and duct tape. Wisely, the deputy coroner did not jump to conclusions and the careful unwrapping of the mummy revealed a sad case of death by accidental sexual asphyxiation of a white male.

Additional examples to be presented include brightly painted toenails on a male airplane crash victim who had attended a bachelor party the night before and similar cautionary cases of potential sex/gender confusion.

Walker PL, Cook D. Brief communication: gender and sex: vive la difference. Amer J Physical Anthrop, 1998;106:255-9.

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Sex vs. Gender, Social Identity, Biologic Identity

H7 Age at Death Determination Using the Skeletal Histomorphometry of the Third Metacarpal and Third Metatarsal From Autopsy and Cadaver Samples

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The goal of this presentation is to present to the forensic community a new method to aid in age at death determination using the microanatomy of the third metacarpal and third metatarsal bones of the human skeleton.

This presentation will impact the forensic community and/or humanity by demonstrating a new method for age approximation using bone histology of the third metacarpal and third metatarsal bones of the human skeleton.

The metatarsal and metacarpal bones have not been examined histologically to determine the possible significance between skeletal age and actual age at death. Our hypothesis is that human cortical bone of the third metacarpal and third metatarsal yields statistically significant results that correlate with documented age, based on the cumulative microscopic age changes of bone. The aim of this ongoing research is to contribute to the growing body of methodologies used for histological aging determination and identification of skeletal material in a forensic context.

Autopsy samples were obtained through signed consent release from the Texas Tech University Health Sciences Center, Division of Forensic Pathology, Lubbock County Medical Examiner's Office. Bone samples were also acquired from cadavers available from the Texas Tech University Health Sciences Center, Department of Anatomy. For each sample, information on the individual's age, sex, height, weight, health conditions prior to death, and cause of death were collected. The documented ages for our 50 samples range from 19 to 93 years of age at death. The histomorphometric analysis involves preparing thin sections of the mid-shaft of the left third metacarpal and left third metatarsal as complete cross-sections. A number of factors were examined at the microscopic level; specifically, we focused on intact and fragmentary secondary osteon counts per mm^2 for the entire cortical cross-section of each bone. The data are then used to produce age-predicting regression formulas. This procedure follows closely to suggestions made by Stout & Paine (1992).

With incomplete fragmentary remains, microscopy of these bones may be one of the only means of age approximation. Based on the concluding statistical significance, age-predicting equations developed for the metacarpal, metatarsal, and for a combination of both bones can be used in conjunction with, or in lieu of, other age determination methods.

Stout SD, Paine RR. Breif communication: Histological age estimation using rib and clavicle. *Amer J Physical Anthrop*, 1992:87(1):111-5.

Bone Histology, Age Determination, Forensic Anthropology

H8 The Effects of Size in Craniometric Discriminant Functions

Franklin Damann, MA and John E. Byrd, PhD, Joint POW/MIA Accounting Central Identification Laboratory, 310 Worchester Avenue, Hickam AFB, HI 96853*

After attending this presentation, attendees will be able to recognize of the effects of size in craniometric discriminant functions designed for sex determination. An approach is recommended that mediates size effects.

This presentation should lead to an improved understanding of the discriminant function, and its use for sex determination of skeletal remains. The presentation offers an alternative approach to sex determination when the case involves large females or small males.

Forensic anthropologists have been employing discriminant functions to classify crania for decades. The classic papers by Giles and Elliot provided numerous functions that permitted anthropologists to address questions of population affinity (i.e., race) and sex using cranial measurements. The discriminant function approach was attractive because it enjoyed error rates similar to those of experienced anthropologists rendering subjective judgements, but was clearly more objective. More recent years have seen the development of the software package FORDISC (Ousley and Jantz 1996), which uses reference data from numerous human populations to calculate custom discriminant functions suited to a specific case. This study explores the effects of size on discriminant functions designed to determine the sex of a specific cranium. When presented with a case specimen from an apparent male who was of relatively small size, the authors subjected the 16 cranial measurements from the case specimen to a discriminant analysis in FORDISC, which indicated that the individual was female. We hypothesized that

this result was due to the small size of the cranium. To address our hypothesis, we calculated C-scores (Howells 1995) for the 16 measurements using the craniometric data in FORDISC (black and white, males and females) and calculated a new discriminant function. The new function classified the individual as male, but not convincingly, as the discriminant score was close to the sectioning point. Finally, we selected a set of 6 measurements that contributed strongly to the first C-score discriminant function, and calculated a second function based on these. This second function classified the case specimen unequivocally as male. This study highlights the fact that discriminant functions derived for sex determination and based on raw measurements will key on the size differences between males and females. Thus, large females and small males will systematically misclassify. For cases where such circumstances are suspected, we recommend the calculation of functions based on C-scores as an alternative approach.

Craniometrics, Discriminant Functions, Sex

H9 A Tale of Two Museums: Available Fetal Collections at the National Museum of Natural History and the Albert Szent-Gyorgi Medical University, Hungary

Angie K. Huxley, MA, PhD, PO Box 493812, Redding, CA 96049-3812*

The purpose of this presentation is to inform the forensic science community of the two fetal collections worldwide available for research – the fetal collections at the NMNH, Washington D.C., U.S.A., and the Hungarian collection at the Albert Szent-Gyorgi Medical University, in Szeged, Hungary. The biological profiles of the collections will be discussed, the nature of the collection process will be compared, and the inherent limitations of the reviewed.

This presentation will impact the forensic community and/or humanity by allowing for a rare opportunity to study fetal materials that are not readily available elsewhere. While there are inherent limitations involved in using museum collections, as the materials may be pathological, anomalous or unwanted, the fact that there are no other collections available necessitates their usage. Such data may be useful to develop fetal profiles for forensic cases, and thus determine fetal viability.

Forensic fetal remains are occasionally submitted to the Office of the Medical Examiner for age determination, as well as possibility of fetal viability. There are few references on forensic fetal osteology, and there are fewer collections available for research. These fetal collections are located the at the National Museum of Natural History (NMNH), in Washington D.C.,, U.S.A., and the Albert Szent Gyorgi Medical University in Szeged, Hungary, Eastern Europe. The primary objective of this presentation is to inform the forensic anthropologists of the two fetal collections, the composition of the collections, the nature of the collection process, and the inherent limitations of these materials.

The fetal collections at the NMNH were collected in the early 1900s by organizations and private physicians. The collection consists of 271 fetuses, of which 120 are white and 151 and black, mixed or "mulatto." These represent 119 males and 94 females between the ages of three lunar months and newborns. The card catalog may provide limited information on ancestry, phenotypic sex or even age. The materials were obtained from private physicians or during autopsy, then donated the NMNH through Dr. Hrdlicka. Since most of the collection represents spontaneous abortions, the collection is probably biased towards anomalous or pathological materials.

The Hungarian remains were collected after WWII to present. The materials collected immediately after WWII may represent illegally aborted fetuses, as abortion was outlawed in the country after the war. The fetuses collected thereafter may represent spontaneously aborted fetuses, or maternal/fetal demise that were submitted the pathologists in the area. These materials were collected, macerated and measured. The morphometric data were published in "Forensic Fetal Osteology" (1978) by Fazekas and Kosa. The collection is composed of 138 skeletons, composed of 71 males and 67 females between the ages of three lunar months and full-term newborns. All of the fetuses are of Eastern European descent. Autopsy records are available on all fetuses, however lunar age may not always be available. Indeed, on would have to pull all of the autopsy records to record which of the fetuses are of known lunar age, and which fetuses had lunar age calculated through Haase's rule.

The two collections are different in terms of their biological profiles. The NMNH collection was collected approximately 100 years ago, and are composed of black, white and mixed fetuses. The ages were given my other mother, or were assigned by the pathologist Yet, there are no other known black fetal materials available for research. In contrast, the Hungarian collection represent a more homogenous population although there are be some fetuses of minority descent intermixed in this material.

Anthropology, Museum, Fetus

H10 Skeletal Markers of Parturition: Analysis of a Modern American Sample

Jonathan D. Bethard, BA, University of Tennessee, 250 South Stadium Hall, Knoxville, TN 37916*

This presentation examines morphological markers of parturition on the bony pelvis. The research presented in this poster tested markers of parturition against known obstetric histories. Preliminary results indicate that workers should not infer parity status from the bony pelvis.

This presentation will impact the forensic community and/or humanity by describing preliminary results which indicate that physical anthropologists should not attempt to assess parity by scoring morphological markers of the bony pelvis.

The goal of this research was to examine the relationship between parturition and morphological changes exhibited in the bony pelvis.

Physical anthropologists and bioarchaeologists are often charged with the task of generating biological profiles from skeletal remains. A particular area of interest within skeletal biology has looked at the effects of parturition on the skeleton. Angel (1969) reported that the degree of pelvic scarring correlates with the number of offspring produced during fecund years. According to Krogman and Iscan (1986:248), "Angel initiated a new research avenue for skeletal anthropologists and indicated that parturition could be determined from skeletal remains."

A thorough literature review indicates that workers have maintained that both positive and negative correlations between parturition and morphological markers exist. Houghton (1974) scored the preauricular sulci of 119 pelves and was able to distinguish two distinct forms of the groove. Differentiated at GL or GP, Houghton remarked that the former designation was applied to innominates presenting a "narrow, short, straight-edged, and shallow groove at the antero-inferior margin of the joint." The latter description was applied to pelves with a coalescence of pits and craters. Houghton reasons that sulci scored GP are more likely associated with parturition than those scored GL. Moreover, the author contends that skeletal makers of parturition are more evident on the sacro-iliac joint than the pubic symphysis.

In an extensive study, Suchey et al. (1979), analyzed 486 pubic bones of modern American females. Suchey and colleagues studied dorsal pitting of the pubis in order to associate the number of full term pregnancies, interval since last pregnancy, and age of decedent with parturition condition. Adhering to methods defined in Stewart (1970), Suchey and colleagues were unable to statistically correlate parturition with specific skeletal markers. As a result, Suchey et al., assert "a rigid system of classification is of dubious value."

The William M. Bass Donated Skeletal Collection curated by the Forensic Anthropology Center at the University of Tennessee was utilized in this research. Female skeletons of known parity status (n=27) were scored for the degree of dorsal pitting of the pubis and morphological appearance of the preauricular sulcus. Pits on the dorsal pubis were scored as either absent, small to trace or well-marked (after Stewart 1970). Pubic bones scored as "absent" were unremarkable with regard to dorsal pitting while "trace to small" indicated the presence of poorly marked or shallow depressions. "Moderate to large" dorsal pits were a minimum of 5mm and noticeably deep. Preauricular sulci were scored similarly following Houghton (1974).

Statistical analyses tested the relationship between parity and scored morphological markers.Non-parametric chi-square analyses assessed the following associations: parity/dorsal pitting, parity/preauricular sulcus, age/dorsal pitting, age/preauricular sulcus and age/parity. Such analyses resulted in statistically insignificant results. Chi-square results were 2.03, 5.03, 39.6, 35.8 and 12.6, respectively. In all cases, $P>0.05$. P values ranged from .143 to .856 and clearly indicate an insignificant relationship between any suggested associations. These results indicate a poor correlation between parturition and skeletal change. Overall, this research further suggests that skeletal markers should not be used to assess parturition in paleodemographic or forensic contexts. While this notion may be counterintuitive, statistical analyses indicate an insignificant relationship.

Angel JL. The basis of paleodemography. *Am J Phys Anthropol* 1969; (30):425-438.

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Krogman WM, Iscan MY. *The Human Skeleton in Forensic Medicine*. 2nd ed. Springfield: Charles C. Thomas, 1986.

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Suchey, JM, Wiseley DV, Green RF, Noguchi TT. Analysis of dorsal pitting in the os pubis in an extensive sample of modern American females. *Am J Phys Anthropol* 1979; (51): 517-540.

Parturition, Physical Anthropology, Skeletal Biology

H11 Variation in Cremains Weight: Tennessee vs. Florida

William M. Bass, PhD, and Richard L. Jantz, PhD, University of Tennessee, Department of Anthropology, 250 South Stadium Hall, Knoxville, TN 37996-0720*

After attending this presentation, attendees will know that the weight of cremated human remains (cremains) exhibit considerable variation, and that weights derived from one sample cannot be extrapolated to other samples.

The presentation will emphasize to forensic anthropologists that cremation weights vary and that much more information is required if we are to understand the variation.

The weight of cremains is of interest in medico-legal situations where questions arise about whether commercial crematoria have returned appropriate remains to family members. We have only been able to identify one published study providing weights of cremated human remains on a statistically valid sample (Warren and Maples 1997), which reports weights from a Florida sample. Since cremains weight reflects bone mass, it is not unreasonable to expect that it will vary regionally, as other anthropometric features do.

A study of weights obtained from a commercial crematorium in East Tennessee was undertaken in order begin an investigation of variation in weight of cremated remains. Cremation was performed according to the standard procedure of the crematorium using standard equipment. Remains were weighed using an OHAUS digital scale, model CS5000, to the nearest gram. Age, sex and race were recorded, but body weight or other anthropometric information was unavailable. Since races other than white were uncommon, the analysis was limited to whites. The sample consists of 151 males and 155 females, ranging in age from 18 to 99.

Summary statistics for cremains weights in grams are:

Sex	Mean	S.D.
Males	3379.77	634.98
Females	2350.17	536.43

These weights are about 500 grams greater than those reported by Warren and Maples, a highly significant difference. We also found that cremains weight decreases with age; the decrease begins earlier and proceeds more rapidly in females than in males. Weight loss with age is related to bone loss in older individuals. The relationship with age does not explain the difference between the Florida and Tennessee samples. Tennessee cremains are heavier when age is controlled.

There are two possible explanations for the difference in cremains weights: 1) difference in cremation technique or 2) difference in bone mass. Unfortunately, the question cannot be answered definitively with evidence available. Cremation techniques are fairly standard so the difference is more likely due to bone mass. Since premortem height and weight are unavailable on the Tennessee sample, this possibility cannot be addressed directly. Regardless of the cause, the results reported here make it clear that there is substantial variation, and cremation weights from one sample cannot be extrapolated to other areas. Whether variation is patterned regionally is not known and the answer to this question must await additional information.

Warren MW, Maples WR. The anthropometry of commercial cremation. *J Forensic Sciences* 1997;42:417-423.

Cremation Weights, Bone Mass, Forensic Anthropology

H12 When DNA is Not Available Can We Still Identify People? Recommendations for Best Practice

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The learning objectives of this presentation are as follows. First, to understand the role played by traditional identification methods in cases of violations against International Humanitarian Law. Second, to show how a systematic process involving experts from different fields increases the chances of identifying war victims trough traditional methods.

This study makes an impact on the forensic community in general and in the forensic anthropology community in particular by providing an example on how a systematic approach to individual identification in cases of serious human rights violations can provide good results in the absence of sophisticated technology.

The application of DNA profiling to the identification of victims of mass disasters is considerably recent, but the use of such techniques to victims of war crimes and crimes against humanity is even more recent. While DNA technology has become more common and the prices of testing have substantially dropped, its use in large-scale projects is primarily dependent on the availability of resources and in turn of the will of political powers to fund such activities. Paradoxically in countries where large number of victims remain unidentified are those in which this kind of technology is not available, and if so only in a limited scale (i.e., Rwanda, Congo, Guatemala). In those same settings the use of "traditional" techniques is generally favored over other more technologically costly. Traditional techniques generally consist of combining witness testimony, personal effects and clothing, and anthropological and dental data in order to corroborate or to exclude the identity of an individual. This paper provides recommendation of best practice to

conduct identifications in settings with technological limitations. The sample consists of 95 cases from victims of the conflict in Kosovo between 1998-1999, in which positive presumptive identifications were generated and were later corroborated through DNA testing.

Generally overlooked in the individual identification of victims of any kind of armed conflict is the investigation on the "event of disappearance" that defines interactions between victim(s) and perpetrator(s) in a place and time. People simply do not "disappear." Forced disappearance is a well-planned practice designed to provoke anguish in the population and relatives of the missing person as well as a sense of relentless and of an unstoppable process. Understanding how people went missing (who took them, how many, in what were they taken, at what time, where were they seen going to) may help to establish their whereabouts. The reconstruction of the "event of disappearance" is crucial to determining the composition of the family target group to participate in the identification process.

Once the family target group is defined, the relatives are selected. A priority is given to next of kin relatives to the missing person. Friends and more distant relatives would participate at a later stage. An ante-mortem form is filled from each relevant relative prior to participating in the clothing exhibition.

The clothes of the victims are carefully washed and dried; preferably photographs of any personal effects are displayed separately from the clothes to which they were associated. The clothes are arranged on the floor, on some kind of tarpaulin or even colored surface, in a roughly anatomical position. Each family member or group of family members from one single missing person is accompanied to look at the display. One or two relatives are given latex gloves and a mask in case they may want to touch or feel the clothes or artifacts. No pressure is exerted over the relatives, they are allowed to take their time and observe the display. Once a recognition is made, the family is encouraged to see the artifacts if any. The family is not shown any specific set of artifacts or told which were the ones found with the clothing.

Once the identification of a person has been triggered, both the post-mortem and ante-mortem files of the person are pulled out and the family is taken to an interview area. The following people typically participate during the interview: one police officer specialized in identifications, one anthropologist, one dentist and one pathologist that remains on call for any specific information that may be required as well as to discuss with the team once the interview is finished. Each specialist asks questions separately. Initial questions concern the clothing and artifacts (make, materials used, whether it was purchased or home made, any anecdotal events associated to them). Subsequent questions concern the biological profile of the victim (age, sex, stature, ante-mortem injuries) and the teeth (the dentist expects some basic clues regarding basic features such as tooth rotations, extractions, prostheses, bridges or repairs, occlusion, etc.). Each specialist scores the responses collected on a scale of 1 to 3 as bad, medium and good.

The main problem with any scoring is however that there are a number of elements that do not depend on the accuracy of the family members but on that of the specialists. For example, while anthropological determinations are a factor of the techniques used (i.e., age, stature), a dental comparison is dependent on the availability of an antemortem odontogram which can only be compared to another odontogram and not to a literary reconstruction of someone else's dentition.

Once the interview is finished, the experts that participated in the interview separately discuss each case. Generally after such discussion cases are classified in a scale of 1-3 as a good, medium or bad match. In any case, traits deriving from the body (anthropology, odontology or pathology) carry more weight than circumstantial evidence such as clothing.

While DNA testing is a favored technique over "traditional" methods, it is not always available. If it is available it still depends on the existence of ante-mortem and post-mortem information to carry out identification. Experts participating in traditional identifications must develop emic categories to transform objective physical features into recognizable categories by the family. They must also do the opposite by developing a system by which the dentist, for example, understands that the cue given by a family member regarding an impacted anterior tooth could be anything from a visible extra tooth to a bump on the gum, or that a prosthesis could also be something removed from the mouth at bedtime.

Identification, DNA, Traditional Methods

H13 Variation in Size and Dimorphism in Eastern European Femora

Richard L. Jantz, PhD and Erin H. Kimmerle, MA, University of Tennessee, Department of Anthropology, 250 South Stadium Hall, Knoxville, TN 37996-0720*

After attending this presentation, attendees will know that there are variations in size and dimorphism of the femur among local Eastern European populations, and by extension, other postcranial bones, that requires population specific skeletal information upon which to base identification criteria.

This presentation will impact the forensic community and/or humanity by encouraging forensic anthropologists working in human rights in foreign countries to develop criteria specific to the populations on which they work.

The conflict in the former Yugoslavia has resulted in hundreds of mass graves containing thousand of individuals. There are still insufficient data from documented skeletons from the region to allow local standards to be developed. Furthermore, there is evidence of variability among ethnicities in the area. Metric data obtained from the femur of Kosovars and Croats provides the first opportunity to examine their relationship to Croats and Bosnians. Implications of variation for sexing and stature estimation will be examined.

Only three variables were taken from the Kosovo femora: Maximum length, bicondylar length and femur head diameter. Only maximum length and head diameter were used. The Kosovo sample consists of 449 males and 73 females. Antemortem stature was also available for about 90 Kosovars and 86 Croats. Femora from 150 American white males and 89 white females were available for comparison.

Both femur length and femur head diameter exhibit significant variation among samples. Variation among samples remains significant when American whites are excluded, so even different ethnicities in the same general region differ from one another. Bosnians, among the Eastern European groups, have the longest femora with the largest heads. Kosovars have short femora with large heads, and Croats are intermediate. American whites exceed all groups in femur length, but have the smallest head diameter. If American white femur head diameter is used as a sexing criterion and applied to Kosovars, over one quarter of females are classified as males.

Stature formulae from Trotter and Gleser (WWII reference sample), Ross and Konigisberg (Bosnian/Croatian reference sample), Sarajlic (Bosnian reference sample) and the Forensic Data Bank (recent American White reference sample) were used to estimate stature of both Kosovars and Croats for whom antemortem stature was available. All three formulae underestimated the Eastern European sample, Trotter and Gleser the most, the Forensic Data Bank the least. The Kosovo and Croat antemortem statures are estimates, mainly from family members. Like Americans, Eastern Europeans appear to overestimate stature, resulting in underestimates when using regression equations derived from measured stature.

These results show the importance of identification criteria from the populations to which they are being applied. American identification criteria cannot be exported to Eastern Europe, and within Eastern Europe, criteria for different ethnicities are desirable.

Postcranial, Sexing Criteria, Stature Estimation

H14 Local Standards vs. Informative Priors in Applied Forensic Anthropology

Lyle W. Konigsberg, PhD, Department of Anthropology, 250 South Stadium Drive, University of Tennessee, Knoxville, TN 37996-0720*

After attending this presentation, attendees will understand statistical methods for obtaining age estimates based on reference sample skeletal aging data and appropriate prior distributions for age-at-death.

The results of this research demonstrate the importance of prior information as well as the appropriate use of reference sample data when determining age-at-death from skeletal material. This research provides a statistical method for unbiased estimation of age-at-death in the applied forensic anthropology context.

Considerable debate over the need for "population-specific" skeletal estimators continues in forensic anthropology for sex, age-at-death, and stature estimators. This debate acquires practical importance when forensic anthropologists are called upon to build descriptive profiles of decedents who come from populations that lack reference skeletal data. This paper addresses the perceived need for population-specific information on age determination by explicitly considering the statistical basis for age-at-death estimation.

It is quite common in studies of age-at-death estimation to order age within each skeletal stage and then to calculate percentiles for ages falling within that particular stage. In some cases, percentiles such as the 2.5th and 97.5th are provided to give a 95% confidence interval for age-at-death conditional on stage. In other cases, the range of ages (from the minimum age, or 0th percentile, to the maximum age, or 100th percentile) is given for broader coverage. These percentile-based confidence intervals are deficient descriptors because of three statistical problems. First, the percentiles themselves are estimates that may be misleading when based on a stage for which few skeletons were observed. Second, the percentiles give a very incomplete description of the age-at-death (conditional on stage) data. Finally, the percentile values depend on not only the biological information contained in the age "indicator," but also the a priori age-at-death distribution of the reference sample.

In this paper it is suggested that a better method for presenting age-at-death data conditional on skeletal stage for a reference sample is to provide the Kaplan-Meier survivorship by skeletal stage. This solves the first and second statistical problems, in that confidence intervals are available for the survivorships (which are percentiles) and the survivorships provide all of the available percentiles. However, the Kaplan-Meier method does not solve the third problem, because the method still depends on both the biology of aging and the age structure of the reference sample. To show that this third problem remains, this paper compares the Kaplan-Meier survivorship by pubic symphyseal phase from a number of reference samples to the survivorship by phase for 232 known age-at-death individuals from the Korean War. The reference data survivorship by phase greatly exceeds that for the Korean War dead, because the a priori age distribution for the Korean War dead is much younger. There may also be population differences in biological aging between the reference samples and the Korean War dead sample.

To address the question of population specificity Kaplan-Meier survivorships by phase for the Korean War dead are approximated using parametric models that depend on an a priori age distribution and information on biological aging from a reference sample. In the case of the Korean War, there is a large amount of information available on the age-at-death for U.S. soldiers killed in action (see Frank A. Reister's "Battle Casualties and Medical Statistics: U.S. Army Experience in the Korea War" available on-line from http://history.amedd.army.mil/), which for the purposes of this paper is modeled using a log-normal distribution. This informative prior must then be combined with information on pubic symphyseal aging taken from a known age-at-death reference sample. For known age samples symphyseal data from the Korean War dead, males from anatomical and forensic collections, and males and females from the Balkans are used.

The results of the parametric models show that, from a practical standpoint, it makes little difference which reference sample is used to age the Korean War dead. The choice of an inappropriate prior, however, can have drastic effects on the models. It can consequently be suggested that forensic anthropology's concern with obtaining "population specific" estimators or "local standards" may be misdirected. Instead, greater emphasis should be placed on characterizing appropriate priors and on extracting information on biological aging from larger well-documented skeletal collections. In a similar vein, it may not be necessary to have, for example, stature estimation equations that are based on very specific reference collections. Instead, a combination of large generic reference samples with appropriate priors can be used to tailor make such "population specific" estimators (Ross and Konigsberg 2002).

Ross AH, Konigsberg LW. New formulae for estimating stature in the Balkans. *J Forensic Sciences* 2002;47:165-167.

Age-at-Death Estimation, Statistical Methods, Survival Analysis

H15 A Bayesian Approach to Calculating Age Using Pubic Symphyseal Data

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The learning objectives of this presentation are as follows. First, to understand how the ages of victims are used in the investigative and evidentiary processes of criminal proceedings. Second, to determine whether population-specific aging criteria are needed for the Balkans. Third, to demonstrate how a Bayesian approach to the construction of age profiles for unidentified victims produces the most accurate and precise age ranges possible, thereby meeting the criteria of *Daubert v. Merrell Dow Pharmaceuticals*, 509 US 579 (1993) for the presentation of scientific evidence in court.

This study makes an important impact both on the field of forensic science and on humanity by providing new aging criteria for the Balkans that meets requirements for the presentation of scientific evidence in court; by establishing criteria that are the most reliable thereby ensuring the best chances for positive identifications to be made for victims; by providing insight into long-standing paleodemographic questions about population variation in aging; and by contributing to our understanding of the effects of individual inter-observer variation in the formulation of new methodology and successful identification.

The ages of victims plays an important role in determining the minimum number of individuals recovered from a mass grave, in individual identification, and in constructing the demographic profile of victims. The demographic profile of victims is one of the central issues in the prosecution of individuals indicted by International Criminal Tribunal for the Former Yugoslavia. The case of The Prosecutor of the Tribunal against Radislav Krstic (Case No. IT-98-33) was a landmark case because it was the first conviction of genocide in Europe and relied on forensic evidence. It was also a precedent setting case for forensic anthropology in that the methods used to construct demographic profiles of victims based on American and Balkan reference samples were questioned in court. The defense team questioned the anthropological expert witness as to why American (Katz and Suchey 1986) and Balkan (Simmons et al., 1999) aging methods differed and which were the most reliable for use in the former Yugoslavia.

The purpose of this study was to determine whether a Bayesian analysis using an informative prior for the age-at-death profile derived from a large non-Bosnian reference sample could produce the most accurate ages for unidentified victims from the Balkans. A reference sample of identified genocide victims from Kosovo, Bosnia, and Croatia (n=876) was used to determine the age structure of genocide victims.

The pubic symphyses were scored in the manner of Suchey-Brooks for a subset of the Balkan sample (n=298), as well as, from various American anatomical reference collections (n=1517). The Gompertz-Makeham hazard model was used to calculate the informative prior for age. The informative prior was combined with the likelihood of being a particular age conditional on a given pubic symphyseal phase that then was compared to the empirical survivorship model by phase. We found that the survivorship model accurately predicts age for each pubic symphyseal phase, indicating the problem with the current methodologies is based on statistical methodology, not biological variation in the aging processes of American and Balkan populations. A revised calibration of pubic symphyseal methodology using a Bayesian approach does provide the most precise and accurate age ranges possible. Finally, four observers scored each pubic symphysis for the Balkan sample independently to determine the effect of inter-observer variation. Correlations among the four observers varied for both pubic symphysis-scoring systems. Correlations for the Todd system ranged from .80-.92 among females (n=83) and .24-.66 among males (n=108). Correlations among observers for the Suchey-Brooks system ranged from .77-.95 among females and .63-.85 among males.

Katz D, Suchey J. Age determination of the male os pubis. Amer J Physical Anthrop 1986;80:167-172.

Simmons T, Tuco V, Kesetovic R, Cihlarz Z. Evaluating age estimation in a Bosnian forensic population: Age-at-Stage vs Probit Analysis. *Proceedings* of the American Academy of Forensic Sciences, 1999;38H.

Bayesian Analysis, Aging Methods, Inter-Observer Variation

H16 Aging the Elderly: A New Look at an Old Method

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After attending this presentation, attendees will learn to present an alternate strategy for aging elderly female pubic symphyses.

This presentation will impact the forensic community and/or humanity by providing the forensic community a better tool to produce age estimates for elderly individuals, which is not currently available.

Physical anthropologists have long been confronted with the problem of estimating skeletal age of elderly individuals. Some believe that it is impossible to determine advanced age with any level of precision. Experts have also questioned the accuracy of ageing skeletal remains from pubic bone morphology. As a result, large age categories such as 40+, 50+, and 60+ years have been used to minimize the impact of these problems. Refinements to the current definitions in the Suchey-Brooks unisex ageing method may alleviate some of the problem. Specifically, if the late phases are refined and an additional stage added (a 7 phase instead of a 6 phase system), the method may be improved. Further, since the determination of age ranges should reflect the demographic profile of a population they are drawn from, then a different statistical approach, transition analysis, should be considered.

This study consisted of 148 female individuals from the University of Tennessee William Bass Donated Collection (Donated, n=63) and a known age Balkan forensic sample (Balkan, n=85). Each pubic symphysis was scored with the aid of a standard desk magnifying glass. The new definitions and decision-making rules for females were as follows:

Suchey-Brooks Phases 1-4: No modifications were made.

Phase 5: The rim is complete at this stage, but the symphyseal face may show a slight depression as it begins to erode. The pubic tubercle is separated from the face. The quality of bone on the articular surface is still good and very compact. In a few cases, a slight amount of porosity may be present, but it usually affects less than 15% of the symphyseal face. Only extremely mild signs of osteoporosity/osteopenia are present (if any) and the ventral aspect of the symphysis is typically not porous.

Decision making traits are: 1) if the articular surface still has majority of compact bone with less than 15% porosity anywhere on surface, and 2) osteoporosity/osteopenia is absent or extremely mild, score as a Phase 5. If either of these two traits is observed greater than specified, then score as greater than a Phase 5.

Phase 6: The symphyseal face is usually depressed and the rim begins to erode, beginning with the superior ventral aspect. The quality of bone on the articular surface is breaking down, no longer retaining the smooth, compact surface. The symphyseal face is eroded, in the form of either porosities or small channel-like structures – coalescences of smaller porosities into oblong pores/channels. Osteoporosis is mild to moderate in this phase. Lipping of the articular surfaces can be present.

Decision making traits are: 1) if less than 50% of the symphyseal surface is porous, and 2) lipping is mild to moderate then it is scored as a Phase 6. If the symphyseal face appears to be borderline (40-60% of face is porous but still a fair amount of compact bone), then osteoporosity/osteopenia should be used as the deciding feature. If this trait is moderate to severe, then it is scored as a Phase 7. The weight of bone should be the primary indicator, though other indications of osteoporosis can be found on the ventral aspect of the pubis where porosity may be present and the bone may have a striated quality.

Phase 7: The symphyseal face is extremely porous and eroded (>50% of its surface). Osteoporosity/osteopenia is present and is typically moderate to severe in nature (the bone is very light in weight). The symphyseal face appears to be relatively flat, since the rim is highly eroded and is losing definition. The ventral surface of the symphysis is typically scarred or has striated bone with ligamentous outgrowths, occurring typically near the obturator foramen. Lipping of the articular surfaces is often moderate, but may be mild or severe. This character is highly variable.

Inter- and intra-observer error was tested among four observers and was not statistically significant, indicating that each observer was scoring in a similar fashion. In order to compare results with the published data from the Suchey-Brooks method (males), regression analyses were conducted on these populations. For the Donated collection, age regressed on phase produced a highly significant model ($r=0.8361$, $R2=0.6992$, $F=144.06$, $p=<0.0001$). Likewise, the Balkan model was also highly significant ($r=0.5164$, $R2=0.2667$, $F=30.19$, $p=<0.0001$). Statistically, the Donated collection compared favorably with previously published male data, even though females are considered more variable than males. The Balkan model explained less of the data variation, presumably due to a small sample size in younger phase categories.

Transition analysis is better suited for categorical data and is therefore used to determine if the proposed 7-phase system is a valuable tool for age estimation. A transition analysis estimates when an individual moves from one phase to the next, given the parameters of a unique population. In this case, the transition analysis also allowed us to determine whether or not certain phases should be collapsed together. If the transitional ages overlap, it would indicate that the phases should be collapsed. The calculated transitional ages for the Donated and the Balkan collection clearly documented the applicability and segregation of the Phase 7 morphology from the previous phases.

The suggested modifications to the Suchey-Brooks method are believed to be beneficial for ageing elderly female pubic symphyses. Given the age structure of today's population, more forensic cases dealing with older age individuals are likely to occur. These refinements will enable physical and forensic anthropologists to better estimate age-at-death.

Aging, Pubic Symphyses, Elderly

H17 Model of Age Estimation Based on Dental Factors of Unknown Cadavers Among Iranians

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After attending this presentation, attendees will be informed about age estimation of unknown human remains of Iranian ancestry based on dental techniques, including Gustafson's method.

This presentation will impact the forensic community and/or humanity by providing a more thorough understanding of dental aging techniques as applied to an Iranian skeletal population.

Estimation of age in unknown cadavers is an important method for their identification. The most common method in adults (older than 25 years) is the use of dental parameters as described by Gustafson in 1947. In 1950, he presented his models based on microscopic and macroscopic features of teeth. Pillai and Bhaskar (1974) showed that Gustafson's method is influenced by external factors such as race and culture in an Indian sample. Gustafson's method was used by Rahimian, Sabaghian and Savabi in Iran. In these two studies, the correlation coefficients between observed and estimated ages were .80 and .95, respectively. However, the models were never calculated. In Iran, age is estimated by formulae that were designed using a Swedish sample. Therefore, appropriate models for application to Iranian samples should be developed.

This study is a cross sectional study. The samples were selected from Iranian cadavers, examined at the Forensic Medicine Organization of Isfahan province. Their ages ranged from 25 to 60 years. This range was classified into five-year age groups. Thirty cases were selected for each group. The inclusion criterion was the presence of at least one single-root tooth on the mandible (premolar, canine or incisor). The cases were selected over a 9 month period. After tooth selection, the distance between sulcus of gingiva and cervix of tooth (CEJ) in the medial aspect of buccal surface was measured (in millimeters) with a probe to calculate the periodontosis factor. After extraction, the teeth were cleaned and put in tubes containing alcohol and glycerin. Alcohol allows for better presentation by dehydration of the translucent area of root.

For each case, variables such as name/surname, age, type of tooth, and the periodontosis factor (mm) were gathered. A non-stop Bego device was used to make sections ranging from .5 to 1.0 mm. Three teeth were deleted from the study due to previous treatment on their roots. Microscopic studies were done by stereomicroscope with a precision of 0.1 mm. The factors and their classifications are defined as the following:

Periodontosis factor (P): ratio of distance between sulcus of gingiva and cervix of tooth (CEJ) to the root. P0: No periodontosis. P1: Beginning of periodontosis. P2: Periodontosis evident coronally on more than one third of root.

Attrition factor (A): extent of destruction of crown. A0: No attrition. A1: Attrition up to enamel level. A2: Attrition up to dentin level. A3: Attrition up to pulp.

Secondary dentine factor (S): ratio of secondary generated dentin to the total volume of pulp cavity. S0: No secondary dentin. S1: Secondary dentin up to upper part of pulp cavity. S2: Secondary dentin up to half of pulp. S3: Diffuse calcification of the entire pulp.

Root resorption factor (R): extent of destruction of root due to resorption. R0: No resorption. R1: Spotted like resorption. R2: Root resorption at the level of cementum. R3: Extensive resorption of cementum and dentin.

Cementum apposition factor (C): extent of increment of cementum. C0: Normal thickness (undetectable). C1: Thickness more than normal (detectable). C2: Generation of thick cementum. C3: Hypercementosis thickness.

Translucency of the root factor (T): ratio of height of translucency area to the length of root. T0: No translucency. T1: Beginning of translucency of root. T2: Translucency more than 1/3 of apical root. T3: Translucency more than 2/3 of apical root.

Statistical analysis of this study is based on linear regression analysis, using sum of the ranks of the factors (SR) as predictor of age. Statistical analyses were done by SPSS.

A total of 210 cadavers comprising 185 males (88.1%) and 25 females (11.9%) were selected. Mean and standard deviation of SR is 6.72 (1.81). Correlation coefficients of age with attrition, periodontosis, root resorption, secondary dentine, cementum apposition and translucency of the root are .394 (P<.001), .384 (P<.001), .169 (P=.014), .522 (P<.001), .251 (P<.001) and .344 (P<.001), respectively. Coefficients of the regression line regardless of the tooth type are calculated as the following [P*(Constant)*<.001, P*(SR)*<.001, R = .641]:

Age = 16.948 + 3.697(SR)

Calculation of the quartiles of error regardless of tooth type revealed that these errors were less than 2.5, 5.7 and 9.2 years in 25%, 50% and 75% of the subjects, respectively. Similarly, quartiles of error based on the 1st premolar model were 2.6, 4.7 and 7.1 years in 25%, 50% and 75% of the subjects, respectively.

There have been two major series of methods for age estimation based on dental parameters, including single and multiple factor methods. The multiple factor method was first used by Gustafson in 1947, using attrition, periodontosis, root resorption, secondary dentine, cementum apposition and translucency of the root. Mean error of estimation in his study was +/- 3.63 years. In 1962, Dalitz disregarded cementum apposition and root resorption. He presented his model by classifying the factor into five categories. The mean error of Gustafson's method was shown to be +/- 4.6 years by Haertig and co-authors (1985).

These studies show that different results with different accuracies based on dental factors can be due to different methodologies, race and environmental factors. In our study, the correlation coefficients of age with each of six single factors are less than the coefficient of age with sum of factors, indicating that the best estimation is achieved by combination of all six dental factors. Furthermore, mean errors of the models are +/- 6.4 in total teeth regardless of type and +/-5.2 years in 1st premolars, respectively. Therefore, the 1st premolar should be used in the first step among Iranians, when Gustafson's method is used for age estimation.

The reason for errors using Gustafson's method for age estimation of Iranians is low variability of dental factors in different ages. It can be due to congenital and environmental patterns including eating habits, which seems to be a determinant of dental factors. Despite these problems, the model is a cheaper, easier and more practical method and should be used as a first step before more sophisticated methods of age estimation in unknown cadavers.

Dalitz GD. Age determination of adult human remains by teeth examination. *J Forensic Science Society*, 1962;3:11-21.

Gustafson G. Microscopic examination of the teeth as a means of identification in forensic medicine. J Amer Dental Assoc, 1947;35:720-724.

Gustafson G. Age determination on teeth. *J Amer Dental Assoc*, 1950;41:45-54.

Haertig A, Crainic K, Durigon M. *Medicolegal identification by the dental system*. Presse Med 1985; 14(9):543-545.

Pillai PS, Bhaskar GR. Age estimation from teeth using Gustafson's method. *J Forensic Sciences*, 1974; 3:135-141.

Age Estimation, Gustafson's Method, Dental Factors

H18 New Formulae for Estimating Age in the Balkans Utilizing Lamendin's Dental Technique

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After attending this presentation, attendees will understand how to estimate age-at-death in the Balkans based on an appropriate reference sample and formula

This presentation will impact the forensic community and/or humanity by providing an appropriate formula based upon a Balkan reference sample to estimate age-at death for genocide victims.

As with all forensic identifications, proper reference samples are critical when anthropologists employ methods to identify victims of genocide. Several methods to estimate age-at-death are utilized in the Balkans, such as osteomorphic changes of the pubic symphysis and sternal ends of ribs, histological sections of the clavicle and Lamendin's dental aging method. This presentation will focus on Lamendin's method and the purpose is two fold: 1) to analyze the consistency and accuracy of four observers employing Lamendin's technique and, 2) to recalculate the formula specific to the reference sample.

Lamendin et al.'s (1992) original research analyzed 306 single-rooted teeth extracted at the time of autopsy from 208 individuals. All individuals were considered to have French ancestry. Three measurements were required to estimate age-at-death: root height (the maximum distance between the apex of the root and the cemento-enamel junction); periodontal regression (maximum distance between the cemento-enamel junctions and the line of soft tissue attachment); and translucency of the root (measured from the apex of the root towards the cemento-enamel junction, using a lightbox to enhance the image). This research produced an overall mean error of + 8.4 years on their working sample and + 10 years on their forensic control sample. Prince and Ubelaker (2002) employed Lamendin's method on an American sample of 400 teeth, where absolute mean errors of 8.23 years and 7.7 years were produced using Lamendin's method and recalculated formulas. Sarajlic et al. (2003) employed Lamendin's original formula and Prince and Ubelaker's formula to Balkan males. They reported that Prince and Ubelaker's white male formula lowered mean errors for the male sample in the Balkans.

The current research applies Lamendin's method to 429 single-rooted teeth of known age and sex, which were extracted at the time of autopsy from genocide victims in the Balkans. Three measurements were taken from each tooth: root height, periodontal regression, and translucency of the root. All measurements were taken from the labial surface with digital calipers and recorded in millimeters. Four observers, three with modest experience of the procedures and one observer with considerable experience, took the measurements from each tooth. Each observer took blind measurements. Attrition scores were also recorded after Smith (1984).

All data were analyzed using the "R" statistical package. A repeated measures ANOVA was utilized to determine any significant difference among the four observers and regression analysis was used to produce the new formula based on the Balkan reference sample.

Although previous research has shown that Lamendin's method is reliable in estimating age-at-death, a formula based on an appropriate reference sample is necessary for application in the Balkans. The author proposes that recalculating the formula based on the sample above will reduce mean errors when estimating age-at-death and be more appropriate for estimation in the Balkans.

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Prince DA, Ubelaker DH. Application of Lamendin's adult dental aging technique to a diverse skeletal sample. *J Forensic Sciences* 2002;47(1):107-116.

Sarajlic N, Klonowski E, Drukier P, Harrington R. Lamendin and Prince's dental aging methods applied to a Bosnian population. *Proceedings* of the Fifty-fifth Annual American Academy of Forensic Sciences; 2003 Feb 16-21; Chicago (IL): 2003;250.

Smith BH. Patterns of molar wear in hunter-gatherers and agriculturalists. *Amer J Physical Anthrop* 1984;63(1):39-56.

Balkans, Age-At-Death, Dental

H19 Sternal Rib Standards for Age Estimation in Balkan Populations: An Evaluation of U.S. Standards Using Alternative Statistical Methods

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The goals of this presentation are: 1) to evaluate the accuracy of US sternal rib standards of age estimation used in the Balkans, and 2) to present cumulative probit regression and Bayes' methodology as alternative statistical methods for the estimation of age at death.

This presentation will impact the forensic community and/or humanity by evaluating the accuracy of existing US sternal rib standards for age estimation used in the Balkans; and presenting to the forensic community an alternative statistical approach for the estimation of age-at-death using a cumulative probit regression model and Bayes' methodology.

Presently, US aging standards are used to generate ages at death for victims of the Balkan war. However, the accuracy of Balkan estimates derived from US standards has not yet been systematically evaluated. This presentation addresses this issue. Further, alternative statistical procedures are used to estimate the ages at death of the US and Balkan samples used in this study.

The US sample contains 156 sternal ribs of known individuals from the William M. Bass Donated (WMB) and Forensic Skeletal Collections (FC) at the Department of Anthropology at the University of Tennessee. Sternal rib data for an additional 32 individuals of known age, sex, and ancestry were obtained from the Forensic Data Bank (FDB) and included in the US sample. Both sexes are represented, and ages at death range from 18 to 94 for white males (with a mean age of 51.22 yrs.) and 20 to 89 for white females (with a mean age of 49.35). The presenter (JS) classified rib ends from the WMB and FC into one of nine phases (0-8) using the rib end phase descriptions developed by Iscan et al. (1984, 1985) for white males and white females. Data obtained from the FDB had been previously collected by various observers from around the country. The Balkan sample contains 529 male and 78 female sternal rib ends of known individuals from the Baraybar Forensic Skeletal Collection. Ages at death range from 17 to 90 years for males (with a mean age of 49.17 yrs.) and 17 to 96 for females (with a mean age of 53.67 yrs.) Four observers (GB, EK, DP, and JS) classified rib ends from the Baraybar Collection into one of nine phases (0-8) using the rib end phase descriptions developed by Iscan et al. (1984, 1985), for white males and white females. Data collected by the observer who produced the highest correlation between rib phase and chronological age (EK) were used in this study.

Traditionally, physical and forensic anthropologists estimate age by assigning a mean age and age range to an unknown individual based on the distribution of the age indicator in a known age reference collection. With the cumulative probit and Bayesian approaches, however, probabilities are assigned to each possible age in the age at death distribution of an unknown individual and the single age assigned the highest probability is the most likely age at death for that individual. While these

approaches involve several computational steps and are mathematically more complex they provide certain advantages over traditional methodology, including: 1) assignment of probability to age-at-death estimates, 2) less subjective age estimates, 3) more realistic error estimates, and 4) practitioners are not forced to use truncated age ranges when estimating the ages-at-death of older adult individuals (i.e., 50+ years).

The US data were analyzed using cumulative probit and Bayesian methods in order to find the highest posterior density of age (i.e. most likely age) for each rib phase. Ages at death were then calculated for a sub-sample of the Balkan data using the "standards" derived from the US sample. If US standards do not provide accurate age at death estimates for the Balkan sub-sample, population-specific standards are warranted.

Iscan, M., Loth, Susan R., and Wright, Ronald K. (1984) Age estimation from the rib by phase analysis:
white males. *Journal of Forensic Sciences* 29(4):1094-1104.
Iscan, M., Loth, Susan R., and Wright, Ronald K. (1985) Age estimation from the rib by phase analysis:
White females. *Journal of Forensic Sciences* 30(3):853-863.

Estimation of Age-at-Death, Population-Specific Standards, Bayesian Approach

H20 Geometric Morphometric Techniques for Ancestry Assessment in Sub-Adults

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After attending this presentation, attendees will be able to assess the way in which geometric morphometric techniques can be used to reliably assess ancestry in skeletal samples of sub-adults.

It is hoped that the Morphometric Forensic Identification of Sub-adults (MorFIdS) resource will facilitate the identification of sub-adult remains in a multi-ethnic context, and that it will eventually be available for use in a 'user-friendly' format, readily applied by experts and lay-people alike.

This paper presents some of the research and developments carried out within the remits of the MorFIdS (Morphometric Forensic Identification of Sub-adults) identification resource. The resource is based on a large dataset of three-dimensional co-ordinates taken from a diverse sample of human skeletal populations. It has been developed specifically to aid in the assessment of ancestry in sub-adults of all ages.

The identification of ancestry in human skeletal remains is an important factor in narrowing down the potential identity of individuals in a forensic context, as well as for repatriation. Hitherto, this type of identification has been based on quantitative or qualitative assessments of the morphology of the adult cranio-facial skeleton.

Similar identification has proven highly difficult in sub-adults, as the degree of allometric changes in the cranio-facial skeleton during post-natal growth is greater than the extent of the possible ancestry-specific morphologies. However, recent advances in analytical techniques have allowed the study of inter- and intra-population differences in facial form during growth (e.g., Strand Vidarsdottir et al., 2002), and led to the examination of the possibility of developing models of population specific morphologies at all ages. This work has revealed that using the geometric morphometric school of techniques, it is possible to identify ancestral morphologies in the cranio-facial skeleton of infants as young as 1 year of age. MorFIdS (Morphometric Forensic Identification of Sub-adults) is a computer-based resource specifically developed from this research for the application of morphometric techniques to the identification of sub-adult skeletal remains. It aims to facilitate identification of ancestry on the basis of complete and partial cranio-facial skeletons. Tests show that given large sample-data sets, in particular where ancestral populations can be narrowed down by other means, sub-adults can be identified to racial group with up to 95% certainty. This is comparable to the success rate of ancestral identification in adults using established techniques.

The presentation will outline the research behind the project, and the possibilities it offers with regards to forensic identification in the field or laboratory, both in an international and US context. It also outlines the future focus of the MorFIdS project, and the ways in which it is hoped to make these techniques more readily available to forensic scientists, archaeologists, and law enforcement personnel.

Vidarsdottir US, O'Higgins P, Stringer C. A geometric morphometric study of regional differences in the ontogeny of the modern human facial skeleton. *J Anat* 2002;201(3):211-29.

Geometric Morphometrics, Ancestry Assessment, Sub-Adults

H21 Population Affinities of "Hispanic" Crania: Implications for Forensic Identification

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After attending this presentation, attendees will understand the extent of the morphological diversity of individuals classified as Hispanics and the potential of geometric morphometric methods for quantifying that diversity and incorporating it into the assessment of unidentified human remains.

This presentation will impact the forensic community and/or humanity by illustrating the importance of regional diversity in the cranial morphology of persons identified as Hispanic in the United States using the relatively new methods of geometric morphometrics.

The term "Hispanic" is used in the U.S. to identify persons of Spanish speaking countries and their descendants. Such classification, however, fails to recognize the varied genetic background of the subsumed populations resulting from the diverse ethnohistories and migration patterns of their native regions. In the forensic setting, the use of such a broad classification amounts to the disregard for potential sources of variation that could otherwise lead to a much more precise characterization of unidentified human remains.

In this report, we present results of research designed to document and begin to address this problem. We use geometric morphometric methods to assess the craniometric affinities of a sample of modern Mexicans using the coordinates of twenty-three standard craniometric landmarks. The Mexican sample (n=31) was compared to samples of an indigenous pre-contact population (Ayalan) from Ecuador (n=13), modern Cubans (n=23), persons of African descent as represented in the Terry collection (n=18), modern Spanish (n=30), and pre-contact Cubans (n=6). Previous analysis had shown the modern Cubans were most similar to the Africans and only slightly less similar to the Spanish, but they were quite distinct from the pre-contact Cubans. This suggests a nearly complete replacement of the indigenous Cuban populations by an admixture of Spanish and Africans with a slightly higher African component. We speculated that other Hispanic populations, such as Mexicans, would show different results with a greater affinity toward indigenous populations and a much reduced similarity to persons of African descent.

A nonparametric multivariate analysis of variance comparing the sum-of-squares accounted for by group membership to that of 999

random permutations of group membership showed differences between all pairs of samples to be highly significant, with p values at or near the minimum (p=0.001) possible for the test (p<= 0.001 - 0.002). A cluster analysis of population means based on Mahalanobis distances supported the earlier speculation of similarities between the recent Mexican sample and indigenous populations and a lack of similarity with the African sample. The Mexicans and Ecuadorians form a cluster distinct from the modern Cubans, Spanish, and Terry samples, and all are quite distinct from the pre-contact Cubans.

These results support the view that people now broadly grouped together as "Hispanics" represent a morphologically diverse assemblage of populations characterized by their individually-distinct genetic histories. The modern Mexican population, while maintaining its own morphological uniqueness, appears to manifest a considerable degree of similarity to native populations and a substantial distinction from Europeans and Africans. This argues for a strong indigenous component in Mexican morphology with little of the admixture with Old World populations that characterize the modern Cubans. Incorporating such information into standard forensic practice could produce a much more informative assessment of unidentified human remains.

Forensic Anthropology, Hispanic Populations, Geometric Morphometrics

H22 International Research in Forensic Anthropology

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This presentation provides discussion to a symposium focusing on international research in forensic anthropology.

This presentation and the symposium it is part of should make the forensic community more aware of: 1) the need for international regional research in forensic anthropology, and 2) current efforts to meet this need.

Forensic anthropology research in North America has intensified in recent years in an attempt to meet the growing needs and concerns of casework applications. Such research has produced significant progress in our collective scientific capability to approach such issues as estimation of time since death, sex, age-at-death, ancestry and taphonomical factors. New methodology and databases greatly supplement the traditional sources to make North American forensic anthropologists more effective in their attempts to interpret human remains in forensic contexts.

The growing interest in forensic anthropology and increased incorporation of the anthropological perspective in forensic investigation are apparent globally. Although much of the research conducted in North America is relevant to interpretation world-wide, some limitations also are apparent. These limitations recognize global geographic and human (biological and cultural) variation.

International research serves to document relevant aspects of variation and to produce new methods derived from local samples that are applicable to regional forensic problems. This interest is coupled with the acquisition of new documented collections and databases from non-North American areas to facilitate future such research. These developments can only strengthen the field of forensic anthropology and increase the accuracy and reliability of its applications.

Forensic Anthropology, International Research

H23 Preservation in Paradise I: El Marañon Cemetery, Isla de Coiba, Republic of Panama

Ann H. Ross, PhD, Department of Sociology and Anthropology, North Carolina State University, Campus Box 8107, Raleigh, NC 27695-8107; Loreto S. Silva, Director of Anthropology, Comision de la Verdad de Panama, Balboa, Republic of Panama; Kathryn M. Jemmott, MA, C.A. Pound Human ID Laboratory, University of Florida, Gainesville, FL 32611; Lazaro M. Cotes, Comision de la Verdad de Panama, Balboa, Republic of Panama*

The attendee will learn guidelines for establishing time since death estimates from human skeletal remains in tropical environments.

This recovery mission afforded unique opportunities to investigate the process of skeletal degradation in a controlled tropical environment and to establish some guidelines for estimating time since death.

The Panamanian Truth Commission's directive is to investigate the deaths and disappearances by the Military Regimes of Torrijos (1968-1981) and Noriega (1981-1989). Excavation efforts were continued on the island of Coiba after the March 2002, field season in May-June 2003, in an effort to locate the graves of several "disappeared" believed to have been buried at the Marañon Cemetery, which is situated at the central encampment of the Penal Colony. The surrounding environment consists primarily of tropical rainforests with a rich red clay soil. The cemetery is oriented north to south and is clearly marked and demarcated by a barbed wire fence measuring 57.7 m at its longest by 21.9 m at its widest points. This paper presents some of the taphonomic processes responsible for skeletal preservation in a tropical environment.

The island of Coiba is positioned between 7°10'N and 81°32' - 81° 56' W and is the largest island in the Mesoamerican Pacific. Coiba is located 24 km offshore and is separated from the mainland on the east by the Gulf of Montijo and on the northwest by the Gulf of Chiriquí. It has an area of 494 sq km and a maximum elevation of 425 m. The island's first inhabitants were indigenous groups dating to 500 BC, which were expelled from the island by Spanish conquistadors sometime in the early part of the 16th century. It was soon abandoned by the Spaniards and it was only re-inhabited again in 1914 when it became a penitentiary, which currently houses approximately one hundred inmates. It was declared a national park on 17 December 1991. Because of its inaccessibility and reputation of having a penal colony comprised of maximum-security inmates, Coiba boasts of having 80 percent of its primary humid tropical forest. The average yearly temperature is 78.8 degrees Fahrenheit with an average precipitation of 3,500 mm.

Fourteen graves were excavated, opened and their contents analyzed in the field. A positive identification was made for Jeronimo Diaz Lopez via dental and traditional forensic anthropological means. Diaz "disappeared" in 1985 and his parents were informed by the military police that he had successfully escaped the island on a raft. This identification also allowed us to compare the taphonomic processes of all the burials and establish a rough estimate for degradation of skeletal remains in a tropical environment. In addition, the unique finding of a Pre-Colombian "packet" style burial allowed us to establish some general parameters for weathering stages in a tropical environment. We adapted our definitions of weathering stages and their relationships to years from Behrensmeyer (1978). The one factor that we found that had a significant effect on the level of preservation was the proximity of a burial to coconut palm trees. The root system of these palm trees can travel a relatively long distance underground to feed off human remains, sometimes completely encasing skeletal elements. In this paper, we present some guidelines useful for establishing time since death estimates for remains found in tropical environments.

Taphonomy, Tropical Environments, Forensic Anthropology

H24 High Velocity Fluvial Transport: A Case Study From Tennessee

Nicholas P. Herrmann, PhD, Beth Bassett, MA, and Lee M. Jantz, PhD, University of Tennessee, 250 South Stadium Hall, Department of Anthropology, Knoxville, TN 37996*

After attending this presentation, attendees will have a better understand variations in skeletal transport in fluvial systems.

This presentation will impact the forensic community and/or humanity by providing insight into the varied patterns of skeletal transport in different fluvial transport systems and will aid crime scene investigators and forensic anthropologists in future case work and research.

Fluvial transport of human remains and the osteological evidence of such transport has been documented both anecdotally and systematically by various researchers during the past several decades. Historically, fluvial taphonomic studies have been applied to the interpretation of paleoanthropological contexts. The classic study by Boaz and Behrensmeyer (1976) documents the transportability of individual elements in flumes to simulate fluvial transport systems and provides an interpretive base for examining bone deposits recovered from fluvial systems.

Researchers attempting to address current issues of fluvial transport in forensic anthropology have provided information on various riverine environments. The research by Dilen (1984) examines remains location and identification through the use of human-like mannequins. The mannequins were used to simulate the riverine transport of a human body and predict the behavior of partially decomposed human remains in such circumstances. Another study by Bassett and Manhein (2002), involves the documentation and evaluation of known Mississippi River cases to aid with the prediction of location of remains lost in a river environment. Still other studies address skeletal disarticulation sequences (Haglund, 1993), osteological indications of fluvial transport and taphonomy (Nawrocki et al., 1997), and isolated cases of fluvial transport (Brooks and Brooks, 1997). While these studies provide valuable information for investigations of deaths involving riverine environments, none of them specifically address evidence of submersion and transport in more seasonal bodies of water.

In this study the effects of a restricted high velocity periodic transport system are examined through a case example from East Tennessee. In the spring of 2003, the University of Tennessee Forensic Anthropology Center participated in the recovery of human skeletal material from a small, unnamed creek in Alcoa, Tennessee. The remains were completely skeletonized. Periodic high flow episodes had occurred in the creek due to heavy rain in the past 12 months and the skeletal material was scattered as a result of fluvial transport. Skeletal elements were recovered along a one-kilometer section of the creek bed.

Topics addressed in this study include a discussion of the pattern of elemental transport relative to past research, illustrations of bone surface evidence of fluvial transport in the form of scratches and scrapes, and a discussion of the depositional context of the elements recovered. Insight into the varied patterns of skeletal transport in different fluvial transport systems will aid crime scene investigators and forensic anthropologists in future case work and research.

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Physical Anthropology, Taphonomy, Fluvial Transport

H25 Investigation of Nocturnal Oviposition by Forensic Flies in Central Texas

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After attending this presentation, the participants will be presented with additional data supporting the idea that forensic flies do not oviposit under nocturnal conditions. These data and those from previous studies support the idea that lack of nocturnal oviposition should be considered in estimating the postmortem interval (PMI).

This presentation will impact the forensic community and/or humanity by providing knowledge regarding the nocturnal oviposition behavior of forensic flies is required for estimating postmortem interval.

The postmortem interval (PMI) establishes a framework within which the time of death can be estimated. Laboratory and field investigations, using non-human oviposition baits, are important in interpreting data associated with human death scene investigations. These investigations in different geographic areas identify the species available for ovipositing, the time of oviposition, and the effects of environmental factors on oviposition behavior.

There continues to be discussion of the ability of flies to oviposit on corpses deposited at night. Several studies have reported nighttime oviposition under artificial lights and in darkened conditions. Other studies have reported no oviposition during the nighttime. Such contradiction continues to promote research to determine the degree to which nocturnal oviposition occurs.

We will report on the effect of artificial light on oviposition by forensic flies in the Waco, Texas area. Three baits were used: 1) freshly killed white rats (*Rattus rattus*) (placed three feet off the ground), 2) recently thawed subadult pigs (Sus scrofa) (placed on the ground), and 3) ground beef (fresh, one, two and three day old; placed three feet off the ground). The fly species attracted to and ovipositing on the baits and environmental parameters at the baits were recorded to determine the degree to which these factors might interact to affect fly attraction and oviposition. The elevated presentation of the rat and beef baits and the short exposure time for the pig baits minimized the effect on oviposition usually experienced from foraging workers of *Solenopsis invicta* (red imported fire ant) common in the area. However, during one observation period the rat bait was foraged on by vespid wasps and they did seem to interfere with oviposition by forensic flies.

Field studies were conducted during the summer of 1993 (rats, seven nights, June-August, 1800-0900 hours CDST, urban site), and the summer of 2003 (pigs, three nights, June and July, 2100-2300 hours CDST, rural site; ground beef, three nights, 2200-0400 hours CDST, rural site). Diurnal oviposition studies determined that flies were present in the area and did oviposit on the baits. All baits were removed from the field sites and maintained under laboratory rearing conditions to determine fly species that oviposited on them.

Species present on the rat bait included *Phaenicia coeruleiviridis* (green bottle fly), *P. cuprinus* (bronze bottle fly), *Cochliomyia macellaria* (secondary screwworm fly) and *Sarcophaga haemorrhoidalis* (flesh fly). With the exception of P. cuprinus, these species oviposited

on rats (freshly killed, viscera exposed; placed at 1800, 2100, 2400, and 0600 hours) in lighted and dark situations before 2130 hours and after 0630 hours. The pig baits attracted *Musca domestica* (house fly), P. *coeruleiviridis*, *C. macellaria*, and *Chrysomya rufifacies* (the hairy maggot blow fly). These species arrived at, and oviposited on, pigs in lighted and dark areas before 2120 hours but not between 2120 and 2300 hours. No flies oviposited on the ground beef baits placed in lighted and dark sites. These data support studies reporting no nocturnal oviposition by forensic flies.

Forensic Science, Forensic Entomology, Nocturnal Oviposition

H26 The Ability to Amplify Skeletal DNA After Heat Exposure Due to Maceration

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After attending this presentation, attendees will become aware that the heat generated by the boiling of skeletal remains during maceration does not adversely affect the ability to amplify and analyze skeletal DNA found in the bone samples.

Forensic anthropologists can take bone samples for future DNA amplification (via the polymerase chain reaction) and analysis before or after removing soft tissues by the process of maceration. The heat and chemicals associated with the maceration process do not hamper the ability to successfully extract and amplify skeletal DNA found within the bone.

The goal of this presentation is to present to the forensic anthropological community the effect of heat exposure, due to the maceration of soft tissues, on subsequent polymerase chain reaction (PCR) analysis of skeletal DNA.

The sampling of skeletal material for genetic analysis is becoming increasingly common in the forensic sciences. For forensic anthropologists, a genetic profile obtained from skeletal DNA complements the biological profile constructed for an individual. In order to conduct a thorough skeletal analysis it is often necessary to remove by maceration any soft tissues that may conceal signs of trauma or bony landmarks used to create the biological profile. The maceration process involves immersing the remains in simmering water for an extended period of time. Because both heat and water are known to increase the rate of DNA degradation, and therefore hamper DNA amplification and analysis it is reasonable to think maceration may complicate the ability to successfully extract and amplify skeletal DNA found within the bone. However, the authors have previously demonstrated that the maceration of skeletal remains can improve the amount of extracted skeletal DNA detectable by chemiluminescent techniques, although the quantity of extracted DNA does not predict the quality or ability to amplify the DNA. This poster will present a subsequent study comparing the differences in the ability to amplify skeletal DNA before and after the process of removing soft tissue by maceration, and show that these differences are insignificant via statistical analysis.

Femora were collected from *Sus scrofa* (pigs) displaying varying stages of natural decomposition, ranging from one month to one year of surface exposure in a wooded area, which would be similar to the condition of skeletal remains that a forensic anthropologist would receive for analysis. Pig remains were chosen because their bone decomposition and microstructure are similar to that of humans, and because specimens are easily obtained for experimental studies. Fifteen pig femora were sampled for genetic analysis before and after six hours of simmering in water, 70 ml of Borax and 100 ml of bleach (in a 50cmx31cmx15cm pan) at 95º C. An additional thirteen pig femora were sampled for genetic analysis before and after ten hours of simmering in water, 70 ml of Borax and 100 ml of bleach (in a 50cmx31cmx15cm pan) at 95º C. Time intervals of six and ten hours were chosen in order to investigate a wider range of heat exposure. Water was periodically added to keep the bones submerged and keep the Borax and bleach concentrations constant.

Short interspersed nuclear elements (SINEs) are common target sites for PCR based genetic fingerprinting because of their high copy number in humans and other higher eukaryotes. A pig specific primer was designed to amplify a 374 base-pair region of the Pre-1 porcine SINE, which is found on several pig chromosomes. The Pre-1 porcine SINE primers were added to the skeletal DNA samples and amplified via PCR consisting of 35 consecutive cycles at 95º C for one minute, 62º C for one minute, and 72º C for one minute. The amplified samples were electrophoresed through an agarose gel and visualized after immersion in ethidium bromide and exposure to ultra-violet light. Amplification success was determined by the presence or absence of amplified skeletal DNA visible on the agarose gel. A total of 15 out of the 28 samples taken before maceration contained amplifiable DNA and 18 out of the 28 samples taken after maceration contained amplifiable DNA. The number of samples containing amplifiable DNA before versus after maceration was compared using McNemar's test for significant changes showed no significant difference between the two groups of samples at $p=0.05$.

High temperatures are known to increase the rate of DNA degradation by disrupting the chemical bonds in DNA molecules and accelerating fragmentation rates. This investigation into the amplification success of skeletal DNA obtained before versus after maceration is of value to forensic anthropologists in demonstrating that the heat generated by the boiling of skeletal remains does not adversely affect the ability to amplify and analyze DNA found in the samples.

Skeletal DNA, PCR, Maceration

H27 Home is Where the Bones Are: Rat Nesting Behavior as a Tool in Forensic Investigations

Tamara L. Leher, BA and Turhon A. Murad, PhD, California State University, Chico, Department of Anthropology, Chico, CA 95929-400*

After attending this poster presentation, the attendee will gain a better understanding of the importance of rat nesting behavior to forensic field investigations, as well as the need to provide resources for appropriately trained personnel to aid in field survey and excavation.

This presentation will impact the forensic community and/or humanity by emphasizing the need to be familiar with the nesting behavior of local rodent species as their nests may be a valuable source of evidence and human remains. This presentation also underscores the importance of providing resources for appropriately trained personnel in the areas of field survey and excavation techniques.

The intent of this poster is to demonstrate the importance of thorough field investigation, highlighting the need to be familiar with rat nesting behavior. A case study will be presented to underscore the importance of investigating rat nests for human remains as well as for other evidence that may shed light on the nature of the events surrounding the death of a particular individual.

It is not always the case that field investigators are able to discover the remains of an individual fully intact. In fact, it is often the case that the activities of any variety of animals can perplex field investigations, resulting in only the partial recovery of a set of remains. Rodents are infamous for their scavenging activity, often leaving their mark in the form of gnawing/bite marks. Eat and run is not always the rule of thumb; in fact some rodent species like to take their new found treasures home.

Neotoma spp. (species vary region by region), known as the woodrat or packrat makes it a habit of collecting various objects, including wood, bone, shell, etc. The packrat will typically range within 100 meters of their dens or nests, often at night and are found at elevations ranging from 0-3700m (depending on the species). Many species do not hibernate and will keep several food caches.

Archaeologists, paleontologists, and others have been investigating rat nests and middens for over 50 years and in that time, have been able to produce not only plants and pollen, but shiny objects and a large quantity of bone as well. The packrats are notorious for incorporating bone into their nests and being attracted to shiny items.

California State University, Chico, was contacted by a county in northern California to aid in the field recovery of human remains. Over a three day period, members of the CSU Chico Physical Anthropology and Human Identification Field Recovery Team traveled to the site, clearing brush, walking survey transects, and eventually excavating four packrat nests.

While conducting the survey, human remains were encountered on the ground surface, protruding from and lying on top of what were identified as rat nests. The area was cleared of excess brush, poison oak, and a few smaller trees. When the area was clear, four distinct mounds were identified as packrat nests. Over the next two days, crews worked to carefully excavate and sift material from the nests. On the last day, a fifth nest was discovered at the base of a tree, resulting in the recovery of additional remains. In total, 85% of the individual was recovered, 75% of which was located within the packrat nests.

A complex case such as this illustrates the importance of packrat nests to field investigations. Familiarity with the scavenging practices, but more specifically the general behavior and habits of the rodent species of a particular region may result in the recovery of a more complete set of remains, as well as additional evidence. This case also underscores the importance of providing the necessary resources for those appropriately trained in field survey and excavation techniques so that they may collect remains and evidence from burial scenes and surface scatters.

Rodent Behavior, Taphonomy, Forensic Anthropology

H28 Anthropological Tissue Depth Measurement Standards: A Comparison For Accurate Facial Reproduction

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After attending this presentation, attendees will obtain comparison information regarding data for facial reproductions.

This presentation will impact the forensic community and/or humanity by contributing additional novel data to a currently accepted investigation method.

A comparison was performed between accepted anthropological tissue depth measurements and documented postmortem tissue depth measurements for the purpose of evaluating a standard facial reproduction (a.k.a. reconstruction) procedure. The intent of such an evaluation is to review standard reproduction techniques and measurements for their accuracy, and perhaps, identify areas where improvements may be necessary.

The association between soft tissue and its underlying cranial morphology has been researched and reported upon in anthropological literature. However, there is a lack of research comparing facial reconstructions with documented tissue depth measurements taken immediately post mortem. Additionally, a comparison of anthropological versus medical measurements, such as those utilized in plastic surgery reconstructions has not been previously conducted.

The procedure of facial reproduction is a subjective matter, which requires much artistic interpretation. While this artistic interpretation is an integral element of facial reproduction, continued data collection may result in a more accurate and therefore, realistic interpretation. The premise of this study was the completion of a facial reproduction as may be executed in the course of an investigation with the artist blinded to all known specimen factors. A comparison of the finished reproduction product to pre-recorded tissue depth measurements was then performed.

A whole body donor was identified and tissue depth measurements taken at various sites of the facial and cranial bones.The cranial specimen was then prepared via an accepted skeletonization procedure to remove the soft tissue and clearly expose the boney structures. The artist then conducted a preliminary examination of the skull to estimate age, sex, and race of the specimen. Both two and three-dimensional reproductions were performed. Upon completion of both, the artist was supplied with the previously collected data. The two dimensional reproduction was visually compared with photographs of the deceased taken approximately five days post mortem. Photographs were taken with scale. The three dimensional reproduction, and the associated measurements collected and utilized with standard methodology, were compared with the pre-documented tissue depth measurements of the specimen, in an attempt to assess accuracy within the facial reproduction/reconstruction process.

Significant discrepancies were noted between standard anthropological tissue depth measurements and those collected post mortem from the donor specimen. The average measurement reported from the differences of the two measurement sets was 2.875 mm with a range of 0.25 mm to 11.00 mm. While some of these variations may be attributable to normal anatomical variation, morphology, cranial position at death or traumatic injury, this does not account for the large range of measurements in all areas. These factors hold importance in the facial reproduction process as they account for a considerable part of the variation in the sketching and modeling processes. Additionally, while few medical measurements are reported in the literature, those that are can be valuable to the discipline of anthropology and specifically to the reproduction procedure(s). Overall results indicate that there is some level of inaccuracy that may be overcome with proper data collection and comparisons.

It is envisioned that with additional research and long-term documentation of tissue depth measurements from donors of various age, gender and racial categories, there is potential for more accurate facial reproductions to be achieved.

Facial Reproduction, Tissue Depth Measurement, Facial Reconstruction

H29 Silent Slaughter in Guatemala: The Importance of Sex, Age, and Pathological Identification in a Case of Large Scale, Deliberate Starvation of Children

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After attending this presentation, attendees will be presented with another case in which complications associated with the application of inappropriate standards for sex, age, and pathological determination complicated a large scale forensic investigation.

This presentation will impact the forensic community and/or humanity by making forensic scientists more aware of the need for the establishment of appropriate standards for sex and age determination as well as pathological lesion interpretation, and to advocate the establishment of population specific standards for populations whose circumstances are unique.

This poster will use a case of large scale intentional starvation in Guatemala to demonstrate the importance of, and complications associated with the application of methods of aging and sexing, as well as the interpretation of pathological lesions on skeletal remains of a population with two confounding factors: subadult age, and chronic malnutrition prior to the event.

The value of reliable techniques of age and sex determination is well known in the forensic setting. It is also well known that the existing techniques for determining age and sex are significantly influenced by outside factors such as population specific variation in growth rate and the influence of illness and/or malnutrition on skeletal maturation. This poster demonstrates a set of circumstances within which sex and age determination are of unique relevance, individually buried, uncommingled remains in an area for which standards for sex and age determination are not established and there is considerable reason to believe that the existing ones are not appropriate.

Additionally, knowledge of the presentation and etiology of pathological conditions is known to be of considerable value in the interpretation of past lifeways from archaeological skeletal assemblages. This paper illustrates an instance in which this knowledge was of considerable forensic value, but that may fall prey to the same problems of interpretation that befall their interpretation in archaeological analyses (the osteological paradox).

In the 1980s, the Central American country of Guatemala was in the midst of a war between the government and the country's indigenous peoples which ultimately resulted in the massacre, forced disappearance, and extrajudicial killings of an estimated 100,000 to 140,000 primarily indigenous people. The year following the coup which resulted in Efrain Rios Montt's seizure of the country's presidency was by far the most devastating for the indigenous groups, only a small group of whom (in the form of leftist guerilla groups) had been fighting to improve their impoverished lifestyles and posed a threat to the government which was debatable at best. In 1982 the systematic removal of the adults and isolation of the children by the army, from the small Maya village of Ilom resulted in the deaths of approximately 150 children. It is suspected that the encirclement of the village by the military ultimately resulted in the deaths of the children by starvation rather than by the violent means used elsewhere. The ODHAG (Oficina de Derechos Humanos del Arzobizpado de Guatemala), a small forensic team funded by the Catholic church aimed, in the summer of 2003 to exhume the remains of some of these children in the hope that evidence supporting the starvation theory might be collected.

The particular circumstances of the interment of these children, including their hasty burial by families upon their return and the lack of grave markers associated with the individual graves, the extent of vegetation growth and finally the fact that 21 years had passed since the graves were dug compromised the confidence with which the anthropologists could follow the information provided by family members regarding grave locations. Often, general grave location was known, but upon contact with remains during excavation, doubt arose in the minds of the anthropologists regarding the reliability of the location of the grave. This was exacerbated by the fact that the estimated ratio of children to adults in the village, as in much of rural indigenous Guatemala is around 10:1, the result being a high number of children in the cemetery with which these children might be confused. Additional complications arose in the lab. It could not be concluded that the use of existing techniques of subadult age determination (based on American and German children) was appropriate to these children given their chronic malnutrition. Also several of the existing techniques for sexing sub adult remains including form of the ilium and mandible were used, but their appropriateness to this particular population was difficult to determine.

This poster illustrates these problems with photographs, diagrams, and comparisons to other data including the INCAP (Institute of Nutrition of Central America and Panama) longitudinal study that chronicled growth patterns of Guatemalan children and their response to nutritional supplementation. Upcoming research will compare specific portions of the INCAP data to the data collected here.

Sex and Age Determination, Pathology Identification, Guatemala

H30 Using Real-Time PCR Quantification of Nuclear and Mitochondrial DNA to Develop Degradation Profiles for Various Tissues

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The goals of this study are to develop nuclear and mitochondrial DNA postmortem degradation profiles for various soft and osseous tissues using real-time quantitative PCR; to compare the effectiveness of several DNA extraction and purification methods; and to mitigate the effects of co-extracted PCR inhibitors.

This presentation will impact the forensic community and/or humanity by allowing investigators to optimize compromised tissue sampling, extraction, and purification protocols in order to facilitate the decedent identification process.

DNA based decedent identification methods are dependant on the successful extraction, purification and amplification of template molecules. Oftentimes, samples encountered in forensic contexts are compromised due to postmortem degradation and environmental exposure. As a result, investigators must have a clear understanding of DNA amplification success potential for various tissues prior to sampling. Successful molecular analysis is also dependent on a comparative awareness of extraction and purification method effectiveness. This study explores DNA degradation as well as the isolation and purification capabilities of various extraction methods and inhibitor troubleshooting strategies.

DNA was extracted from lung, liver, spleen, psoas muscle, parietal bones, ribs, vertebral bodies, and femoral shafts obtained over a two year period from 28 pigs: 14 placed in a pond shore environment and 14 deposited on land beneath a broadleaf forest canopy. Tissue samples were extracted using the Armed Forces Institute of Pathology (AFIP) organic extraction protocol along with the Qiagen QIAamp® silica adsorption protocol. A 250 bp nuclear locus and a 226 bp region of the mtDNA D-loop were then amplified using the ABI® Model 7000 Sequence Detector. A sequence specific fluorescent probe was used to estimate initial template copy number in each sample. During amplification the probe hybridizes to the target DNA sequence. TAQ DNA Polymerase subsequently cleaves a fluorescent reporter dye from the hybridized probe. Upon cleavage the reporter dye fluoresces. As additional target amplicons are produced during each PCR cycle, the fluorescent signal increases. Samples containing a greater initial template copy number will produce a detectable fluorescent signal at an earlier amplification cycle (i.e. detection threshold cycle). The relationship between initial template copy number and detection threshold cycle is used to develop a DNA degradation profile for each tissue sampled over the two year postmortem interval. The degradation profiles provide insight as to the suitability of each sample for nDNA or mtDNA analysis given a particular deposition environment and postmortem interval. The amplification efficiency of each successful reaction is also measured to assess the need for further template purification. Complete amplification failure is further evaluated using quality control PCR (qcPCR) to differ-

entiate between amplification inhibition and DNA degradation beyond the limits of analytical sensitivity. Template samples determined to have co-extracted inhibitors are processed further to facilitate amplification. The effects of adding bovine serum albumin, sodium hydroxide, and larger quantities of Taq Polymerase on amplification efficiency are evaluated.

Based on the aforementioned information, investigators will be able to optimize compromised tissue sampling, extraction, and purification protocols in order to facilitate the decedent identification process.

DNA Degradation, Real-Time PCR, PCR Inhibition

H31 Preservation in Paradise II: A Pre-Columbian Burial in a Contemporary Cemetery

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The goal of this presentation is to document the discovery of a Pre-Columbian burial encountered in contemporary cemetery on the island of Coiba, Republic of Panamá.

This presentation will impact the forensic community and/or humanity by enabling us to identify a unique, non-forensic feature in a contemporary forensic setting as well as providing insight into possible factors involved in the preservation of skeletal remains in a tropical environment.

Pre-Columbian indigenous populations inhabited the island of Coiba, off the Pacific coast of the present-day Republic of Panamá, from approximately 500 BCE until the early 16th century with the arrival of the Spanish. This paper presents the excavation, recovery and analysis of a Pre-Columbian burial encountered in contemporary cemetery (the Marañon Cemetery), during the course of human rights work on the island of Coiba, Republic of Panamá. The Marañon Cemetery has served as a final resting-place for the inmate inhabitants of the Coiba prison colony from 1914 until 1992. The Pre-Colombian remains that are the focus of this work were encountered in a relatively shallow grave, approximately 55-cm in depth, on the west side of the cemetery and were arranged in a neat "packet style" burial.The remains were extremely fragmentary and fragile. All the bones displayed cortical flaking and many elements crumbled upon contact. Roots and dirt were present in almost all of the elements. All skeletal elements appeared to be represented, although the deteriorating preservation did not permit the intact recovery or inventory of all elements. However, even though the general state of preservation of this burial was poor, several nearly complete bones were recovered. The remains were not in an anatomical or articulating position, indicating that they were skeletonized when they were placed in the grave. Historical sources document that the Guaimi Indians of the Chiriquí region observed similar burial practices, exposing the cadaver on a platform for a year and then interring the bones in family burial grounds. The skeleton was determined to most likely represent a female, based on gross cranial and pelvic morphology, in her late teens or early twenties. Age was assessed via the epiphyseal closure method. Fragments of iliac crest displayed clear epiphyseal scars and the vertebral epiphyses were not fused to the vertebral bodies, suggesting an age of less than 25 years. Ancestry was assessed via morphological features and pathologic conditions of the remains. Severe wear was exhibited on the teeth, especially the molars and incisors, exposing the dentin. Some degree of flattening was observed on the occipital. Expansion of the diploë was noted, with cranial thickness measured at 10mm. Porotic hyperostosis was present on the parietals and the occipital while significant bilateral cribra orbitalia was noted on the orbital plates of the frontal. These latter conditions are indicators of anemias that are commonly observed in prehistoric populations, but are rarely seen in contemporary populations. Linear enamel hypoplasias were noted on a canine and an incisor. This suite of traits indicates that these remains are of pre-Columbian indigenous origin and not of forensic medico-legal significance. While the state of preservation of this burial would by and large be considered poor, the authors were surprised to find that it was actually better preserved than many of the contemporary burials that were examined. Factors possibly contributing to this differential preservation may be the fact that the burial was located further away from the destructive palm root systems on the east side of the cemetery, and that the remains were skeletonized when they were buried, depriving the root systems and insects of soft tissue on which to feed. This unique burial enabled us to identify a non-forensic feature in a contemporary forensic setting as well as providing insight into possible factors involved in the preservation of skeletal remains in a tropical environment.

Pre-Columbian Burial, Forensic Anthropology, Tropical Environment

H32 The Archaeology of Tyranny

Lazaro M. Cotes, Comision de la Verdad, Balboa, Panama City, Panama; Kathryn M. Jemmott, MA, CA Pound Human ID Laboratory, University of Florida, Building 114 SW Radio Road, Gainesville, FL 32611; Loreto S. Silva, Comision de la Verdad, Balboa, Panama City, Panama; Ann H. Ross, PhD, North Carolina State University, Department of Sociology and Anthropology, Raleigh, NC 27612

The goal of this presentation is to present the identification of human rights victims in the Republic of Panamá.

This presentation will impact the forensic community and/or humanity by demonstrating anthropological methods that can be successfully used for human rights identifications, even in tropical environments, that are not conducive to good preservation of remains.

The Republic of Panamá has experienced a tumultuous first century of independence from Colombia, including the military dictatorships of Omar Torrijos (1968-1981) and Manuel Noriega (1981-1989), and the United States invasion in 1989. During the period of the dictatorships, over one hundred individuals were "disappeared" or executed for their political views. In 2001, the Panamanian Truth Commission (Comisión de la Verdad) was formed in attempts to identify the "disappeared" and offer some closure to the families of the victims. Based on informant testimony received by the Truth Commission that suggested some of the "disappeared" may be on Coiba, the authors, under the auspices of the Truth Commission, and with the cooperation of the National Police and the assistance of many others, undertook a large scale excavation of the Marañon Cemetery on the island of Coiba, Republic of Panamá. A T-probe was used to locate soft areas in the ground, suggesting possible graves. Workmen shoveled down through the ground until the outlines of a grave or remains were located, or until hard, undisturbed ground was reached. Careful excavation of the remains then followed, in hopes of retrieving intact elements to aid in the identification process.

This paper will focus on the analysis of the remains of two individuals, one who remains unidentified, the other who now has name, Jerónimo Díaz Lopez. The first individual nicknamed El Pectorado, for the large wooden cross lying on top of the chest area, was in a relatively good state of preservation. The remains were determined to represent an adult male of indigenous ancestry (like the general population of Panama) most likely in his late thirties or forties. A reactive healing fracture was noted at the distal third of the left fibula. In addition, there was evidence of a healed fracture to the right nasal and frontal process of the maxilla. A perimortem, comminuted fracture with no evidence of

healing was observed approximately one third of the distance from the acromial end on the left clavicle. Fractures of the outer third of the clavicle are relatively rare, involving only 15 to 30% of clavicular fractures. The fracture appears to have resulted from a direct blow to the anterior aspect of the one, rather than a fall on a shoulder, which is the most common cause of clavicular fractures. This individual may represent one of the prison inmates or one of the "disappeared," and the authors continue to hope that his biological profile may match a profile as information continues to be revealed.

The other set of remains, now identified as Jerónimo Díaz Lopez, displayed variable states of preservation with the long bones being relatively well preserved, while the axial skeleton was very fragmentary and poorly preserved. Several religious artifacts, such as rosaries and religious icons, were found around the neck area. Sex was assessed via gross morphology of the cranium and pelvis and age was assessed via the epiphyseal union method. The remains were determined to be those of a male in his early twenties, with African admixed ancestry. Seven coins were also recovered in the grave with dates ranging from 1965 to 1983, indicating a date of death no earlier than 1983. All of these factors were consistent with the biological profile of Jerónimo, who was said to have escaped Coiba on a raft in 1985. The clinching identifying characters were two gold upper central incisors, one of which was false, the other was a gold cap inscribed with what appeared to be the letter "V." These teeth were consistent with those of Jerónimo, described by his sister, and positively identified by his brother. After 18 years of wondering where Jerónimo was, if he would ever come home, his family now knows where he has been and that, unfortunately, he cannot return home. This work demonstrates that anthropological methods can be successfully used for human rights identifications, even in tropical environments, that are not conducive to good preservation of remains.

Human Rights, Panama, Forensic Anthropology

H33 An Historical Perspective on Nonmetric Skeletal Variation: Hooton and the Harvard List

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After attending this presentation, attendees will learn the historical perspective on Earnest Hooton's research on nonmetric morphological variants as indicators of ancestry.

This presentation will impact the forensic community and/or humanity by demonstrating increased awareness of the development of nonmetric trait analysis within forensic anthropology.

Earnest A. Hooton (1887 – 1954) was perhaps the most influential physical anthropologist among early researchers interested in the field of race and race studies. Hooton single-handedly trained most of the dominant contributors to the study of race. During his tenure at Harvard University, beginning in 1913, and ending with his death in 1954, he displayed an active interest in all things racial. The focus of this presentation is his research detailing the nonmetric morphological variants he prescribed as useful indicators of racial affinity.

Hooton believed it was possible to find non-adaptive morphological variants capable of differentiating the various 'races' of man and that morphological features were of greater anthropological significance than diameters and indices. In lecture notes obtained from the Peabody Museum, Hooton expresses his views concerning the advantages and disadvantages of morphological (as opposed to metric) observations as racial criteria. Advantages of anthroposcopy and morphological traits according to Hooton are: "1) [They] spring to the eye, [and are] qualitative as well as quantitative; 2) [They are] dependent upon form difference rather [than] size, [or] proportions; and 3) [Are] more certainly heritable." The only disadvantage of morphological treatment, according to Hooton, was that many of the traits are incapable of metric treatment. Hooton, whose list of students represents a Who's Who of later race/ancestry researchers, passed on to his students traits he deemed diagnostic of race. They are not referenced to a particular study by Hooton; rather, they represent his legacy as a teacher. These traits, and their perceived value in ancestry determination, have continued to be passed on from mentor to student, almost unchanged to the present day. Despite their widespread use, actual frequencies in more modern populations have only recently been adequately assessed.

To facilitate data collection, Hooton began to develop the forms and standard descriptions known as the Harvard List. The List has changed little since the time Hooton was recording data. Although no one knows for sure how many anthropologists use similar versions of the List, it is reasonable to assume that a majority of Hooton's students used or borrowed from it when establishing their own laboratory protocols for data collection. Hooton believed that "methods and methodology [were] the very vitals of any study and should be kept up to date and in the forefront of ones thinking." In an unpublished manuscript, Hooton tests the Harvard List on five of his former students – Coon, Angel, Birdsell, Lasker, and Newman – to assess their ability to score nonmetric variants without standard illustrations. This preliminary test failed miserably, with the observers in agreement in only 18.7% of the cases. These formative tests pointed out a shortcoming of the List – a lack of standardized scales for observation. Unfortunately, the Hooton archives do not include the second trial of these five participants utilizing standard scales, so it will never be known whether the scales would have helped, or whether Hooton was satisfied with the use of the Harvard List by subsequent researchers. Despite his awareness of this shortcoming and his attempts to resolve the issue, the lack of standardized descriptions of morphological variants continues to present a serious obstacle to accurate and consistent ancestry determination by modern physical anthropologists.

Ancestry, Nonmetric Variation, E. A. Hooton

H34 Nonmetric Trait Frequencies and the Attribution of Ancestry

Steven N. Byers, PhD, University of New Mexico at Valencia, 280 La Entrada Road, Los Lunas, NM 87031*

After attending this presentation, attendees will understand the value of nonmetric trait frequencies in attributing ancestral group to human skeletal remains.

Forensic anthropologists and other scientists will realize the complexity of using nonmetric traits to attribute ancestry.

A study was performed to explore the possibility of attributing ancestry to human skeletal remains from nonmetric trait frequencies. Since the attribution of ancestral group (e.g., race) is one of the four major demographic characteristics used by law enforcement agencies to begin the process of matching skeletal remains to missing persons files, any method that aids in the correct determination of this trait is of no small importance to forensic anthropologists.

Published statistics of ancestral groups in the United States (e.g., White, Black, Asian, American Indian, and Hispanic) were gathered both from the general population and from population subgroups (e.g., state, local statistics) as well as from US crime statistics. Also, the frequency of nonmetric traits of the teeth (e.g., shovel-shaped incisors, Bushman canine), skull (e.g., os japonium, Inca bones), and postcranium in these groups also were gathered. Using simple mathematical (e.g., combinatorics) and statistical techniques (e.g., Bayes' Theorem), these data were analyzed several different ways to determine their value in attributing ancestry. First, the occurrence of a trait was used to compute the probabilities of ancestral grouping using raw frequencies of indi-

vidual characteristics. Next, these frequencies were combined to determine the value of the occurrence of multiple traits to attribute ancestral group; at this stage, methods were used to combine these traits assuming both independence and dependence of trait occurrence (e.g., the probability of shovel-shaped incisors and incisor winging). Finally, these data were entered into Bayes' Theorem to estimate ancestry from the occurrence of a trait or suite of traits given the breakdown of ancestral groups both in the general population and within smaller demographic areas (e.g., state, county) as well as statistics on deaths due to murder, suicide, and accident.

Some surprising, and even unlikely, results were obtained. For example, although shovel-shaped incisors are much more common in people of Asian ancestry (including Native American) than those descended from native people of Europe and Africa, the occurrence of this trait in a skeleton gives only a probability of p=.345 that the person was of Asian ancestry. This is due to the small portion of people in this group (approximately 4.5%) in the general US population. The probability of White ancestry with the occurrence of this trait is approximately p=.526 while it is p=.129 for Black ancestry. This result is surprising considering the weight given by forensic anthropologists to the appearance of such features. With this and similar findings in mind, a number of questions emerge from this study. First, how accurate are the published frequencies of these traits? (Hrdlicka reported a frequency of 8.8% for U.S. Whites with shovel-shaped incisors.) Second, how representative of the general population of the United States are these frequencies? Third, should the frequencies in the general population be used in these calculations or are local and even death statistics (particularly, criminal deaths) more appropriate? Given the complexity of this situation, it appears that considerable judgment must be used when employing nonmetric traits in the attribution of ancestry.

Nonmetric Traits, Ancestry, Bayes' Theorem

H35 Non-Metric Indicators of Ancestry: Making Non-Metric Traits More User Friendly in Racial Assessments

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Attendees at this presentation will be able to assess the utility of racial assessment of skeletal remains primarily between Caucasoid and Negroid ancestries. They will learn the accuracy of radiographic technique on cranial remains and which infracranial non-metric traits are best suited for accurate racial assessment. Finally, they will have an appreciation of the most productive infracranial traits used in discriminating between Negroid and Caucasoid ancestry in skeletal forensic cases or cases involving human rights violations.

The addition of techniques, procedures and methodology in the estimation of racial ancestry in difficult forensic cases-either current legal cases or cases of human rights violations.

During the last 25 years, a number of techniques have been employed to use non-metric traits, either singularly or in various sets, as an indicator of skeletal ancestry. Works by Finnegan and Schulter-Ellis, 1978; Cooprider et al., 1980; Finnegan and Rubison 1984; and Finnegan 1994, have addressed the usefulness of a variety of radiographic and observational non-metric trait techniques in assessing the racial affiliation of earlier human crania and infracranial skeletons and the more applied assessment of single skeletal remains to their parent racial group using various non-metric traits. While classification accuracy of pairwise comparisons ranges from 85% to 95% in infracranial archaeological and cadaver dissection room materials samples and specific cranial pairwise comparisons approach 98% accuracy between Caucasoid and Negroid cranial samples. However, a number of the necessary techniques are either quite time consuming or statistically tedious and therefore not in general use. A general, less cumbersome discriminant analysis is needed if non-metric infracranial traits can be employed in current and future case work in forensic anthropology.

To these ends, the data on thirty infracranial traits were taken on 356 individuals from three earlier archaeological samples; Aleuts, Coast Eskimo and Yukon River Eskimo, and two cadaver dissection room samples, Americans with predominately Caucasoid ancestry. and Americans with predominately Negroid ancestry. All samples were housed at the Department of Anthropology at the Smithsonian Institution. The sex of the skeletons was known in the dissection room samples. In the archaeological samples, sex was estimated on the basis of pelvic morphology. While infracranial non-metric traits are rarely significantly different from side to side in population samples, they are often asymmetric from side to side within the individual. Therefore, for the purpose of racial differences, each side was considered a data set, thus allowing 2N for our sample, or 712 items. Since all individuals did not have all or complete elements, the number of observations per skeleton varied slightly. As well, those elements showing pathology or trauma, either antemortem or postmortem, were also excluded. As a result, the final sample sizes were slightly reduced.

The criteria for scoring the non-metric traits was taken from Finnegan (1978). To eliminate inter-observer error, all observations and data recordings were made by the author. Skeletal elements read early in the day were reread late in the day to control any evolution in the reading criteria.

The results of pairwise comparisons and the accuracy of individual assignments varied considerably between population groups (68% to 92%). None of the individual comparisons met the accuracy suggested by reported cranial or infracranial non-metric population studies! However, some selection of particular infracranial non-metric traits did produce more consistent classification assignments (78% to 96%), but an a priori selection limiting the number of non-metric traits and population samples was necessary. This a priori selection may not distract from the usefulness of using infracranial non-metric traits in the assessment of ancestry in skeletal forensic cases or cases involving human rights violations.

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Finnegan M. Schulter-Ellis FP. The tympanic plate in forensic discrimination between American Blacks and Whites. *J Forensic Sciences*, 1978;23(4):771-777.

Race, Skeletal Remains, Ancestry

H36 Playing the "Race" Card Without a Complete Deck: The Addition of Missing Asian Data to Aid Racial Determinations in Forensic Casework

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After attending this presentation, the viewer will understand: 1) the application of non-metric methods in race determination of human skeletal remains in forensic casework, 2) the necessary utility this affords the forensic scientist in determining an individual biological profile and ultimately, individual identification, and 3) improvements needed in the reference population data set.

This presentation will impact the forensic community and/or humanity by improving the accuracy in making racial estimations of human remains within the context of forensic identification casework, specifically addressing the problem of a lack of a true Asian population in the reference data used in the determination of Mongoloid remains.

The identification of human skeletal remains in forensic casework often requires both inductive and deductive observations. The process requires first the deductive capability of building a singularly clearer picture, or biological profile, of an individual from potentially a whole suite of smaller clues – in the case of the forensic anthropologist, specific bony landmarks. Inductive processes then take over in the comparison of specific characteristics from this unknown individual with like characteristics observed in medical and dental records of known individuals fitting the same general profile. This is a practical application of the science of anthropology to problems in the "real" world.

The forensic application of anthropology to the problem of racial estimation is often misconstrued as inconsistent with theoretical components of biological anthropology. However, basic tenets must be emphasized in the application of anthropological techniques towards forensic ends: (1) Forensic anthropologists do not place value judgments on their determinations of race, and unlike pure academic anthropology, which focuses on describing population groups and their life-ways, forensic applications of the science ultimately seek to identify the individual; (2) Race is an important social construct that can often be assessed through skeletal observation, and since the public that is served by forensic investigation requires descriptive diagnoses which can be applied to narrow the search for individual identity, forensic anthropologists would be remiss to disregard the ability to identify these skeletal traits. Forensic determinations of racial affiliation do not further notions of racism. At the same time forensic anthropologists must work within the framework understood by the living, applicable to how they perceive themselves. Genetically based, phenotypically expressed, or characteristically perceived, race determinations are a valid and important tool used in the forensic sciences successfully to help achieve positive identifications and bring needed closure to both loved-ones and the judicial process.

It is the nature of comparative methods that a reference sample representing a population be a true model of that group. For years, the broad reference population designated "Mongoloid" has been defined by studies almost entirely derived from "Southwestern Mongoloid" remains (Rhine 1990). The model in general has been developed by researchers most familiar with American forensic cases, skeletal series such as the Terry and Hamann-Todd collections, and a variety of Native American archaeological populations. Clearly, data specifically including Asian and Southeast Asian populations are under-represented. Our research involves an examination of non-metric cranial features in modern Southeast Asian skeletal populations. Skeletal collections from the Chiang Mai University Medical School, Thailand, the Mahidol School of Medicine in Bangkok, Thailand and a collection of remains stored in the Memorial Museum at the former Choeung Ek Khmer Rouge prison camp near Phnom Penh, Kingdom of Cambodia were subjected to non-metric trait analysis. The results will be evaluated by critical comparison to the model for Southwestern Mongoloid as described by Rhine in his 1990 publication "Non-Metric Skull Racing," in the edited work Skeletal Attribution Of Race (Gill and Rhine 1990). Standard criteria were used for assessing racial affinity in forensic contexts. It is hypothesized that the Southeast Asian remains will display some trait frequencies relatively consistent with the standard repertoire of Mongoloid traits, but that they will also display features and trait frequencies that contradict the commonly accepted model. The end result of this research will be presented here and will contribute to the important ongoing critical evaluation of forensic racial assignation, expand the overall database of non-metric cranial traits in human populations, and refine the criteria for assessing racial affiliation in forensic contexts.

The opinions and assertions expressed herein are solely those of the authors and are not to be construed as official or as the views of the United States Department of Defense, the United States Department of the Army, or the United States Army Central Identification Laboratory, Hawaii.

Non-Metric Race Determination, Human Skeletal Remains, Forensic Casework

H37 The Zygomaticomaxillary Suture: A Study of Variability Within Homo Sapiens

Amy A. Holborow, BS, MA, Department of Anthropology, University of Wyoming, PO Box 3431, Laramie, WY 82071*

After attending this presentation, attendees will understand how one can use zygomaticomaxillary suture patterning to aid in the identification of an individual's ancestry.

This research will have an immediate impact throughout the field of forensic anthropology because it illuminates previous studies and gives more detailed insight into population biology.

This research examines the frequency of occurrence of different zygomaticomaxillary suture shapes/forms among major populations of *Homo sapiens*. This study tests the hypothesis that zygomaticomaxillary suture shapes do not differ in frequencies within various major populations of *Homo sapiens*. This research expanded on a previous study (n=133) by examining a sample size of 769 individuals from eleven major worldwide populations. Frequencies of these two suture shapes were determined for each of the populations and this evidence was used to determine the forensic utility of this trait. Populations examined for this study include U.S. Whites, American Indians from the Southwest, American Indians from the Great Plains of North America, U.S. Blacks, Japanese, Northern Chinese, Southeastern Chinese, Mongolians, Australian Aborigines, Peruvians, and East Polynesians from Easter Island.

The primary goal of this research is to assess the frequencies of suture shapes within a sample that represents many of the world's major populations. A second objective of this study is to determine whether or not other suture shapes exist besides the curved and angled forms described in previous studies. The third goal has been to determine the forensic utility of using suture patterning to aid in the identification of an individual's ancestry.

Two methods, a visual assessment and a metric assessment, are used to classify the angled and the curved suture patterns. For many years, the visual method was accepted as the standard way to assess the zygomaticomaxillary suture pattern. While testing the visual method, the author found that many individuals are hard to assess visually, meaning it is difficult to tell whether they have angled or curved patterns. These borderline patterns appear to look 'straight' until the use of metrics allows one to determine reliably whether the pattern is angled or curved. Through testing, the author established a more accurate method using calipers to take three measurements along the suture. The three measurements taken along the suture are: M1= zygoorbital breadth; M2 = bimaxillary breadth; and M3 = widest breadth along the sutures at any point above the bimaxillary points. These measurements allow for the assessment of the overall suture pattern for an individual in a manner that is more objective, replicable, and testable.

After collecting data from 11 different populations (n=769) the null hypothesis was rejected. As a result of this study it was discovered that many populations do pattern well and have significantly higher frequencies of angled or curved forms. The author established that the previously documented curved and angled forms are the only two shapes that consistently pattern well within populations. Furthermore, the author determined that this trait is forensically useful in assessment of ancestry, however, it is not as definitive as suspected in previous studies. This research also revealed the weakness in using one trait solely for race attribution. The zygomaticomaxillary suture is a useful forensic trait *only* when combined with the many others used to assess ancestry. With documented suture pattern frequencies for many populations, forensic

anthropologists will now know what the probability of assessing ancestry is using zygomaticomaxillary suture patterns. This research will have an immediate impact throughout the field of forensic anthropology because it illuminates previous studies and gives more detailed insight into population biology.

Forensic Anthropology, Zygomaticomaxillary Suture, Ancestry

H38 Racial Variation in Palate Form and the Shape of the Transverse Palatine Suture

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After attending this presentation, attendees will have been presented for consideration of forensic and physical anthropologists the racial differences noted between Black, White, and Native Americans in palate shape and transverse palatine suture form.

This presentation will impact the forensic community and/or humanity by demonstrating that both palate form and transverse palatine suture shape differ significantly by major racial population and are, therefore, of value in assessing ancestry from skeletal remains. Palate form is shown to be of much greater utility in this regard than is palatine suture shape and can be seen from this study to be one of the very best areas of the skeleton for the attribution of race within Homo sapiens.

Regardless of the debate over the validity of race, the identification of ancestry through the quantification of observable racial characteristics has proven essential in forensic casework in order to help establish a victim's identity. This study defines two skeletal traits thought to be important to skeletal biologists and forensic anthropologists – the shape of the external bony palate and the form of the transverse palatine suture. The frequency of occurrence of both traits is determined for three North American skeletal population samples, which will be referred to here as Black American, Native American, and White American.

As early as 1916, physical anthropologists noted variations in palatal form. Earnest A. Hooton created a checklist for anthropology students at Harvard University to insure consistency in the research performed on various osteological specimens. On this list, Hooton noted shapes of palates. While these data were collected, they do not appear to have been compiled in any systematic scientific study. After the creation of the Harvard Checklist, palatal forms went virtually unnoticed until the latter half of the 20th century. Although researchers mention variation in palatal form, a comprehensive study of these forms was not performed until the early 1980s. Then, George W. Gill added palatal forms to the University of Wyoming's Osteology Checklist. Samples of Plains Indians and Pioneer Whites were examined from the University of Wyoming collections, as well as American Blacks from the Terry Collection of the Smithsonian Institution. After 15 years of collecting data on forensic and archaeological specimens, Gill noticed what he thought were clear patterns of palatal form variation. Gill also described palatal form trends within major geographic populations.

Masters student Patrick Chapman was asked, in the early 1990s, to begin compiling data on palatal forms. Chapman began to compile data for the study from additional records of the osteological repository at the University of Wyoming. This survey included specimens returned to law enforcement agencies, Native American groups, Peruvians, Polynesians, and others.

From these data, Chapman recorded the palatal forms he looked at in three basic categories outlined in the Harvard Checklist – triangular (parabolic), elliptic, and hyperbolic. Chapman further illustrated what Gill had suggested – that these palatal forms occurred in different frequencies within the various major geographic racial groups represented in the United States. According to Chapman's compilation, Black Americans frequently exhibit hyperbolic palatal forms, Native Americans and East Asians often show elliptic forms, and White Americans tend to display parabolic palatal forms. Chapman also worked with many specimens from Gill's research on Easter Island and in Peru, finding interesting correlations with these populations as well. However, the current study focuses solely on Black, Native, and White American groups.

Chapman also compiled research collected by Gill on transverse palatine suture forms. These sutures, Chapman noted, fit into four basic categories, which he defined as anterior curved, anterior jagged (jagged), posterior curved, and straight. While each of these suture forms exists within all North American populations, posterior curved sutures seem to rarely occur outside Polynesian peoples. Within the U.S. populations reviewed in Chapman's work, the following correlations between transverse palatine suture forms and races were made: Black Americans most often displayed anterior curved sutures, Native Americans and East Asians frequently exhibited straight sutures, and White Americans tended to show jagged sutures.

The current study began mainly as a way to expand the samples of the populations researched by Gill. Because the majority of the research on American specimens performed by Gill and compiled by Gill and by Chapman centered on the western United States, the present research investigates palatal forms and suture types on populations not explored in previous studies. This was done to determine whether the correlations between palatal forms, transverse palatine sutures, and race exist in populations throughout the United States. Of particular interest are Native American populations since the Chapman and Gill research centered primarily on Plains Indian populations.

The current study further performs statistical analysis of non-metric traits to determine the association, if any, between population and palatal form, as well as between population and transverse palatine suture shape. These statistical analyses are then compared to those of Chapman and Chapman and Gill. It evaluates palatal shapes and transverse palatine suture forms based on the visual criteria defined by Gill. The study makes three discrete observations, which are palatal form, palatine suture form, and a new method of palatine suture form classification.

Palate, Palatine Suture, Population Variability

H39 Femoral Variation Between Whites and American Indians

H. Anne Halvorsen, MA and Rick L. Weathermon, MA, Department of Anthropology, University of Wyoming, Laramie, WY 82072*

This discussion will present to the physical and forensic anthropological community a detailed study of three areas of the femur which demonstrate significant variation between two populations, U.S. Whites and American Indians, and which show promise in distinguishing these populations in a forensic context.

The femur has long been studied in physical anthropology, and notable differences have been found between major human populations. Studies at the University of Wyoming have focused primarily on morphological differences noted between whites and American Indians. The current study expands on three such studies, and provides a way to quantify these differences. This study compares the means of these populations in three areas: femoral torsion, platymeria, and intercondylar notch height. Statistical analyses were run to test the hypothesis that in each of these areas independently no significant variation exists.

Torsion height is a single measurement taken with standard sliding calipers, where the maximum height of the femur head is measured from the surface upon which it is resting, with both condyles lying flat on the surface. Differences between American Indian femora and those of whites have been noted in the degree of torsion, with American Indians evidencing higher torsion. Statistical analyses from the current sample have supported this observation, and noted that the difference is quite significant. At the extremes of the populations, racial discrimination in a forensic context can be obtained with a high degree of certainty from this trait alone.

Femoral platymeria has been shown to be another trait useful in distinguishing individuals from these populations, with American Indian femora exhibiting a much higher degree of platymeria, or flatness, of the proximal femur. Platymeria is obtained through two standard measurements of the femur, anterior-posterior (A-P) and medial-lateral (M-L) subtrochanteric diameter. Together these measurements quantify the observed morphology of the proximal end of the femur in cross-section; whites tend to be more circular in cross-section, with similar values of both A-P and M-L, while American Indian femora exhibit a flatness of the femur, with a smaller A-P diameter. Statistical analyses of these populations in the current study again show that there is a significant difference in this trait, and that it is another trait which can be extremely useful in distinguishing femora from these populations.

Finally, variations in the intercondylar notch height of the distal femur were compared between the two populations. Intercondylar notch (ICN) height is another single measurement taken of the maximum height, wherever found, of the ICN from the surface upon which the bone is resting, in the same position as with torsion height. Statistical analysis demonstrated that there is a significant difference between the means of the two populations, with whites exhibiting a higher ICN height. With this trait alone, femora of these populations can be distinguished with a high degree of certainty at the extremes of each population.

This study has been conducted in an attempt to explore and quantify variations between the femora of whites and American Indians, and has its most value, perhaps, in a forensic context to help in the identification of individual unknown skeletal remains from these populations. Each area of the femur explored here has shown variation between these populations which has proven to be statistically significant. This study lends credibility to the observed morphological differences which have been noted in the past, and quantifies how valuable are these techniques of racial differentiation by use of the femur.

Femoral Variation, American Indians, US Whites

H40 Population Variability in the Proximal Articulation Surfaces of the Human Femur and Humerus

George W. Gill, PhD, Department of Anthropology, University of Wyoming, Laramie, WY 82071*

This presentation will demonstrate the magnitude of racial difference between American Indians and Whites with regard to two important long bone articulation surfaces, and then to provide a new, adjusted metric scale for accurate sexing of native remains.

Since Thomas Dwight, the father of American forensic physical anthropology, conducted his pioneering work on the human femur at the end of the 19th century, the maximum diameter of the head of the femur has been known to vary significantly between males and females. Since the work of Dwight's student, George A. Dorsey, on the vertical height of the head of the humerus (1897 – only three years after Dwight's historic Shattuck Lecture) the proximal end of that bone has likewise been acknowledged as a reliable indicator of sexual dimorphism. Pearson and others soon followed these earliest investigations with additional work, particularly on the femur. The majority of these metric studies however focused on the large-statured Whites of Europe and North America, with little attention to the more moderately proportioned populations indigenous to Asia and the Americas.

T. Dale Stewart, a pioneer of these kinds of sexual dimorphism studies within the modern era of forensic anthropology, did extend these same metrics to significant samples of American Blacks. He found the means for the two populations (U.S. Blacks and Whites) regarding maximum diameter of the femoral head, at least, to be nearly identical. White males average 48 mm in femur head diameter while Black males average 47.2. The White female mean of 42 mm is even closer to the Black female average of 41.5 mm. Such close patterning between these two large populations of North America has, over the years, led forensic anthropologists, bioarchaeologists and other human osteologists to tend to utilize a single scale for the sexing of the skeletal remains of all populations of Homo sapiens.

In order to test the reliability of the use of this metric scale (published first by Stewart and then later by Bass and others in modern standard textbooks) beyond the initial population samples of U.S. Blacks and Whites, the present study was undertaken. During the author's excavations and analysis of prehistoric skeletal remains from coastal West Mexico in the 1960s, data collection for these two measurements of the femur and humerus was initiated. The focus at the time was to test these dimensions collected on a short-statured population of indigenous Mesoamericans against those collected historically from samples of American Whites and Blacks. Initial results were suggestive of meaningful racial differences, so in order to develop further data from another contrasting sample of American Indians, similar measurements were collected on Northwestern Plains Indians. Within the past year all metrics have been compiled from both American Indian population samples, with a total adult skeletal sample of 67 Mesoamerican Indians, and 58 Northwestern Plains Indians. The means for these two Native American populations on both femoral head diameter and the vertical diameter of the head of the humerus are nearly identical. On the other hand, they are smaller than (and differ significantly from) the means for Blacks and Whites. This has led to the development of new metric scales for the sexing of American Indian skeletal remains that are specific to Native Americans and therefore provide more accurate results in skeletal analysis. These results also underscore the importance of testing for racial differences in important skeletal traits of Homo sapiens before using them beyond the initial population samples upon which they are based.

Population Variability, Femur, Humerus

H41 Racial Assessment Using the Platymeric Index

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The goal of this presentation is to illustrate the usefulness of the platymeric index as an indicator of race.

This presentation will impact the forensic community and/or humanity by demonstrating that subtrochanteric shape can be successfully used to distinguish between Native Americans and American Whites and Blacks in skeletal cases.

Noticeable differences in the shape of the proximal diaphysis of the femur have been observed between populations. The two most frequently cited causes for these differences are biomechanics and genetics. In the anthropological literature, biomechanics have probably received the most support, but Gill and his colleagues have argued that marked racial, and therefore genetic, differences are present in the shape in the proximal femur. In general, Gill and colleagues have found that the subtrochanteric anteroposterior diameter in Whites and Blacks is greater than that of East Asians and Native Americans. In other words, Whites and Blacks tend to have eurymeric (rounder) diaphyses, while Native Americans and East Asians have platymeric (flatter) proximal femur shafts.

In this paper, we examine variation and population differences in proximal femur shape using the platymeric index (PI) on a sample of nearly 3000 individuals. Among populations, the PI typically ranges from approximately 70 to 100. Individuals with an index below 85 are

considered to display platymeria, while those above 85 are eurymeric. For the analysis of population differences, we examined five populations: American Blacks (N=319), American Whites (N=672), Native American (N=1280), Polynesian (N=179), and non-Indian Mexicans (N=40). We then, as did Gill and colleagues, grouped Native Americans and Polynesians into one group and American Whites and Blacks into a second group. The Native American group was then subdivided into six geographical regions (Northern Plains, Central Plains, Southern Plains, Prairie, Great Basin, and Southwest) and three subsistence strategies (Agriculturalists, Hunter and Gatherer, and Village Horticulturalist). No significant differences were found between males and females within populations, so the sexes were pooled for analysis.

Our results generally support Gill and colleagues' assertion that the PI can be used successfully by forensic anthropologists to distinguish Native Americans and Polynesians (81% correctly classified) from American Whites and Blacks (74% correctly classified). Native Americans (mean PI=78) and Polynesians (mean PI=71) are on average more platymeric than American Whites (mean PI=90) and Blacks (mean PI=91). Non-Indian Mexicans (mean PI=89) generally have a subtrochanteric femur shape more similar to American Whites and Blacks. Our results strongly suggest, however, that some caution should be used when using the platymeric index to discriminate between populations. The range of variation in all populations is considerable, making discrimination between the five populations difficult. Native Americans, for example, range from extremely platymeric to eurymeric and frequently classify as Polynesian or non-Indian Mexican.

Within Native Americans there are differences between regions and subsistence strategies. The PI is least in populations from the Northern Great Plains (mean PI = 75), the Native American population studied by Gill and colleagues, and greatest in the Southern Plains (mean PI = 83). Populations from the Southwest (mean PI = 78), Northern Prairie (mean PI = 79), Great Basin (mean PI = 81), and Central Plains (mean PI = 82) are intermediate in their PI. Village Horticulturalists (mean PI = 77) and Agriculturalists (mean PI=78) are generally more platymeric than Hunter and Gatherers (mean PI = 81).

We agree with Gill and colleagues that the shape of the proximal femur can be used successfully by forensic anthropologists to distinguish between Native Americans and American Blacks and Whites. But, our results also suggest that there is great variation within groups, and differences between populations are probably due to both genetics and biomechanics. As a result, we suggest that caution should be taken when using only the femur for the estimation of race.

Forensic Anthropology, Femur, Subtrochanteric Shape

H42 Race — A New Synthesis for a New Century

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Before WW II race was a major subject of study in physical anthropology and some social sciences. Race was viewed as a logical extension of the Linnean binomial system, working from Family, Genus, and species to sub-species, or race. The horrible excesses of the National Socialist Party in racially "purifying" Germany in the 1930s and 1940s lead many anthropologists and others to decry the concept of race as dangerous and declare race to no longer exist in living humans. Other criticisms include the fact that anthropologists cannot agree upon the number of races that exist, the inability to precisely define the geographical extent of racial boundaries, and the lability of human variation chronologically. There can be no logical answer to the charge that if race exists it shouldn't because of the catastrophic mischief that some have wreaked in using the concept; that is an unfortunate fact of history which no person of good will wishes to see repeated. Answers or explanations can be provided for other criticisms. To the criticism that race does not exist because we cannot agree upon the number of races – there is also disagreement as to the number of sexes in humans; is it two or three or six or thirty-two? If race does not exist because of disagreement as to number, neither can sex exist and we are a unisex species. As to the criticism that we cannot draw clear geographical boundaries between races, the author submits that discrete boundaries are a better definition of incipient species or genera than subspecies. We will always expect contiguously distributed subspecies to interbreed and create fuzzy boundaries that may change through time, even short periods of time. Another criticism, that race cannot be ascribed to an individual, the author submits that forensic anthropologists can and ought to attempt to do this in every case submitted to them. Papers to be presented later in this symposium will present means of identifying individuals of different racial groups and even racial mixes, and sometimes the statistical probability of a correct ethnic or racial identification. We regularly do this with anthroposcopic skeletal traits and can now do so with an adequate DNA sample. A last criticism of the racial concept is that individuals in the same nuclear family may belong to separately defined sub-sub races or sub-sub-sub races. Rather than dealing with "race," perhaps we are dealing with major gene complexes which merit further genetic rather than taxonomic study. In the past 60 years anthropology matured in methods of studying human variation, human genetics and increased types of variation have been discovered and described. We have also become more sophisticated in theoretical and philosophical issues. Following a Wittgensteinian suggestion, a new approach is suggested in viewing race as a legitimate taxonomic level by referring to race not as a firm, fixed racial "type," but rather as a floating concept, emphasizing trait associations much like the definitions of culture areas in cultural anthropology and languages in linguistics. In each, we can define a culture area or language, but the exact borders may not be precisely definable, and we expect considerable cultural or linguistic (or genetic) variation within each. That does not vitiate the validity of the culture area concept or the idea of a language – each obviously exists – any more than fuzzy and labile borders of genetic groups vitiates the concept of race; whatever groupings may arise should be determined empirically, not denied emotionally. While still not in favor, the recent interest in sexual selection ought to refocus our interest on superficial anthroposcopic traits as suggested by Darwin in 1871. Despite the social and biological differences which exist today, we must remember that we are all united as a single species with a shared history and a shared future.

Taxonomy, Race Classification, Evolutionary Theory

H43 Forensic Anthropology and the Belief in Human Races

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This paper will present the view that races are cultural constructs not biological entities; and that migration patterns and historical events are largely responsible for the emergence and persistence of current, unscientific notions of human race.

This presentation will impact the forensic community and/or humanity by demonstrating by exploring the notion that races or subspecies of humans do not exist; that there is no scietific justification for human races; and that current views of race or human subspecies are the result of historical events including non-random human migration patterns.

Leonard Lieberman has documented a steady decline in references to race in anthropological journals and an increasing rejection of the concept of race by physical anthropologists. Despites his findings the traditional belief that humanity is divisible into 3 or 4 major groups with some kind of biological meaning appears to be alive and well among some forensic anthropologists. Certainly, a significant number take the view that human variation is gradual over space and that human races

have no foundation in biology. There are probably fewer people that take intermediate views than one might imagine. In this paper, two aspects of the race debate will be examined: 1) recent thinking about the scientific bases for human races, and 2) the seeming reality of race in America.

It is well known that the current concept of the 4 major races stems from the 18th century writings of Linneaus and Blumenbach. Writing a century before Darwin and Mendel and 200 years before the development of modern genetics, Linneaus knew nothing about evolutionary theory or the nature of the human genome and very little about human variation. Nonetheless, his ideas persist virtually unchanged.

The race concept need not be an issue of belief. It should be an issue of science. Unlike religious tenets, the existence of human races is testable. Formal definitions of race and subspecies have been debated, the distribution of genes in human populations is becoming better understood and population histories and lineages are being reconstructed. Alan Templeton (2002) explicates the problem of human races by exploring exactly what races are and how humans fit into the model. Templeton points out that there are two definitions of race customarily applied to plant and animal species. Races are either "geographically circumscribed, genetically differentiated populations," or "distinct evolutionary lineages within species." Then he systematically applies data on human genetic diversity to demonstrate how human populations satisfy neither definition. There is no scientific justification for the existence of races in our species, in fact to the contrary, modern molecular genetic data demonstrate quite clearly that human races do not exist.

Why then is the concept of race so compelling to a group of modern forensic anthropologists? The answer lies in large part to human migrations. It is often assumed that if races ever were a reality for human populations, the concept has been blurred in recent centuries by human migration. Borrowing from the sociocultural concept of the ethnographic present, the author of one text has coined the term the heterographic present referring to the past when human populations were in areas of the world inhabited by their ancestors. It might seem like the massive migrations of the past several centuries have mixed up otherwise stable populations and races that represent the true nature of human diversity. Actually, the opposite is true. Human migrations are a significant contributor to the emergence and persistence of the race concept.

Before people began to move about in large numbers, human variation was gradual in space. There is no evidence to the contrary. Of course, there were differences between local populations, to a greater or lesser degree depending on isolating mechanisms and gene flow. Native Australians and Tasmanians were isolated by water, the Amish by religious and ethnic views. However, more than anything else, differences between groups reflected geographic distance.

When early European explorers encountered peoples of Africa and Asia, often by ship, they saw individuals at the extremes of their distribution (West and Southern Africa, East Asia) not the myriad, gradually varying populations in between. Likewise, the post Columbian peopling of the Americas reflects mainly selective migrations from Western Europe, West Africa and the Far East. It is the juxtaposition of people from widely separated parts of the world that emphasizes biological differences and creates the illusion of discrete groups or races. In different parts of the world with different migration histories, races (or something like them) are perceived, but they are different.

There needs to be a clearer understanding of the nature of human diversity. An understanding based not on belief, but on scientific evidence. The formal application of modern genetic data to taxonomic rules governing subspecies illustrates that there is no valid justification for a subspecific taxon in the species Homo sapiens. This paper argues that the dominant notion of human races in the U.S. is the result of a unique population history and a non-critical acceptance of 18th pre-Darwinian notions about the nature of human diversity.

Forensic Anthropology, Race, Scientific Justification

H44 The Deconstruction of Race: Its Origins and Existence

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This paper describes some aspects of the 'race debate' among forensic anthropologists and how it applies to their practices.

This presentation will impact the forensic community and/or humanity by demonstrating an understanding of the historical context of race, its progression into popular convention, and its use and practice in forensic anthropology.

Perhaps the greatest reigning debate among forensic anthropologists is the concept of whether 'race' truly exists. This important question has spurred many intelligent debates, and provided many noteworthy perceptions from each side. However, a common conclusion has yet to be reached.

The term race appeared in the eighteenth centuries, especially in the literature by Linnaeus and Blumenbach. However, their distinctions and divisions among the human species would undoubtedly be characterized as strongly racist in today's scientific societies as they were based on an exaggerated amplification of physical traits, moral characteristics, overall temperament, and political behavior. A later theory by Darwin was based on the natural selection idea that man had evolved from an apelike ancestral form. He believed that since there are no white apes, the white race was more civilized than the dark races, which he thought to be closer to their nonhuman ancestors. This explanation of human associations became widely accepted in both scientific circles and in popular convention.

In 1951, a group of fourteen physical anthropologists and geneticists came to a unanimous agreement on a common definition of race. However, this definition must not have sufficed for many physical anthropologists because the debate of the existence of race caused a significant uproar during the 1960s, with the attack on the concept of race being led by Montagu, Livingstone, and Brace and its defense by Dobzhanzky and Coon and Garn. During the 1970s, those authors of physical anthropology textbooks with a strong oppositional opinion of the race concept openly expressed their opinions in their text. Based on the large number of these authors supporting the notion that race does not exist, it seems that there is an indication of a decline in support for classifications of race. In 1993, physical anthropologists at the American Association of Physical Anthropologists pushed for a modification of the UNESCO statement on race. However, since anthropologists do not agree on the existence of race, their amendment was defeated.

It seems that most of the 'great race debate' centers on the relevance of the actual term 'race' and the connotations derived from its use. Thus, part of the disagreement on race is attributable to the lack of consensus on its definition and use in scientific analyses. Some alternative suggestions for the replacement of the word 'race' have included terms such as genogroup, population, ethnic group, and ancestry. In addition, many scientists are unclear on the origins of the term 'race' and its progressive use among scientific communities. Since the definition of race cannot be agreed upon, it seems that the focus has evolved as to whether or not race exists as a biological reality among human populations and if it can, therefore, be correctly determined by forensic anthropologists. While many physical anthropologists and scientists believe that race does not exist, how is it that the race myth persists in popular convention? How can forensic anthropologists determine race for a biological profile if it does not exist? This presentation serves to further examine the historical context of race, its progression into popular convention, and its use and practice in forensic anthropology.

Race, Ethnicity, Ancestry

H45 Race vs. Ancestry: A Necessary Distinction

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This paper presents a historical and archaeological perspective on the development of racial classifications as they have been applied to forensic anthropological analysis.

This presentation will impact the forensic community and/or humanity by demonstrating a critical assessment of race, a difficult concept that is used in our analyses of skeletal material.

Development of a biological profile, which includes sex, age, and ancestry, is a basic component of the anthropological assessment for forensic purposes. The use of racial classifications in issues of personal identification is often critical to narrowing the search parameters. While the error factors for correct estimation of age and sex determination are relatively straight-forward, the quantification of "correct" assessment of ancestry is less clear. Although it is possible to scientifically quantify and describe human biological variation, linking this variation to socially recognized racial categories is problematic. Two primary areas of concern can be distinguished. First, the social categories themselves have changed and continue to change. Self-identification entails many factors other than direct ancestry and often varies by the context in which the identification is made. Identification by other parties may be based on limited knowledge of ancestry and incorporate assumptions about descent that have little foundation in reality.

The second area from which difficulties arise concerns the basis upon which the assessments themselves are based. The skeletal material from which we take measurements and test hypotheses regarding ancestry was collected during a time when nonscientific definitions of biological race were prevalent. The exact ancestry was often not known for the individuals in our major collections, and racial classifications were assigned based on soft tissue morphology. Some skeletal collections were even amassed for racist purposes by anatomists and anthropologists trying to correlate anatomical variation with social superiority or inferiority. The historical record, however, shows that European, African, and Asian ancestral groups mixed rapidly after arriving in America. Examination of the archaeological record, as well as recent studies of genetic relatedness, show that while people may still have been identified as belonging to one "race," their ancestry often reflected many different sources.

In this presentation, information from a series of historic archaeological sites is utilized to show how the issues of identity and ancestry became confounded during the historical period. Issues of class, community, and access to resources become as important for establishing "race" in the social context as the actual ancestry. Biological and non-biological definitions of race and ancestry are considered and a discussion of how social conceptions of race have shaped our discussions of biological variation is offered. The implications to those who practice forensic anthropology are also addressed. When combined with the current understanding of the biological definition of "race" and the uncertain empirical basis, the confusion between race and ancestry is highlighted.

Biological races of humans do not exist, regardless of the social categories, if we stand by the biological definition of race as a subspecies or variant. Therefore we may be attempting to scientifically sort phenotypic variation by studying groups socially classified within recent history. These socially classified groups may have shared equally in racial prejudice and socioeconomic discrimination but less substantially in ancestry. It is therefore timely to reconsider the nature of the variation we are attempting to quantify, both for forensic purposes and for skeletal biological studies of health and nutritional status among historic skeletal populations.

Race, Ancestry, Biological Profile

H46 Race as a Viable Concept

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This presentation presents an argument for retaining racial categorizations in physical anthropology within appropriate contexts.

This presentation aims to add to the discussion of the contentious issues of the use of the race concept and race terminology in physical and forensic anthropology.

The concept of race is discussed in reference to the American Association of Physical Anthropologists' 1996 "AAPA Statement on Biological Aspects of Race," the intent of which was to formalize the Association's position on this contentious issue. The position of the AAPA via the "statement" is that racial divisions are perpetuated by the social convention of race, that the concept of race itself is not biologically and scientifically sound, and that the discipline of physical anthropology is obligated to move away from the race concept. This is to prevent the perpetuation or perceived legitimization of racial discrimination based on research within physical anthropology. The issues of social race versus biological race and historical and contemporary conceptions of the term *race* are considered in order to explore the race concept. It is argued here that race, as currently used in physical anthropology, is closely aligned with its social component, is neither bound by past misuses nor an idea of rigid and discrete biological boundaries, and remains a viable concept.

Categorization, clinalism, and their relationship with the concept of biological race are discussed in the first section. The tendency of humans to categorize is considered in terms of historically hierarchical racial divisions and other human categorizations in order to illustrate the cogency or lack of cogency of such categorizations, and to show that discrete and pure examples—the absence of which opponents of the race concept cite as reason to do away with it—are not a necessary condition for a categorization to be valid and useful. The concept of clinalism and the critique of race based on historical racial ideas speak against the continued use of the race concept. This would be reasonable if race as currently conceived and employed in physical anthropology retained its historical typological character. This issue is examined through a comparison of clinal concepts and historical racial notions with the usage of racial terminology and the meaning of race in contemporary physical anthropology.

The second section discusses the relationship between social race, racism, and the concept of biological race. With social race a reality, what is its relationship to concepts of biological race? The problem of racism is discussed in reference to this question, and it is argued that racism, while based on differences of many kinds, is a phenomenon neither grounded in nor activated by scientific realities. Racism is therefore not susceptible to contrary scientific proof or argument, and the effectiveness of moving away from the biological race concept is questionable in terms of its ability to alleviate the problem. This situation is complicated by the undisputed existence of social race. It is suggested that a more effective strategy for combating racism than race denial is acknowledgment of and dialog about differences, whether social or physical, such that these differences can be placed within their proper contexts and parameters. The acknowledgement of human biological variation is not fated to be bound to hierarchical schema, but is and can be presented as a unifying and positive component of the human condition.

The practicality of the race concept is discussed in the final section. Forensic anthropology makes use of racial categories and has highly accurate methods for assessing ancestry, one of several critical determinations in the important business of identifying unknown dead, whether victims of crime, disaster, war or other circumstances. Critiques of forensic anthropological methodology are considered, as are alternatives to the use of racial terminology and the race concept within the subdiscipline. The use of the race concept in forensic anthropology illustrates the reorientation of the biological concept of race from the historical, determinist model to its current, more limited and accurate model of expressing human adaptive variation.

Race, Ancestry, Racism

H47 Deaths of Undocumented Immigrants in Southern Arizona

Bruce O. Parks, MD, Eric Peters, MD, Cynthia Porterfield, DO, David Winston, MD, and Diane Karluk, MD, Pima County Forensic Science Center, 2825 East District Street, Tucson, AZ 85714; Sam Keim, MD, University of Arizona Department of Emergency Medicine, University of Arizona College of Medicine, Tucson, AZ; Michael Kent, MD, Emergency Department, Northwest Hospital, Tucson, AZ*

The attendees for this presentation will better understand the perils that face undocumented immigrants and the spectrum of injury and disease that cause death. They will also have a better understanding of related issues that face local death investigation systems.

This presentation will give forensic scientists a better understanding of how death investigation systems are involved with a unique population of individuals. Ultimately, the mortality these people experience may be reduced.

This presentation will detail the pathologic findings of undocumented aliens who die in Southern Arizona as they attempt to reach destinations throughout the United States, primarily for better employment opportunities.

There has been a dramatic increase in the number of deaths of non-United States citizens who illegally enter the Southwest deserts of Arizona and California from Mexico. The largest percentage of these deaths is due to exposure to the hot environment of the summer and late spring. Other causes of death include trauma, natural disease and exposure to the cold. In a number of cases, the cause of death remains undetermined due to advanced decomposition and the absence of historical information. These individuals often remain unidentified.

Deaths which occurred over a two-year period, 2002 and 2003, are presented. The bodies were brought to the Pima County Forensic Science Center (Office of the Medical Examiner) for examination. Most of the individuals were discovered dead within Pima County and many of these individuals were on the Tohono O'odham Indian Reservation to the west of Tucson. Occasionally people were found alive but died after being transported to local hospitals. A minority of the cases were referred to the office from adjacent Southern Arizona counties. The study group consisted of a broad age range with men outnumbering women. Occasionally children were involved. Complete autopsies were performed on this population unless medical diagnoses have been established through hospitalization.

The increase in heat-related deaths is mainly responsible for the overall rise in immigrant deaths. In the desert southwest, temperatures are often over a hundred degrees Fahrenheit from June to September. It is speculated that greater numbers of immigrants are passing through the more dangerous, hot, barren, desert because the United States government is more closely monitoring the safer, populated regions along the border. Pathologic findings are often minimal in those dying from exposure to the hot environment. Most of the individuals show features of decomposition, which occurs quickly at such high temperatures. Even if the body is recovered soon after death prior to the development of putrefaction, rarely does one see previously described, heat-related pathologic processes such as cerebral edema and petechiae of the skin and internal organs.

Chemical evidence of dehydration was a common finding as manifested by elevated sodium and chloride levels often with elevated blood urea nitrogen and creatinine. However, dehydration was not always a factor for the cause of death. Toxicology testing was routinely performed although rarely positive for both legitimate and illicit drugs. Ethanol was often discovered and usually attributed to postmortem bacterial production.

The cause of death for heat-related death was certified as hyperthermia or probable hyperthermia even though body core temperature information was usually lacking. Simply certifying the cause of death as heat-related was not considered adequate by the local vital records department. When death was delayed and medical attention was provided to a small number of these individuals, elevated body temperatures were discovered.

The rather large number of these deaths has strained the resources of multiple agencies along the Arizona border including medical examiner's offices. Complete autopsies are generally performed on these individuals in order to best understand the cause of death. This information may be useful to help reduce this trend. In addition, should there be efforts to prosecute any individuals involved with organized efforts to smuggle immigrants into the United States, the most accurate cause of death will be available.

Heat-Related Death, Immigrants

H48 Metric Description of Hispanic Skeletons: A Preliminary Analysis

Richard L. Jantz, PhD, University of Tennessee, Department of Anthropology, 250 South Stadium Hall, Knoxville, TN 37996-0720*

After attending this presentation, attendees will appreciate the importance of obtaining a better understanding of the skeletal features of this rapidly growing component of the American population.

This presentation will impact the forensic community and/or humanity by demonstrating that it should emphasize the importance of understanding the skeletal biology of this important component of the American population.

Mexican Americans have been a large component of the population in the Southwest for a long time, but in recent decades they have been expanding into areas of the U.S. where their numbers have traditionally been small. The 2000 census reveals increases of 150-200 percent in some states such as North Carolina and Tennessee. Yet compared to Blacks and Whites, the formal knowledge base of Hispanic skeletons is low. Since forensic anthropologists in any part of the country are now likely to encounter Mexican American skeletons in their caseloads, it is obviously important to understand metric variation and to develop identification criteria specific to them.

The Forensic Anthropology Data Base now has information about 130 remains that may be termed Hispanic. These include various ethnicities, e.g., Puerto Rican, Cuban, Guatemalan, but the majority is of Mexican origin. This paper will deal with those of Mexican origin. Mexican skeletal remains are often found in circumstances that make positive identification difficult or impossible. Consequently, about 1/3 are not positively identified. Cranial remains are more frequent than postcranial. Sample sizes are too small to develop a definitive characterization of Mexican Americans, but it is useful to present a preliminary picture to illustrate the importance of a more complete picture of their skeletal variation.

Compared to American Blacks and Whites, Mexican American crania are somewhat smaller overall, with shorter vaults, narrower faces and orbits. Cranial morphology places Mexican Americans in an intermediate position in relation to Whites, Blacks and Amerindians, reflecting their hybrid status. However, crania are sufficiently distinctive to distinguish them from other groups. Postcranially, long bones are shorter and femur heads are smaller. The femur midshafts are rounder and more robust, and the subtrochanteric region is mildly platymeric. Sexing criteria derived from American Whites, whether cranial or postcranial, over classify Mexican American males as females, because of their smaller size. There are only 17 individuals in the database with some sort of stature, an inadequate number on which to base stature estimation.

Hispanics, Cranial Variation, Postcranial Variation

H49 Ours or Theirs?

Walter H. Birkby, PhD, Forensic Science Center, Office of the Medical Examiner, Pima County, 2825 East District Street, Tucson, AZ 85714*

After attending this presentation, the viewer will understand the complexity of the Undocumented Alien (UDA) issue and the implications this presents to the Medical Examiner's Office and the identification of human remains.

The case studies presented will help discern some skeletal characteristics which will give the forensic investigator insight into the problem of trying to determine regional origins.

Undocumented aliens (UDAs) who enter the U.S. along the Arizona border must traverse an extremely hostile environment very nearly devoid of water and shade. Daytime temperatures often exceed 120° F on the desert floor for days on end. Since the region is sparsely populated – and the UDAs are generally leery of contacting anyone north of the border lest they be Immigration Officials – when their water runs out each UDA becomes a probable Medical Examiner case sometime within the ensuing year or years.

From past cases, it is known that all who are retrieved from the desert floor are not necessarily Mexican Nationals. South Americans and Central Americans are also represented on occasion, as are Southwest Native Americans and Hispanic Americans. In a decomposed or mummified or skeletonized (complete or incomplete) condition, can the Forensic Anthropologist suggest a probable ethnicity for the Medical Examiner based on cranial, dental, and/or postcranial morphology?

This paper seeks to address this issue by presenting a series of case studies and their ultimate conclusions. Each year the Forensic Science Center, Pima County, Arizona, is faced with an increasing UDA caseload and is tasked to work with the Mexican authorities to try to resolve the identities and fate of the unidentified remains. Increasingly as well, both skeletal and circumstantial evidence are sometimes recovered indicating that this is truly an international problem – that not all UDAs crossing our borders in the Southwest are Mexican citizens, but hail from other Central and South American countries. The case studies presented will help discern some skeletal characteristics which will give the forensic investigator insight into the problem of trying to determine regional origins.

Undocumented Aliens, Southwestern U.S., Human Skeletal Identification

H50 Skull-Photo Superimposition and Border Deaths: Identification Through Exclusion and the Failure to Exclude

Todd W. Fenton, PhD, and Norman J. Sauer, PhD, Michigan State University, Department of Anthropology, 354 Baker Hall, East Lansing, MI 48824*

After attending this presentation, attendees will understand the methodology and application of skull-photo superimposition.

This presentation will impact the forensic community and/or humanity by demonstrating an improvement on the application of skull-photo superimposition as a technique for identification.

This paper has four objectives: 1) to present a case in which five individuals (undocumented aliens) died after crossing over the southern Arizona border with Mexico; 2) to discuss the role of video skull-photo superimposition in the identification of two individuals in this "closed disaster;" 3) to describe the methods employed which resulted in identifications through exclusion and the failure to exclude; and 4) to explore the application of the logic of science to this cranio-facial technique of human identification.

Many of the individuals who die trying to illegally cross into at the United States along the Mexican border do not leave behind existing antemortem x-rays or fingerprints on file. As a result, skull-photo superimposition presents a very useful technique in the investigation of border deaths, particularly in the identification of undocumented aliens. Identification in these cases can be the result of either the exclusion of, or the failure to exclude, the skull as a match to the photo.

On February 11, 2003, a hiker discovered human remains in a remote desert area of southern Arizona near the town of Ajo. The Pima County Sheriff's Department responded and led a search team which also included rangers from the Bureau of Land Management. The scene, located on the lower slope of a mountain, was rocky with low, sparse desert vegetation consisting mainly of mesquite trees, palo verde trees, ocotillo, and various forms of cacti. The search took place over the course of two days and resulted in the recovery of five skulls, five backpacks, four personal identification cards, clothing, and a large number of skeletonized postcranial remains scattered over a 50 to 100 yard radius.

With this evidence, investigators at the Forensic Science Center in Tucson, Arizona and the Pima County Sheriff's Department began working with the Consulate of the Republic of Mexico to identify the deceased. Through these cooperative efforts, the names of all five of the individuals traveling in this group were presumably known. As a result, this case of multiple border deaths is analogous to a "closed disaster" (such as a small aircraft crash in which there is a passenger roster).

The anthropological analyses conducted at the Forensic Science Center determined that the disarticulated skeletal remains represented two adult Hispanic males and three adult Hispanic females. The two males and one of the females could be segregated and tentatively identified and assigned names. The other two females reputed to be traveling in this group, however, were close in age and height, which made skeletal separation extremely difficult. It was at this point that the authors were asked to assist the identification efforts by performing skull-photo superimpositions at the Michigan State University Forensic Anthropology Laboratory.

The system at Michigan State utilizes two video cameras, a video mixer, a monitor, two VCRs, a computer, and image capturing software. The superimposition process begins by placing tissue depth markers on the skull and then generally sizing and orienting the skull with the photo. The "dynamic orientation process" follows, which is the most difficult and time-consuming part of the methodology. The goal of this process is to arrive at the "best fit" possible in the alignment of the skull with the antemortem photo. This is achieved by superimposing specific anthropometric landmarks on the facial soft tissues over the corresponding landmarks on the bones of the skull.

In the ideal situation, the first step in the dynamic orientation process is to align the skull and photo at porion. In the second step, the left and right Whitnall's tubercle of the skull is aligned with the left and right ectocanthion points of the face. These first two steps are critical in establishing the correct angle of inclination and declination in the superimposition. In the third step, the subnasal point of the skull is adjusted to align with the subnasal point of the face. In the fourth step, gnathion on the skull should align with gnathion on the face in the photo.

Allowing for slight variations which may be present due to photographic variables (lens, distance, angle, etc.), if all of the landmarks align the next step is to systematically evaluate a list of morphological points of correlation between the face and skull. This list includes the contour of the head and jaw line, the eyebrow and brow ridge area, and the eye orbit and cheekbone region. The evaluation of these areas is greatly enhanced by the placement of tissue depth markers on the skull. The last step in this superimposition methodology is a metric analysis of the facial proportionality of both the aligned skull and the photo.

The approach to image identification utilized at Michigan State is an adaptation of Popperian scientific method. Rather than prove hypotheses, the proper role of science is to construct hypotheses that are capable of falsification. In other words, it is improper to attempt to prove

that two data sets (a skull and a photograph, for example) represent the same phenomenon.

This approach begins with the assumption that the known and unknown images represent the same individual. Repeated attempts are made to reject (or falsify) the assumption. If there are any inexplicable differences between the skull and the photo during the "dynamic orientation process," the evaluation of morphological correlation, or the metric analysis, then the individual is excluded from a match. The strength of the falsification or identification in a skull-photo case depends on the quality of the images, the experience of the experts, the thoroughness of the analyses, and the equipment. The process of comparing and matching features is essentially the same as traditional approaches to identification, however the logic of falsification frees the investigator from generating statements about probable or highly probably identification.

In this case of multiple border deaths, two adult female skulls and a photograph reported to be one of the missing women were submitted. Using video skull-photo superimposition, one skull was excluded and the other was not excluded as a match. The ability and the failure to exclude were both the result of extensive comparisons and metric evaluation of facial proportionality, as well as the comparison of a number of morphological features of the face and skull. Due to the presumed closed nature of this case, the exclusion of one skull and the failure to exclude the other skull represented identifications.

Finally, it is the opinion of the authors that in the absence of clear images of unique dental features, skull-photo superimposition does not yield a positive identification. Exclusion or the failure to exclude, on the other hand, are more typical outcomes of the method.

Forensic Anthropology, Identification, Skull-Photo Superimposition

H51 Reuniting Families: Using Phenotypic and Genotypic Forensic Evidence to Identify Unknown Immigrant Remains

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The authors will explain the formation of a new database and DNA effort to help identify immigrants that perish crossing the US/Mexico border.

As the database grows, additional state offices participate and families become aware of the project, it is anticipated and hoped that the project can assist in significantly lowering the number of unidentified immigrants from the current 44%.

Every year more than a million individuals pass illegally between the United States and Mexico. Along this line of passage spanning roughly 2,000 miles between Texas, Arizona, New Mexico, and California, there remain few migratory routes not well patrolled by the Department of Immigration and Naturalization, and these are confined to areas of extremely inhospitable terrain. As a result, individuals perish at an alarming rate, more than 500 people in 2001 alone, in their attempt at illegal immigration. Unfortunately, 167 of the 503 *known* deaths remain unidentified. To date there is no centralized, private, federal or state-mandated mechanism that attempts the collection, curation or repatriation of the unidentified recovered remains. Municipal law enforcement agencies are further hampered in their efforts at identification because of the traditional lack of proper data sets necessary to make reasonable assumptions about the genetic heritage of discovered remains. The purpose of this project is to provide a database to aid in the identification process, helping to take some of the burden from the overloaded agencies that currently handle this work. In addition, the database will provide a link for families to a system that can help provide answers.

This initiative has created a distributed on-line database, accessible by public officials and private citizens interested in searching for missing individuals based on both phenotypic and genotypic characteristics. This broad effort includes the exhumation of individuals from geographically disparate pauper graves, the classification of their physical characteristics, and the cataloging of observed metric traits, to include associated articles of possession, in a local relational database. The physical data alone represents a significant increase in our experimental data set, and therefore our knowledge, about the quantitative characteristics of individuals of both North and Central American heritage.

Concurrent with the documentation of physical forensic evidence is the examination of individual DNA signatures. This project will attempt to perform genetic analysis of all unidentified immigrant remains and store the results for later comparison with candidate family members. The molecular analysis includes the sequence examination of the mitochondrial DNA (mtDNA) D-Loop region and, as funding permits, Short Tandem Repeat (STR) analysis.

Because the Reuniting Families initiative is created around the paradigm of a password-controlled on-line relational data interface, it simultaneously achieves two objectives. First, as the curated repository grows, it will provide a much-needed set of genetic data that will aid in identifications, both in known immigrant cases and in other forensic situations. Secondly, relatives or friends of missing immigrants will be able to participate in an on-line search of the database using unique physical characteristics (height, age, sex, skeletal trauma) and descriptions of articles of clothing to help identify missing individuals. If this provides a possible match, DNA testing of a maternal relative will be done to confirm identification, and steps toward the repatriation of the remains will be taken.

In July 2003, the first DNA identification of the project was performed thanks to the individuals at the Pima County Medical Examiners office and their extraordinary efforts. As the database grows, additional state offices participate and families become aware of the project, it is anticipated and hoped that the project can assist in significantly lowering the number of unidentified immigrants from the current 44%.

mtDNA, Immigrant Deaths, Database

H52 Migrant Deaths Along the California-Mexico Border: An Anthropological Perspective

Madeleine J. Hinkes, PhD, San Diego Mesa College, 7250 Mesa College Drive, San Diego, CA 92111*

Through this presentation, the author intends to facilitate multidisciplinary information sharing and discussion among border jurisdictions

This presentation will impact the forensic community and/or humanity by bringing to the forensic community an awareness of some medicolegal issues unique to border jurisdictions.

Any discussion of illegal border crossing between the United States and Mexico is fraught with political and cultural issues, such as the need to enforce enacted laws, maintain security, and caretake human rights. People will continue to cross international borders in search of a better life. Some will be caught and repatriated, some will be successful, and some will die trying. They are betrayed by guides, beset by gangs, beaten, robbed, raped, packed in hot airless vans, hit by cars, drowned, and abandoned to the elements. These are the individuals who come to the attention of the medical examiner or coroner and forensic anthropologist. At this point, medicolegal issues supercede sociopolitical ones. The deaths need to be investigated, remains autopsied and identified, next of kin notified.

California shares a 150-mile border with Mexico. Along the border, remains are discovered by Border Patrol agents, hikers, off-roaders, and other migrants. They are predominately male (88%, using 1997-2003 San Diego data). They range in age from 14 to 75 years, with most in their 20s. They come mainly from Mexico, El Salvador, Honduras, and Guatemala. Some are found soon after death, others are in various stages of decomposition, due in part to the ecological diversity of San Diego County. Prior to 1995, the principal cause of death was motor vehicle accidents, at the rate of 2 per day. This changed in 1995 when the California Department of Transportation built a barrier fence in the median of Interstate 5 south of the San Clemente checkpoint. Recently, the principal cause of death is exposure. Eastern San Diego County has a very "long thermometer" with extremes of daytime heat and nighttime cold.

Identification can be difficult. Medical or dental records are rarely available. There may be a voter's card or a bus ticket. Family members, often working through the Mexican consulate, identify clothing, new shoes, or distinctive belt buckles. Sometimes fellow migrants offer identification. Unfortunately, many of these bodies are still John or Jane Does. California's recent so-called "John Doe" law mandates that dental samples be retained at the medical examiner's office for these unidentified remains; further, in San Diego these bodies are buried, not cremated.

In the 1990s, the Border Patrol began a concerted effort to establish and maintain control of the border, beginning in urban areas. Operation Gatekeeper began in October 1994, reaching from the Pacific Ocean to halfway across San Diego County. This heightened law enforcement presence changed the westernmost segment of the border south of San Diego from the most permeable to the least permeable stretch of the border. This spatial restructuring pushed migrants into more dangerous crossing areas, making their trip longer and more physically challenging as they made their way on routes through the mountains and deserts and more rural areas. A 2001 study by the University of Houston Center for Immigration Research documents how intensified border campaigns are affecting migrant death patterns through this redirection of flow. They attempted to quantify data from San Diego to McAllen, Texas, the full extent of the border with Mexico, using vital registration data supplemented by interviews with Border Patrol agents, law enforcement officers, and coroner's personnel.

Their findings accurately reflect what we see in southern California. For example, deaths due to exposure in harsh environmental conditions in San Diego County range from a high of 36 in 1988 to a low of 5 in 1998. Conversely, Imperial County shows a low of 2 in 1996 and a high of 21 in 1998. Imperial County presents its own set of challenges to migrants. They have a choice of waterless desert or the swiftly flowing All-American Canal. Not surprisingly, drowning deaths have increased from a low of 3 in 1996 to a high of 24 in 1998 as migration routes shifted eastward.

The author's anthropological jurisdiction since fall of 1994 has been San Diego and Imperial Counties, and the effects of spatial restructuring are being played out in southern California. The case database is 124 from San Diego County and 71 from Imperial County, although the actual number of medical examiner migrant cases is higher. In San Diego these cases represent only about 2% of the annual medical examiner caseload, and Border Patrol personnel, based on their weekly live apprehension reports, estimate that the number of deceased migrants represents only about 1% of the total migrants who cross the southern California border. This may appear insignificant, but these cases still represent a very real forensic and human problem.

Forensic Anthropology, Border Patrol, Migrant Deaths

H53 Issues Concerning the Skeletal Identification of Deceased Illegal Aliens Recovered on the Texas Border

David M. Glassman, PhD, Texas State University-San Marcos, Department of Anthropology, San Marcos, Texas 78666*

After attending this presentation, attendees will understand the general taphonomic alteration of bones, patterns of death, sex and age profiles, and other issues associated with skeletal identification of illegal aliens along the South Texas border.

This presentation will impact the forensic community and/or humanity by demonstrating an appreciation for the difficulties in identifying human skeletal remains found along the South Texas border with Mexico.

Each year a number of unknown skeletal remains are recovered from the contiguous counties of Texas that border Mexico. Generally, if the remains belong to a U.S. citizen of any ancestry, including Mexican-American, a positive identification is likely to follow a routine investigation of missing person's reports and media coverage. However, if the deceased represents an illegal alien from Mexico, skeletal identification becomes hindered due to a number of constraints that affect the forensic anthropologist, medical examiner, and responsible law enforcement agency to resolve the identity and cause of death objectives mandated by the State of Texas.

Although illegal aliens enter Texas using a variety of means including hiding in automobiles, tractor-trailer trucks, and train cars, much more commonly they enter on foot, at night, and in groups. Getting lost without appropriate provisions such as water may be responsible for the death of some illegal aliens. To maximize their chance of a successful crossing, a group may hire a *coyote*, or guide, to assist them across the Rio Grande River and into the larger South Texas cities of El Paso, Del Rio, Eagle Pass, Laredo, McAllen, Harlingen, and Brownsville. The illegal aliens, as well as *coyotes*, know that crossing in the most rural, desolate portions of the Texas border counties decreases the likelihood of being caught. However, this means an extremely long arduous walk to reach the city destinations. Therefore, a compromise appears to be the more common pattern.

Illegal aliens who choose to cross the border in more rural areas place themselves at greater risk of death by natural causes or violence at the hands of a companion traveler or by the *coyote*, if one was used. Death in either case would likely not be reported due to fear of exportation or retribution. The vastness of the Texas terrain within the border counties is responsible for the typical long periods of postmortem interval between death and recovery of illegal aliens. Indeed, many of the human remains found in the border counties have been bleached white, weathered, and have sustained taphonomic destruction and loss of bone elements by animal activity prior to discovery. The accidental discovery of human remains near the border is primarily attributable to ranchers who oversee large South Texas ranches and by members of the U.S. Border Patrol while conducting their routine policing activities.

Sixteen skeletal identification cases involving suspected illegal aliens from Mexico were reviewed for identifying patterns of association. Variables examined included, sex, age, degree of completeness, taphonomic bone alteration, and cause of death. In addition, morphological comparisons were made to determine the frequency of certain non-metric traits thought to be common among Mexican cranial morphology such as shovel-shaped incisors, wormian bones, and palatine tori.

Forensic Anthropology, Skeletal Identification, Taphonomy

H54 Identifying the Dead: Methods Utilized for Undocumented Immigrants, 2001-2003

Bruce E. Anderson, PhD, Pima County Office of the Medical Examiner, Forensic Science Center, 2825 East District Street, Tucson, AZ 85714*

After attending this presentation, the attendee may better appreciate the problems associated with effecting identification when sparse antemortem records are present. The attendee will also become familiar with how the Pima County Office of the Medical Examiner collects and archives information for those who are not identified.

This presentation will impact the forensic community and/or humanity by demonstrating how our office is coping with the identification of an increasing number of deaths associated with undocumented immigrants.

The Pima County Office of the Medical Examiner has investigated an increasingly growing number of deaths of undocumented immigrants over the past three years. This additional number of deaths has greatly impacted the office in several ways, to include an increased need for accurate antemortem data in order to effect the identification of these unfortunate individuals. To this end, our office works closely with the local office of the Mexican Consulate to exchange antemortem and postmortem information. This exchange of information, in the successful case, typically results in a circumstantial identification being effected. Defined here, circumstantial identifications strive to attain multiple consistencies between antemortem and postmortem records, and to exhibit no unexplainable inconsistencies. Positive identifications are defined here as relating to a unique correspondence between an antemortem record and a similar postmortem record, again while exhibiting no unexplainable inconsistencies. Among the latter, those based on fingerprint comparisons constitute a decided minority of the total number of identifications, while those based upon comparisons of dental or medical radiographs are virtually non-existent. Thus, the majority of the identifications our office has effected over the past three years have been of the circumstantial variety, based in part upon consistencies in "individuating" characteristics such as tattoos, dental features, scars, and other healed traumata. Mitochondrial DNA sequence comparisons have been utilized in selected cases and presently remain a tool within the circumstantial realm of identification because of the inherent sharing within a maternal lineage. The technique of skull-photo superimposition, another utilized tool, is also considered in most cases to be a form of circumstantial identification.

The Pima County Office of the Medical Examiner investigates deaths for three of the four counties that border Mexico, as well as another county to the immediate north, making our jurisdiction a formidable piece of the southern Arizonan landscape. Thus, a death resulting from an unsuccessful desert crossing into Arizona has a good chance of being investigated by our office. For the past two years (2002 and 2003) these cases have constituted approximately 10% of the yearly caseload. While the resources spent on performing the autopsy are commensurate with most other cases, and even less so when skeletal remains are examined, the resources expended on attempting to effect identification is decidedly greater than those cases involving US citizens. The principal reasons are two-fold: Firstly, because the vast majority of these deaths occur during the hottest months of the year, decomposition can render the victim's face unrecognizable within a few hours. Secondly, the scarcity of written antemortem records, due to either their non-existence or unavailability, creates a situation in which traditional comparisons can not be made.

Partly because of this, some of these individuals are not able to be identified, and eventually are subjected to a standard office protocol (developed for use on all unidentified remains) prior to being interred in a county cemetery (state law prohibits cremation in these cases). In this protocol, an extensive postmortem record is constructed, complete with radiographs (both dental and osseous) and tissue samples suitable for a possible future DNA comparison. It is hoped that by maintaining these postmortem records, each containing a full biological profile and recovery information, that potential future identifications could be made without the need of disinterment.

Undocumented Immigrants, Positive Identification, Circumstantial Identification, Postmortem Record

H55 Personal Identification and Death Investigation of Documented and Undocumented Migrant Workers in Florida: Demographic, Biographic, and Pathologic Factors

Anthony B. Falsetti, PhD and Heather Walsh-Haney, MA, C.A. Pound Human Identification Laboratory, Department of Anthropology, University of Florida, Gainesville, FL 32601; Martha J. Burt, MD, Medical Examiner Department, Miami-Dade County, Number One on Bob Hope Road, Miami, FL 33136*

After attending this presentation, participants will develop a better understanding of the unique demography, migration patterns and specific anatomical characteristics of documented and undocumented laborers and farm workers.

This presentation will impact the forensic community and/or humanity by demonstrating insight in special forensic considerations for a specific population.

Estimates on the number of migrant, documented and undocumented combined, workers in the state of Florida are varied, however the *Atlas of State Profiles*, prepared by the US Department of Health and Human Services in 1994, reports that there are approximately 185,000 migrant farm workers and 253,000 seasonal farm workers for a total of 435,375. Of these, 75% are born outside the United States; two-thirds of that percentage were born in Mexico, while another one-sixth are from Central America; of those born in the US most (one-third) are from Puerto Rico. Eighty-two percent consider themselves to be Hispanic and 75% report that their native language is Spanish. The mean age of Florida farm workers is 32 years and approximately 25 percent are female. The numbers of documented versus undocumented workers also vary; however the same report notes that at least one-third of the total number of migrant workers are illegal. The leading causes of death in this population are resultant from traumatic injuries and complications related to HIV infection.

The anthropological literature on occupational markers suggests that communities involved in laborious work or repeated positional behavior experience over-use injuries of the lower limb that include the classic 'squatting facets' presenting on the talus and distal tibia, as well as evidence of lumbar and thoracic injuries. These anatomical characteristics are thus resultant from repeated mechanical loads over a period of time and have been used widely by anthropologists to denote specific behavioral patterns for populations of individuals as well as the reconstruction of life ways. The forensic anthropologist working in coordination with the medical examiner may also use such markers, and others to individuate an otherwise unknown skeleton or set of decomposed human remains.

Case histories from the C.A. Pound Human Identification Laboratory (CAPHIL) and the Medical Examiner Department, Miami-Dade County involving individuals who were thought to be or identified to be part of the migrant labor community in Florida were examined for their demographic profiles, injuries, causes and manners of death. Cases from Miami-Dade are limited to that district's jurisdiction, while those from CAPHIL include individuals statewide. In addition to the traditionally noted 'squatting' and 'kneeling' facets of the lower limb and foot, marked changes are observed in the lumbar and thoracic vertebrae, as evidenced by lipping of the marginal bodies as well as the skeletal presentation of Schmorl's nodes. Upper limb joint surfaces, such as the

glenoid fossa and humeral head, display arthritic change as well as additional non-specific degenerative bony changes to the hand and wrist. Further noted is evidence of untreated traumatic injuries that include displaced fractures of the upper and lower limbs (including the hand and wrist) and the mid-facial skeleton. The biological or demographic profile of these individuals follows the primary population description for migrants in that they are predominately young males (mid-twenties to early thirties) of Hispanic descent. The *manners* and *causes of death* are similar to the population as a whole.

For the personal identification of individuals thought to be migrant workers whether documented or undocumented, it is recommended that, in addition to the presentation of the classic over use injuries, one should fully examine the entire skeleton for a suite of characteristics that are suggestive of repetitive behaviors. The biological or demographic profile of the decedent is also of import. Further, information from the scene, including its relative location to fields and crops, time of the year and the phase of the growing season, all need to be taken into account and recorded. These characteristics, both population-wide and specific, should allow investigators to narrow down the numbers of unknown decedent records that need to be examined and assist the medical examiner in preparing the death certificate for submission for the tracking of trauma and disease, and other health-related issues in this population.

Personal Identification, Migrant Farm Workers, Forensic Anthropology

H56 Fatal Footsteps: The Murder of Undocumented Border Crossers in Maricopa County, Arizona

Laura C. Fulginiti, PhD, A.L. Mosley, MD, V. Shvarts, MD, J. Hu, MD, K.D. Horn, MD, P.E. Keen, MD, and R.M. Hsu, MD, Forensic Science Center, 701 West Jefferson, Phoenix, AZ 85007*

After attending this presentation, attendees will learn about a new trend of killing undocumented workers in Arizona. The majority of deaths among this group are from dehydration and exposure while crossing the desert to seek work. However, some of these individuals are being held for ransom and then killed when the family is unable to pay. The additional burden this places on the medical examiner and law enforcement will be discussed.

The forensic community will be made aware of a disturbing change in the manner of death for undocumented workers crossing the border from Mexico into Arizona.

The mortality rate among undocumented workers in Arizona has increased seven fold in the past five years (Bureau of Customs and Border Protection, as quoted in The Arizona Republic). Border patrol agents in California and Texas have tightened control over their borders with Mexico thereby increasing the amount of traffic from Mexico into Arizona. In 1998-1999, the number of deaths among Arizona border crossers was 28. That number increased dramatically in 1999-2000 to 106. As of July 17, 2003, 104 crossers had died, indicating (albeit anecdotally) a further increase in mortality among this group. The number of deaths expressed as a percentage of persons apprehended has also increased during the same time period. In 1998, 5 individuals died for every 100,000 apprehended. Today, that number stands at 33.7 per 100,000.

In the past, most immigrant deaths occurred as a result of dehydration and exposure. More recently, a new trend has emerged, that is, death of border crossers at the hands of the persons hired to lead them across the border. These smugglers, known as "*coyotes*," charge thousands of dollars for their services. In some cases, the smugglers attempt to extort additional money from the families of their victims by holding them hostage once they have crossed the border.

Eight deaths in Maricopa County during the months from January 2002 through March 2003, are reflective of this trend. The individuals were recovered from a remote location on the northwestern side of Maricopa County. Each was young to middle aged and became the victim of homicidal violence. The period since death in the cases ranges from very recent to months. Three of the eight remain unidentified. There are striking similarities in these deaths, including the location of recovery, the condition of the victims and the way in which they were killed. The consistencies are suggestive that the same group of suspects was involved in the use of this area, or at the least that a network of information was available about the remoteness of the site. The location was abandoned after the Sheriff of Maricopa County announced increased surveillance. No additional bodies have been recovered in the area since this announcement.

Three theories are currently at work in these cases. One suggests that the deaths are warnings from vigilante groups opposed to the undocumented workers crossing over from Mexico. There is no evidence to support this contention, however the investigating agency has not ruled it out. Drug trafficking was initially the prevailing theory, however evidence came to light that in some of the cases extortion was a more likely explanation.

Some *coyotes* have turned from drug trafficking to human smuggling in part because profits can be made and the penalties are far less severe. Rival smugglers hijack one another's "cargo" and ransom the victim's to their families. Alternatively, the original *coyote* holds the border crosser hostage until the family can provide more money. In either case, if the family cannot pay, the individual is killed.

This disturbing trend, as illustrated by the eight cases in this paper, places a different kind of burden on law enforcement and the medical examiner. The autopsies are more protracted while the investigation is more complicated and often leads back to the undocumented worker's country of origin. Usually, the most complex part of the investigation in the more typical undocumented worker's death is that of identification and notification of the next of kin. If those tasks are accomplished, the body is returned and the case is closed. In the case of homicide, identification of the decedent is only the first step towards resolution of the case. This paper will present the details of the eight homicides and discuss the change from death by dehydration to murder.

Undocumented Workers, Mexican Border, Homicide

H57 Osseous Traumata Caused by a Fall From a Height: A Case Study

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The goal of this presentation is to present a case study concerning the effects of a fall from a height on the skeleton.

This presentation will impact the forensic community and/or humanity by detailing analysis of skeletal remains from an individual who fell from a height.

The remains of an incomplete and fragmentary human skeleton were found in the Grand Canyon at the bottom of a four hundred foot cliff when authorities went into the canyon to recover an unrelated witnessed suicide jumper. At the time, information on sex, age, race, stature, pathology, and trauma was requested. The individual was later identified as a white male, age forty-five, and of European ancestry.

The remains were completely skeletonized and had minimal associated desiccated soft tissue. The skeletal elements were badly fragmented with evidence of carnivore activity and differential exposure to the weather and sun. Only seven cranial fragments and four teeth were recovered. A rough estimate of one to five years was given for elapsed time since death.

The pattern of perimortem trauma in this case, and the location where the remains were found suggest that the individual fell approximately four hundred feet from the cliff edge above. The manner of death, whether accident, suicide, or homicide could not be determined from the skeletal remains. Evidence indicating a fall from a height from the cranium, humeri, ribs, vertebrae, pelvis, femora, and tibiae is discussed in the sections below.

Both humeri sustained injuries that appear to be perimortem in nature. The diaphysis of the left humerus was obliquely fractured in a manner consistent with spiral oblique fractures in fresh bone. Also, the right humeral head was separated from the shaft at the anatomical neck in a clean transverse fracture. Fractures were present at the sternal ends of at least two ribs, and perhaps a third. The trauma to the ribs appears to have occurred in fresh bone because the bone was depressed in a linear fashion, as if it were bent inwards in a "greenstick" type of fracture. Not all of the vertebrae of this individual were recovered. A careful examination of the vertebrae present led to the discovery of one small fracture on the transverse process of the fifth lumbar vertebra. The fracture line is visible and a piece is displaced, but it was not broken off, suggesting that the bone was fractured perimortem.

The pelvis displayed several fractures indicative of impact after free fall. There is a fracture on the left iliac blade that is depressed, suggesting that the fracture was created in green bone. The fracture line itself is depressed and a fragment on the edge of the line is pushed inwards. A fracture is also noted at the edge of the left acetabulum where bone is bent in with a visible fracture line and displaced fragments. The ischial fractures present may or may not be postmortem in nature and cannot be accurately used to support the idea that this individual fell from a height while still alive.

In the femora, fractures requiring a great deal of force were noted. Both the right and left femoral heads were sheared off at the neck. The fractures of the femoral necks are not typical of carnivore damage. Animal activity does affect the proximal and distal ends of long bones, but usually involves chewing, tearing, and gnawing. No tooth marks or signs of gnawing were found at the proximal ends of the femora. The damage is more consistent with perimortem shearing trauma than postmortem damage.

The right tibia was badly fractured longitudinally into at least five pieces. Part of the lateral tibial plateau is cracked longitudinally, which may or may not be perimortem damage. The edge of the medial aspect of the tibial plateau and the medial malleolus on the left tibia appears to be sheared off as well. The right and left fibulae are both fragmentary.

The osseous traumata visible in this individual found at the bottom of the Grand Canyon suggests that he either jumped or fell four hundred feet, impacted a slope, and then probably rolled or bounced for an unknown distance. Primary impact was likely with the feet, but secondary impacts probably occurred as his body continued down slope from the primary impact point. The shearing fractures of both femoral heads from the necks and the longitudinal fracturing of the tibiae strongly support the hypothesis that the individual landed feet first. However, in the vertebrae that were present, there were no compression fractures, which are common in feet and buttock primary impacts. Furthermore, few tarsals and metatarsals were recovered, and those that were did not show any signs of impact trauma. The fact that very little of the cranium was recovered suggests that it was fractured into many pieces either from direct contact with the ground surface in a secondary impact, or from the force of the vertebral column bursting through the base of the skull upon primary feet impact. Fragments of the occipital were not found, making it impossible to determine if a ring fracture was present. The remaining fractures of the humeri, ribs, pelvis, and vertebrae can be attributed to secondary impacts after the body struck the slope initially at a depth of approximately four hundred feet and continued to bounce further down slope.

Forensic Anthropology, Falls, Fracture

H58 Multidisciplinary Efforts in the Identification of Three Unidentified Females in the State of New Jersey

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The goal of this presentation is to present cases to the forensic community that utilize various forensic disciplines in the tentative identification of unidentified bodies.

This presentation will impact the forensic community and/or humanity by demonstrating the utility of using different forensic disciplines in the identification process of unidentified remains.

This poster reports on the combined multi-disciplinary efforts of forensic pathology, forensic anthropology, radiology, hair analysis and composite drawing in the identification process of three unidentified females in the State of New Jersey. The results of these efforts will be presented for review.

On July 18, 2001, an unidentified clothed and mummified body was found in Trenton, New Jersey, at the bottom of steps leading to a basement of a bar that had been closed since June 1996. The forensic anthropological examination determined the victim to be a Negroid female, between 25-35 years of age at the time of death and between 4'9"-5'0" in height. The cause of death was listed as "Extensive fractures of skull" and the manner of death was determined to be "Homicide". Postmortem x-rays revealed a healed mandibular fracture. Unique "jewelry" and a diastema between the upper central incisors were also useful identifiers in this case. A forensic composite drawing was rendered which was based upon the anthropometric measurements provided by the forensic anthropologist and tissue thickness measurements for a Negroid female. A newspaper article and composite of the victim resulted in a tentative identification. Positive identification was subsequently made through fingerprint comparison after successful rehydration of the fingertips.

On March 4, 2002, an unidentified skeletonized/mummified body was found in a wooded area in Denville, New Jersey. The autopsy revealed the presence of three tattoos on the mummified skin unique enough for tentative identification. The forensic anthropological examination determined the victim to be a Caucasian female, between 24-34 years of age at the time of death and between 4'9"-5'0" in height. Examination also determined that she had at least one child. The cause of death was listed as "Pending further studies" and the manner of death was determined to be "Pending." A forensic composite drawing was rendered which was based upon the anthropometric measurements provided by the forensic anthropologist and tissue thickness measurements for a Caucasian female. A flyer was subsequently made which included the composite and the tattoos. Positive identification was made through fingerprint comparison after successful rehydration of the fingertips.

On November 18, 2002, an unidentified and nude female body was uncovered by a backhoe in a vacant lot in Tinton Falls, New Jersey. At autopsy, the body measured 5'0" and weighed 106 lbs. in the body bag. The victim had dark, straight hair. The forensic anthropological and radiological examination determined the victim to be of Caucasian/ Hispanic ancestry and between 15-17 years of age at the time of death. Hair analysis determined the hair to be 5-6 inches in length, dark brown in color with 1 - 1 ½ inches of the tips tinted orange. The analysis also determined that the hair was recently cut and racial characteristics were of Caucasian origin. The cause of death was listed as "Homicidal violence of undetermined etiology" and the manner of death was determined to be "Homicide." The only physical identifier found with the

victim was an initial ring with the cursive letter "F" with white or clear stones. A forensic composite drawing was rendered which was based upon the anthropometric measurements provided by the forensic anthropologist and tissue thickness measurements for a Caucasian female. A newspaper article and composite of the victim resulted in a tentative identification. Positive identification was subsequently made through fingerprint comparison using fingerprints filed with the Immigration and Naturalization Service only 3 months prior to discovery of the body.

Identification, Forensic Anthropology, Composite Drawing

H59 Bullet Wipe on Bone: Production and Detection

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After attending this presentation, attendees will understand the influence, if any, of caliber, range, angle, and bullet design on the production of bullet wipe; to determine the effect of maceration on the detection bullet wipe; to find whether proton-induced X-ray emission (PIXE) analysis may be used to detect non-visible bullet wipe.

This presentation will impact the forensic community and/or humanity by codifying much that had been believed to be true, but had not been examined by any previous study. The issue of cross-contamination in maceration is addressed for the first time.

Most bullets in civilian use are made of lead hardened with tin or antimony. Lead is a soft, dense metal with a low melting point (Fahrenheit 621). When it passes through bone, it often leaves traces in the form of small fragments in the hole or on the surface of the bone itself. These radio-opaque traces are called bullet wipe. In the absence of a well-defined entrance or exit wound, bullet wipe is a useful indicator of gunshot. This study was undertaken to determine what factors influence the production and detection of bullet wipe.

A total of 345 gunshot wounds were produced in 69 pig crania and postcrania. Two revolvers were used: a 1909 Model Army Colt in .38 Special and a North American Arms Black Widow mini-revolver in .22 Long Rifle and .22 Magnum. The pig bones were shot five times each, at ranges of ten feet and hard contact, at angles of ~90 degrees and ~180 degrees, with a variety of ammunition (full-metal jacket, jacketed soft point, hollowpoint, and unjacketed lead). After being shot, the specimens were radiographed. They were macerated for a minimum of 24 hours, cleaned, and radiographed again. The presence of bullet wipe on each specimen was scored before and after maceration on a scale from 0 (no traces present) to 3 (large traces present). Proton-induced X-ray emission (PIXE) analysis was used to search for bullet wipe on bones for which no wipe was observable.

Conclusions

1) The presence of bullet wipe on bone is determined by bullet design. Bullet wipe may be separated into two distinct types. Direct bullet wipe is produced by physical contact between the primary mass of the bullet and bone, and is found on the margin of a gunshot wound. Indirect bullet wipe is produced by fragments shed by the bullet. The presence and nature of bullet wipe on bone is determined by bullet design. The study found range and angle to be irrelevant to the production of bullet wipe.

2) Full-metal-jacket, unjacketed, soft-point, and hollow-point bullets cause different patterns of bullet wipe. Bullets with a full metal jacket, which have no exposed lead, typically produce no visible wipe at all. In the extremely unlikely event that any wipe is present, it is indirect. Unjacketed bullets produce both direct and indirect wipe in ample amounts. Soft-nosed bullets produce direct and indirect wipe, but much less of each than unjacketed bullets, and hollowpoints produce indirect wipe and little direct wipe. Because .22 caliber rounds are open at the base, these generalizations do not hold for small-caliber ammunition.

3) Maceration can affect the presence of bullet wipe and result in cross-contamination. Direct bullet wipe does not appear to be affected by maceration. Indirect bullet wipe, however, can be reduced or eliminated. Small particles of indirect wipe may transfer from one specimen to another if the specimens are macerated together. Pre-maceration radiography is essential to guard against such cross-contamination.

4) PIXE analysis is a useful tool in analysis of bullet wipe, particularly when reconstruction of trauma is difficult.

Bullet Wipe, Gun Shot, PIXE

H60 Skeletal Evidence of Homicidal Compression

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The goal of this presentation is to present the forensic anthropological community with examples of cranial and postcranial fractures due to the application of compressive force. This presentation will also provide a framework and protocols for the recognition and interpretation of compression damage to the skeleton.

This presentation will impact the forensic community and/or humanity by increasing awareness of compression injuries in the context of homicide.

Compression fractures occur when bone tissue is compacted to the point of failure. In forensic cases, such fractures are often seen in falls from height but may also be encountered in victims of homicide. Our experience with recent cases demonstrates evidence of homicidal cranial and postcranial compression skeletal injuries.

When coroners and medical examiners turn to the anthropologist for assistance, the remains are often decomposed to the point that evidence of soft tissue injury no longer exists. The remains may be partial due to taphonomic processes and postmortem damage may overlap the antemortem and perimortem defects. Careful examination and documentation is essential.

Compression injuries in instances of homicide usually involve the head or chest. This pattern is in contrast to compressive injuries encountered in motor vehicle accidents and falls, which typically involve compression of the long bones, spine or pelvic region. Homicidal injuries may be more difficult to detect as the fractures are often incomplete due to the lower forces imparted. Careful preparation of the skeleton combined with macro and microscopic examination of all bone surfaces is essential to recognize and interpret trauma.

In the cases presented in this poster, compression was applied to the body of the victim resulting in incomplete fractures. Four cases are included in this report:

Case 1: The remains of an adult female in her mid-fifties were found under a house. Minimal damage was evident on the left lateral portion of the anterior vault and some in the orbits. However, internal examination revealed extensive perimortem fracturing in the sphenoidal region suggesting compression of the skull.

Case 2: The remains of an adult female were found in a remote wooded area. The alleged perpetrator gave a detailed confession that could be matched to the skeletal defects. Included among the damage was an incomplete fracture of the internal surface of the sternum that matched his claim that he knelt on her chest in order to twist her neck.

Case 3: The decomposed remains of an adult male were discovered in a wooded area, located along side a road. The remains showed extensive perimortem trauma, including at least nine discrete blunt force injuries to the skull. The hyoid and thyroid cartilage displayed complete fractures. In addition, incomplete fractures were noted on the sternum, right rib six, left rib six, cervical vertebrae five and six, and right clavicle, suggesting excessive compressive force was applied to the anterior chest.

Case 4: Remains found in a dumpsite showed compression fractures of the rib cage, but were more consistent with the presence of a carnivore and were presumably inflicted after the death of the individual from other causes.

These cases demonstrate that subtle damage can be interpreted. Postmortem damage due to carnivores may be a compounding factor in skeletal trauma interpretation.

Trauma Analysis, Compression Injuries, Incomplete Fractures

H61 Determining Medicolegal Significance: Human vs. Selkie

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After attending this presentation, the participant will be aware of the morphological similarities and differences between human and seal thoracic vertebrae. Detailed morphological comparisons between human and seal thoracic vertebrae will provide invaluable knowledge to forensic anthropologists and pathologists who may encounter marine mammal skeletal remains due to the coastal jurisdictions they cover.

This presentation will impact the forensic community and/or humanity graphically documenting and illustrating the morphological similarities and differences of human and seal thoracic vertebrae.

Background: In many cases, the first question asked by a forensic anthropologist is whether the skeletal remains are human or non-human. For the vast majority of those cases, the question is answered relatively easily and quickly. Comparisons between human and non-human skeletal remains typically rely on macroscopic aspects of skeletal morphology (maturity, size, architecture of articular surfaces, areas of muscle attachment, fusion of elements, thickness of cortical bone, density of cancellous bone, delineation of cortical and cancellous bone, etc.), as well as microscopic aspects (osteon organization, plexiform bone, Haversian systems, etc.). The human skeletal possesses morphological features which reflect our primate ancestry and unique evolutionary adaptations (bipedal locomotion, enlarged brain, reduced faces, etc.), and it is these features which allows for the determination as to whether any given complete/partial skeleton or individual skeletal element is human or non-human. However, if the remains are those of a pathological human specimen or human fetal specimen with congenital birth defects, the determination of human/non-human becomes far more difficult. Additionally, several non-human skeletal elements have and continue to confuse some law enforcement personnel and forensic scientists (bear paws, pig premolars, horse distal caudal vertebrae). This poster will present another non-human skeletal element that has and could confuse forensic scientists.

Case History and Pathological/Anthropological Assessment: On June 19, 2003, skeletal remains (two thoracic vertebra and rib fragment) were found by a 10 year old boy digging in the water behind a relative's home at Oak Beach, New York. The County Police Department was notified and collected the remains and turned them over to the County Medical Examiner's Office where a pathological examination was conducted on June 24, 2003. The initial assessment of the vertebrae was that the remains were potentially from an adult human. On June 27, 2003, the anthropological examination of the two thoracic vertebrae and rib fragment revealed them to be "non-human," from an immature animal. On a cursory level the vertebrae looked very similar to human thoracic vertebrae, but detailed morphological features of the transverse processes, vertebral body, and the presence of vertebral body epiphyseal disks not rings were not consistent with human morphology. Consultation with Darrin Lunde, Collections Manager, Department of Mammalogy, American Museum of Natural History on July 21, 2003, resulted in the identification of the skeletal elements as belonging to a seal (Order: Pinniped; Family: Phocidae; exact genus and species not yet determined).

Conclusions: The determination as to whether any given set of skeletal remains is human or non-human, in most circumstances, is a relatively easy task to perform. The forensic literature is replete with analytical and anecdotal evidence of non-human skeletal remains that have and continue to be misidentified as human. A thorough search of the forensic literature found no reference to seal skeletal remains potentially misidentified as human. Though infrequently encountered, knowledge of the similarities and differences between human and seal thoracic vertebral morphology will prove invaluable to forensic anthropologists and pathologists whose jurisdictions include coastal regions where seal and other marine mammal skeletal remains may be recovered by civilians and law enforcement personnel.

Human vs. Non-Human, Seal, Thoracic Vertebrae

H62 Assessment of Saw-Blade Wear Patterns and Wear-Related Features of the Kerf Wall

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This poster presents the results of a preliminary study investigating the effects of progressive saw-blade wear on the appearance of kerf walls.

This presentation will impact the forensic community and/or humanity by adding to the established methodology for the interpretation of saw-marks in human bone in cases of postmortem dismemberment. Furthermore, it allows for greater specificity in reconstruction of postmortem events by providing the forensic anthropologist with additional information about the tool(s) used in dismemberment.

Post-mortem dismemberment of homicide victims creates a challenge for forensic anthropologists charged with identification of the victim and reconstruction of the events of the crime, based on evidence contained in the victim's skeletal remains. The pattern and distribution of the cuts may provide investigators with clues to the motivation and intent of the perpetrator in carrying out the dismemberment. By determining what class of tool was used in the dismemberment (i.e. knife, ax, or saw), the forensic anthropologist can provide police with an additional avenue by which to connect a suspect to the victim. The methodology for distinguishing among different types of saws potentially used in the dismemberment, based on the appearance of the cut marks (kerfs) they produce is well established. By virtue of the cutting action of their numerous identical teeth, saws create distinct, repetitive patterns of fine striations on the sides (kerf walls) of the cut mark. These patterns yield information on all the key characteristics of the saw in question: type and width of tooth set, tooth type, number of teeth per inch, and if it is a hand- or power-saw.

This preliminary study seeks to compliment the established methodology of cut mark interpretation by investigating the impact of increasing saw-blade wear on the appearance of the kerf wall. Three questions were considered:

1. How can cuts made by a brand-new saw be distinguished from those made by a saw that has been subjected to normal usage (and now shows a fair degree of wear) based on the appearance of the kerf walls? Can corresponding differences be observed in the appearance/condition of the saw blade?
2. Is there an observable difference between saw-blade wear generated by use on bone and wear generated by use on the saw's intended substrate (i.e., wood for crosscut and rip saws; metal for hacksaws)? Correspondingly, will there be differences between the appearance of kerf walls created by saws used only on bone and those created by saws which were used first on the intended substrate and then on bone, beyond anticipated wear-related differences?
3. How will incidental damage (e.g., broken or bent teeth) to the saw-blade, occurring in normal use of the saw, affect the appearance of the kerf wall?

In this study, brand-new blades of three common types of saws (cross cut, rip cut and hack saws) were used to make series of 30 cuts in white-tailed deer (*Odocoileus virginianus)* tibiae; the kerf walls of each cut were then examined under a stereoscopic light microscope. By this manner, it was observed that the patterns of coarse and fine striations on the kerf walls became progressively more shallow and indistinct with increasing saw-blade wear. This pattern correlated well with the accumulation of rounded-off teeth and edges and eburnation of teeth along the length of the saw. Control groups, made by using three saws which were identical to those in the first group to saw through wood and metal, showed highly similar wear patterns to the saws used only on bone. No differences were observed in the appearance of the kerf walls of cut marks in bone made by saws used only on bone versus those made by saws used first on wood or metal. Only one broken saw-tooth was observed in the course of this study; it produced deep, erratic gouges on the kerf walls, which also became progressively more shallow as the cut series progressed.

Tool Mark Analysis, Dismemberment, Forensic Anthropology

H63 Hereditary Multiple Exostoses: An Identifying Pathology

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This poster presents a case of hereditary multiple exostoses, or osteochondromatosis, and demonstrates the utility of stable, non-aggressive lesions in antemortem/postmortem radiographic identification.

This presentation will impact the forensic community and/or humanity providing an example of how certain stable, non-aggressive pathological lesions can make personal identification relatively straightforward if antemortem resources are available.

Hereditary multiple exostosis, also known as osteochondromatosis or diaphyseal aclasis, is a condition where multiple benign, cartilaginous tumors (exostoses) develop at the metaphyses of endochondral bone. Although exostoses may be pedunculated or sessile in appearance, both develop cortex and spongiosa continuous with that of the bone on which they appear. Most commonly twenty or more tumors are found distributed bilaterally and growing away from the closest joint. Usually exostoses are found on one or more of the following: the distal femur, proximal/distal tibia, proximal humerus, distal radius or proximal/distal fibula. In addition to exostoses, individuals with osteochondromatosis also tend to be of a shorter stature and exhibit expanded metaphyseal areas of affected long bones. There may be significant growth asymmetry, secondary deformation of a nearby unaffected bone or increased susceptibility to fracture of an affected bone. The disease is usually manifested by age 12. This case history illustrates the utility of these types of lesions in personal identification from skeletal remains.

In spring of 2003, police found a body in an advanced state of decomposition suggesting a postmortem interval estimation of over two months. Almost all skeletal elements were recovered and taken to the laboratory for identification and trauma analysis.

The decedent was determined to be an adult male, who would probably have been classified as "white" based on metric and non-metric traits. Antemortem trauma was evident in the form of several healed fractures of the face, hand, lower leg and several ribs. The decedent exhibited pathological traits consistent with extensive osteochondromatosis including: multiple lobulated lesions on the metaphyses of the distal femora and the proximal/distal tibiae and fibulae, trumpet-shaped metaphyses and internal orthopedic fixation of the distal tibiae and fibulae to correct bilateral pathological fractures.

Postmortem radiographs of the tibiae, fibulae and femora were taken in order to confirm the diagnosis of multiple exostoses and to image the fractures and surgical appliances.The cranium was radiographed as well to illustrate a maxillary fracture and the frontal sinus pattern. Antemortem radiographs of the suspected victim, a 48-year-old white male, were then obtained and compared to those taken of the recovered remains. The antemortem radiographs pre-dated the time of death by several years. These films showed an acute fracture of the left maxilla within the floor of the orbit, an acute spiral fracture of the proximal shaft of the right tibia, multiple bony lesions on the proximal and distal metaphyses of the tibiae and fibulae, healed fractures of both distal fibulae with internal fixation via an orthopedic plate and an associated malleolar fracture of the tibia fixed with two cannulated orthopedic lag screws. The investigation revealed that the decedent's father had also suffered from hereditary multiple exostoses.

Comparison between the antemortem and postmortem radiographs showed identical placement of the aforementioned trauma and pathology, with the exception of the acute fracture of the tibia which was well-healed by the time of the postmortem radiograph. The frontal sinus pattern was also identical.

Based on the attributes of osteochondromatosis, i.e., tumors and pathological fractures, a positive identification was easily made. All of the imaged lesions displayed remarkable stability, further demonstrating that the lesions were benign and non-aggressive. These types of benign lesions, including single lesions of osteochondroma, osteomatoid exostoses, and myositis ossificans can serve as excellent life history markers of personal identity.

Human Identification, Hereditary Multiple Exostoses, Forensic Anthropology

H64 Empirical Validation and Application of the Quality-Control Polymerase Chain Reaction (qcPCR) Inhibitor Detection System

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The primary objective of this study is to optimize the quality control Polymerase Chain Reaction (qcPCR) inhibitor detection system by empirically determining its breadth of effectiveness and its sensitivity range. Effectiveness and sensitivity will be tested by utilizing several commonly encountered PCR inhibitors. The qcPCR detection system will then be compared to several other methods used to detect the presence of inhibitory substances in PCR template solutions. A variety of soft tissue and bone samples with prior negative amplification results are evaluated using qcPCR.

This presentation will impact the forensic community and/or humanity by developing a more accurate understanding of the relative effects of various PCR inhibitors. Investigators will also be able to differentiate between amplification inhibition and DNA degradation beyond the current limits of analysis.

Many current forensic DNA analysis methods are dependent on the successful amplification of a template DNA sample using the polymerase chain reaction (PCR). However, forensic samples often contain co-extracted diffusible compounds that partly or completely inhibit amplification of the template DNA molecules producing false-negative PCR results. Common diffusible inhibitors encountered in forensic contexts include substances produced by the body (e.g., heme-products, bile

salts, collagen) and compounds introduced from the environment by diagenetic processes (e.g., humic and tannic acids). Identifying PCR template samples that contain inhibitory substances allows investigators the opportunity to utilize inhibitor neutralization strategies, increasing the chance of a successful re-amplification attempt. This study will provide empirical evidence supporting the development of a PCR-based method to identify false-negative amplification results.

The proposed qcPCR system utilizes a 500 base-pair region of lambda phage DNA as the reporter template that is amplified using lambda phage specific primers. Test template solutions that have failed to amplify during previous attempts are spiked into the reporter amplification reaction. The qcPCR solution is then thermocycled using parameters optimized for reporter (lambda DNA) template amplification. The yield of amplified DNA obtained from the test template-spiked qcPCR is compared to that of a positive-control qcPCR lacking the test template. If both reactions yield the same amount of reporter amplicon (500 bp of lambda DNA), the test template solution does not contain diffusible inhibitory compounds capable of blocking or reducing the amplification efficiency of the reporter reaction. If however the test template-spiked samples yield less reporter amplicon than the control, the test template solution is assumed to contain diffusible inhibitors, suggesting genetic analysis will be compromised.

While a theoretically sound method, little empirical work has demonstrated its applicability to a range of known PCR inhibitors commonly encountered in forensic contexts. A variety of diffusible PCR inhibitors (humic acid, tannic acid, heme-products and collagen) are used to test the effectiveness and sensitivity range of the qcPCR system. Different concentrations of each inhibitor are mixed with varying concentrations of inhibitor-free genomic pig DNA. An amplification success matrix is constructed to determine the minimum inhibitor concentration necessary to reduce amplification efficiency. The inhibitor-genomic template mixes are then spiked into a qcPCR to assess the system's detection capabilities for single inhibitors. The aforementioned inhibitor/DNA templates are also used to evaluate the following inhibitor detection methods: spectrophotometric measurement of template purity, amplification efficiency calculation using real-time PCR, and the presence of oligonucleotide primer dimers in failed amplification attempts. Results are compared to assess the inhibitor detection capabilities of each method. The qcPCR inhibitor detection method is then used to evaluate lung, liver, spleen, psoas muscle, parietal, rib, vertebral body and femoral shaft DNA extractions that have failed to amplify during previous attempts. These samples were obtained over the course of two years from 28 pigs: 14 placed in a pond-shore environment and 14 deposited on a forest floor. Additionally, qcPCR analysis is reported for femoral DNA extractions from historic human burials.

This study will demonstrate that the proposed qcPCR inhibitor detection method allows investigators to reliably identify specimens that require more rigorous DNA extraction and purification procedures, thus facilitating the diagnostic amplification process and minimizing the potential for false-negative results.

Quality Control Polymerase Chain Reaction (qcPCR), PCR Inhibitors, Inhibitor Detection

H65 Defining Perimortem: Blunt Force Trauma

Derinna V. Kopp, MA, Jacquel Arismendi, MA, and Shannon A. Novak, PhD, Department of Anthropology, University of Utah, 270 South 1400 East, Room 102, Salt Lake City, UT 84112*

After attending this presentation, attendees will understand the quantiative and qualitative changes to bone when blunt force trauma is induced at 30-day intervals over six months.

This presentation will impact the forensic community and/or humanity by demonstrating that if the morphological changes in fracture characteristics of bone throughout the decomposition process can be quantified and statistically validated, such findings would facilitate skeletal trauma analysis and subsequently the testimony of forensic anthropologists.

Determining whether a traumatic lesion occurred perimortem or postmortem is one of the most important concerns in the analysis of skeletal remains. Distinguishing between perimortem trauma and damage that occurs after deposition, however, can be difficult. While the different fracture characteristics of fresh and dried bone are known and easily identifiable, the varying fracture characteristics of bone throughout the decomposition period are unknown. As bone decomposes, moisture, grease, collagen fibers, and other organic materials that give elasticity to the bone degrade, resulting in bone that is more friable and fragile with time. The rate at which these materials are lost is dependant on postmortem environmental and climatic factors. In fact, the fracture characteristics of fresh bone may remain for several weeks after death, making it difficult to determine when a fracture occurred during the decomposition process. If these morphological changes could be quantified and statistically validated, such findings would facilitate skeletal trauma analysis and subsequently, the testimony of the forensic anthropologist.

To examine the differing fracture characteristics of bone throughout the perimortem to postmortem interval, a trauma study using sheep humeri was conducted. A constant blunt force was used to induce trauma on sheep humeri at 30-day time intervals for six months. The study bones were obtained from ewes of the same age, when they were sacrificed as part of a biomedical femoral-tibial joint replacement study. At the time of sacrifice, the right and left forelimb of twelve animals was dissected, the wool and skin removed, and the humeri disarticulated at proximal and distal joints. The muscle tissue was kept on the humeri to allow for more realistic trauma induction and decomposition of the remains. Two hours after sacrifice, trauma was induced on two right humeri—these specimens served as time "0" or the perimortem baseline.

The remaining specimens were placed in a wire mesh cage in the western desert of Utah between May and October 2003, allowing the humeri to decompose naturally. Temperature and humidity at the location was monitored with an Oakton RH/TempLog at fifteen-minute intervals for the entire length of the study. Every 30 days, two of the humeri were retrieved, measured, photographed, and subjected to blunt force trauma.

Blunt force trauma was induced with a metal femoral head component attached to a guillotine apparatus, which allowed for a consistent reproduction of known force (designed by Dr. Kent Bachus, director of the biomechanics Laboratory at the University of Utah School of Medicine). The right humeri were clamped to the base of the apparatus at the proximal and distal joint surfaces to allow for trauma induction on the anterior-lateral midshaft. The guillotine was dropped from a height of 67 cm, resulting in trauma induced at 25.3 joules.

Following trauma induction, anterior-posterior and medial-lateral contact-radiographs and photographs were taken. All adherent soft tissue was carefully removed, making sure not to alter the fractured surface. The skeletal trauma was photographed, reconstructed, illustrated, and described in detail. The following variables were measured for each specimen:

- Thickness of cortical bone at impact site
- Fracture type
- Number of fragments
- Minimum and maximum length of each fragment
- Angle of fracture margin bevel (internal, external, flush)
- Number and length of radiating fractures
- Color of host bone and color of bone at fracture margins

These variables will be coded for the two specimens in each of the six time periods. Multivariate statistical analysis will be conducted to assess any temporal trends in the data. At the time of abstract submission, our analysis of the first three time periods has identified distinct differences in fracture morphology, especially in the size and number of

fragments. Specifically, there is a 1200% increase in micro-fragments (<1mm), an 80% decrease in small fragments (1mm - 10 mm), and a 400% increase in the number of radiating fractures. Change was also observed in the angle of the fracture bevel. Internal beveling decreased by 42%, external beveling decreased by 2%, and flush margins increased by 66%.

Perimortem Trauma, Blunt Force Trauma, Postmortem Damage

H66 Footnotes: Diabetic Osteopathy Used in Human Identification

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This poster discusses the pathophysiology of diabetes mellitus. We present three cases from the C.A. Pound Human Identification Laboratory in order to highlight how diabetic pedal osteopathies helped to establish positive identifications.

This presentation impacts the forensic community by discussing how multiple lines of evidence (medical histories obtained from physicians and families; skeletal analysis; clinical data) can be used to establish positive identification.

Diabetes mellitus is characterized by a reduced production of, or impaired response to, insulin hormone. To the exclusion of gestational diabetes, diabetes mellitus results as either: 1) an autoimmune condition that begins during childhood, with pancreatic islet ?-cell destruction and *absolute* insulin deficiency (e.g., Type-1 or Insulin-dependent Diabetes), or 2) begins in adulthood as insulin resistance or *relative* insulin deficiency (e.g., Type-2 or Non-insulin-dependent Diabetes). Type-2 Diabetics tend to be clinically obese and have a strong genetic propensity for the disease—more so than Type-1 Diabetics. Because insulin regulates how glucose is metabolized and therefore, controls body functions at a cellular level, diabetes mellitus often leads to a variety of clinical complications, including renal and ocular problems (e.g., glaucoma and cataracts), artherolosclerosis, and mucormycosis. Peripheral vascular disease, in particular, can cause additional problems, leading to diabetic neuropathy and subsequent increase in injury. Nerve damage and poor circulation, especially to the distal extremities are major contributing causes of diabetic osteopathies and amputations. Bony changes include *Charcot* joints, reduction in the size of and *sharpening* of pedal phalanges, ulcers, osteomyelitis, and transmetatarsal fractures.

The ubiquitous nature of diabetes mellitus (United States = 16.9 million people 20 years of age and older have the disease; National Disease Information Center 2003) makes it a disease in which a patient's family members, co-workers, and others, may be aware of or help the patient monitor his/her condition. Peer and physician awareness of the need for "foot monitoring" stems from the knowledge that foot ulcers, thick calluses, nerve damage and circulation problems can lead to gangrene, osteomyelitis, osteopenia, generalized insufficiency fractures, amputation, and systemic infections that, if left unattended, may lead to death.

In forensic settings, an unidentified decedent can be positively identified when the antemortem medical records and radiographs are compared to the postmortem findings and radiographs and reveal multiple consistencies and similarities. Yet, medical records and/or radiographs may not be available (e.g., destroyed or regulated by the Health Information Patient Protection Act (HIPPA)) or nonexistent due to lack of medical intervention secondary to a victim's low socioeconomic status. Therefore, interviews with a victim's family, friends, neighbors, and co-workers, who may have had knowledge of the victim's diabetes mellitus and secondary foot problems, may help medico-legal death investigators reach a presumptive identification.

We present three forensic anthropology cases from the C.A. Pound Human Identification Laboratory in order to demonstrate the use of diabetic osteopathies in positive identifications—especially when other biological factors are taken into account (age, sex, ancestry, stature, and other idiosyncratic characteristics). For the three cases below, gross, metric and radiographic osteological analysis was conducted.

Case 1: In 2002, one incomplete skeleton was discovered in a Bayou in Shreveport, Louisiana. Osteological analysis indicated that the remains were those of an elderly, black female. No obvious signs of perimortem trauma were noted. Postmortem change included carnivore and rodent scavenging damage. Antemortem trauma and pathology included severe osteophytosis, osteoporosis, bi-lateral craniotomy with evidence of craniotomy suture wires still present, and shortening and narrowing of the phalanges of the right foot.

Case 2: In 2002, one incomplete skeleton was discovered in Jacksonville, Florida. Osteological analysis indicated that the remains were those of a middle aged black male. No evidence of perimortem or postmortem trauma was noted on the remains available for analysis. Antemortem trauma and pathology included an amputated left first metatarsal, necrotic foot joints, and periostitis on both tibiae and fibulae, with a possible subperiosteal hematoma on the tibia.

Case 3: In 2001, one mostly complete skeleton was found in Volusia County, Florida. Osteological analysis indicated that the remains were those of an elderly, white male. No obvious signs of perimortem trauma were noted on the remains available for analysis. No postmortem trauma was present. Antemortem trauma or pathology included amputated pedal phalanges, including both first, proximal phalanges, and a well-healed fracture of the left ulna.

In each case, gross examination of the feet revealed skeletal alterations consistent with complications of diabetes mellitus. For all three cases, the victim's medical history came from family members**,** rather than the physicians' medical records because those records and radiographs were not available. Nevertheless, multiple lines of evidence, including those presumptive in nature, were used to establish the positive identifications.

Diabetes Mellitus, Foot Osteopathy, Identification

H67 Diagnosing Degenerative Pathologies in an Unidentified Skeleton

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By attending this poster presentation participants should expect to learn: the challenges of creating a biological profile for an unidentified skeleton with multiple pathological conditions; will learn the osteological indicators of several other conditions that exhibit similar markers; and will learn the methods used to evaluate unique pathologies.

This presentation will impact the forensic community and/or humanity by illustrating the challenges of diagnosing pathologies. The forensic science community can benefit from the methods and process of evaluating overlapping pathologies and the challenges faced in this case of creating a biological profile for an unidentified individual.

In 1997, a nearly complete human skeleton was discovered by utility workers in a remote, uninhabited wetland area in Staten Island, New York. The upper portion of the skeleton was found under a water heater, partially inside a plastic bag. The individual was fully clothed and skeletonized, with only a small amount of mummified soft tissue adhering to the patellas and proximal tibii. The skeleton was analyzed by the anthropologist at the Office of Chief Medical Examiner, City of New York. A biological profile was created evaluating the individual's age, sex, and stature. Examination of the skeleton revealed features associated with at least two separate pathological conditions severely affecting the spine and joints.

Anthropological examination of the innominates, mandible, and postcranial skeleton suggest the individual is male. The age range based on pubic symphysis morphology and sternal rib end analysis is 45-60 years of age. A comprehensive analysis of ancestry could not be conducted, as the cranium was not recovered. The individual's stature was obtained by using the forensic femur formula, yielding an estimated stature of 5'4"+/-3.4".

The most prominent of the skeleton's pathological features is the thoracic region of the spine where T3 through T7 are completely fused and form a 90-degree anterior bend. There is no intervertebral space and the discs are compacted and calcified. The inter- and supraspinousligaments on the posterior surface of these vertebrae are ossified. The anterior and lateral surfaces the vertebral bodies display thick syndesmophytes making it difficult to differentiate them. The lower ribs are very straight, likely due to the anterior bend of the torso and the pressure exerted by the organs. In the thoracic region several ribs are also fused at the costovertebral joint.

The first through the fourth lumbar vertebrae are fused by thin, vertical fibrous endesopathic growths appearing at the insertion of the longitudinal spinal ligament on the anterior surface and lateral margins of the vertebral bodies. These vertebrae are connected by thin bony bridges called sydesmophytes. Several of the lumbar vertebrae are also fused at superior and inferior zygapophyses. Cervical vertebrae 3 through 5 and 7 have small fused syndesmophytes on the anterior vertebral bodies and the intervertebral space is maintained. The sacroiliac joints are fused and entheses of the femur, patellae, scapulae, clavicles, tibiae, fibulae and os coxae display ossified tendons and ligaments.

Tuberculosis of the spine (Pott's disease) is characterized by the collapse of a portion of the spine into an angular kyphosis. Pott's disease begins with an abscess in the vertebral body caused by inhalation of *Mycobacterium tuberculosis* into the lungs, passing through the lymphatic system to the spine. This leads to the destruction of the intervertebral space and collapse of the spine into an angular deformity. It usually affects between two and four vertebrae, often at the lower thoracic and upper lumber region. The involvement of at least four thoracic vertebrae is necessary for diagnosis.

Pott's disease is a lytic process and bone regeneration is uncommon. This case has significant bone regeneration, however it is likely due to the bone-forming attributes of another origin. Pott's disease rarely affects the posterior neural arch, transverse processes, and spinous processes, but this has been observed in untreated adults.

Ankylosing spondylitis is a degenerative inflammatory disease affecting connective tissue at ligament insertions. It often affects males between the ages of 15-35. It is of unknown etiology, however individuals with the disease often have the antigen HLA-B27 in their blood. The disease causes erosion of the bone at entheses and new bone replaces it and the connecting ligament ossifies. A new insertion is formed above the cortical bone creating an irregular bony process. In this case, the os coxae, the lesser trochanter, and both femora and patellae all display these enthesopathies. Fusion of the sacroiliac joints, which has been called the hallmark of ankylosing spondylitis, is present in this case as well as the progressive fusion of the anterior longitudinal ligament. Syndesmophytes, bridge the gap between the vertebral bodies and consequently fuse several vertebrae together forming a bamboo-like appearance. The lumbar and cervical vertebrae are consistent with this diagnosis as they display symmetrical syndesmophytes that become smaller in the cervical region. Involvement and fusion of the zygopophyseal joints and costovertebral joints may be present in cases of ankylosing spondylitis and are present in this case. The features of the appendicular skeleton, as well as the early stage of bamboo-like appearance of the spine are consistent with a diagnosis of ankylosing spondylitis.

In an effort to understand the origins of these pathologies and create a more complete biological profile, a DNA test is being conducted to determine if the individual did indeed have Pott's disease. In addition, it is believed that this individual also suffered from ankylosing spondylitis. In spite of these distinctive skeletal changes, the decedent remains unidentified.

Forensic Anthropology, Ankylosing Spondylitis, Tuberculosis

H68 Symmetrical Fracturing of the Skull From Self-Inflicted Gunshot Wounds: Reconstructing Individual Death Histories From Skeletonized Human Remains

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The goal of this presentation is to describe a potentially diagnostic pattern of fractures associated with submandibular shotgun wounds.

This presentation will impact the forensic community and/or humanity by making it possible to diagnose submandibular, mid-line gunshot injuries from cranial fracture patterns, even in cases where the remains are skeletonized and highly fragmented.

The attendee will become familiar with a potentially diagnostic pattern of fractures associated with self-inflicted midline gunshot wounds. The three objectives of this poster is to present two cases in which skeletonized remains were found in association with a shotgun; to describe and display the observed perimortem "suite of fractures" in both cases and discuss the observed bilateral symmetry of those fractures; and to suggest a possibly diagnostic pattern of fractures consistent with self-inflicted midline gunshot wounds.

In the following two cases, skeletonized humans remains were recovered from remote areas and submitted to forensic anthropologists. Following identification in each case, the main focus of the anthropological analysis was the skeletal trauma. In both cases, the skull was submitted in a highly fragmented state. Nevertheless, by focusing on the pattern of perimortem cranial fractures, the anthropologists contributed key information regarding the circumstances of death in these cases.

Case 1: In September of 2000, skeletonized human remains were recovered from a wooded area in mid-Michigan by a law enforcement search team. At the scene, a shotgun was found in association with the remains. Anthropological analysis determined that the remains were those of an adult male of European ancestry, and a positive identification was made through comparative radiography. The skull was recovered in a fragmentary state with at least 45 distinguishable fragments present. Most of the skull fragments were recovered making it possible for a complete reconstruction. During the process of charting and photographically documenting the linear fractures displayed by the skull, a bilaterally symmetrical perimortem fracture pattern became apparent.

The "suite of symmetrical fractures" observed in this case are enumerated by aspect as follows. The anterior aspect of the skull displays transverse fractures of the mandible in the chin region, vertical fractures of the mandibular body, Le Fort II fractures of the maxillae, tripod fractures of the zygomatics, and a midline frontal fracture. The lateral aspect of the skull exhibits fractures running along the temporal lines of the frontal, a diastatic fracture of the coronal suture which continues laterally along the parietals, horizontally oriented fractures of the parietal, and vertical fractures of the parietal. The basilar aspect of the skull displays occipital fractures adjacent and posterior to the foramen magnum, a midline fracture of the basi-occiput, as well as fractures of the palate and pterygoid processes of the sphenoid.

Based on this symmetrical pattern, as well as the pattern of mandibular fracturing, and the orientation of beveling on the palate and frontal bones, the trauma was attributed to a submandibular gunshot wound.

Case 2: In January of 2003, hunters discovered skeletonized human remains and an associated shotgun in a wooded area of the western lower

peninsula of Michigan. The remains were those of an adult male of European ancestry. A positive identification was made through comparative mitochondrial DNA analysis. The cranium and mandible were recovered in a fragmentary and incomplete state, with only 26 skull fragments present. As a result, it was not possible to reconstruct the cranial vault. Even so, the recovered portions of the skull exhibited a bilaterally symmetrical fracture pattern very similar to the skull in the above case, which lead the authors to believe that this was a case in which either a submandibular or intraoral gunshot wound was the cause of the skeletal trauma.

In both of the above cases, the skulls did not exhibit the classic gunshot entry or exit injuries. They did, however, exhibit important evidence in the form of bilaterally symmetrical fracture patterns. This distinctive pattern is believed to be the result of submandibular or intraoral shotgun wounds in which there is a centralized explosive dispersion of gases. It is known that when these expansive gases enter the restricted space of the cranial vault, the increase in intracranial pressure causes fragmentation and fracturing of the skull. These two cases may illustrate that this type of fracturing does not occur randomly, but rather along predictable planes. The lines of fracture most likely occur in areas that are structurally weaker which crumple under the force of such explosive events. These findings lead the authors to believe that it may be possible to diagnose submandibular or intra-oral mid-line gunshot injuries from cranial fracture patterns, even in cases where the remains are skeletonized and highly fragmented.

Forensic Anthropology, Shotgun Wounds, Skeletal Trauma

H69 In the Name of the Dead: The Panamanian Truth Commission's Search for the "Disappeared"

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The goal of this presentation is to present the results of the skeletal analyses of the victims of human rights violations in Panama.

This presentation will impact the forensic community and/or humanity by exposing the forensic community to human rights investigation efforts in Panama.

Panama's democratic history came to an abrupt halt in 1968 after a coup d'etat toppled President Arnulfo Arias ten days and eleven hours after his administration began. This coup set in motion Panama's twenty-one years of military dictatorships that began with General Omar Torrijos (1968-1981) and continued with General Manuel Noriega (1981-1989). Forced disappearances, tortures and arbitrary execution of its victims, characterized the military regimes of the 1970s and 1980s.

In 1999, several clandestine graves were discovered one of which later was identified as the remains of Heliodoro Portugal. His remains were positively identified via DNA on 21 August of 2000. Heliodoro Portugal had been identified as a leftist by the military junta and was last seen being forcibly pushed into a car on 14 May 1970. As a result of these findings, the Panamanian Truth Commission (La Comisión de la Verdad de Panamá) was formed on January 18, 2001 by Executive Order issued by the lady President Mireya Moscoso. The objective of the Truth Commission as written in the executive decree "is to contribute to the clarification of the truth regarding human rights violations fundamental to life, including the disappearances committed during the military regimes that governed Panama beginning in 1968…"

As of April 18, 2002, the Truth Commission has amassed enough information to recognize 110 persons assassinated and disappeared. However, these numbers have already increased considerably as new information is gathered, including the positive identification of Jerónimo Díaz Lopez in June 2003. Fifty percent of the victims were murdered or disappeared between 1968-1972, twenty percent between 1973-1983, twenty-eight percent between 1984-1989, and two percent with no known information.

Thirty-four excavation sites have presently been identified in the provinces of Panamá, Chiriquí, Veraguas, Coclé, Bocas del Toro and Colón. However, much of the resistance against the military regimes was felt in the province of Chiriquí. Skeletal identifications are extremely difficult because of various taphonomic processes (for example, soil acidity, insect activity and bacterial activity, roots, humidity, etc.), conditions that are not conducive to good skeletal preservation and therefore the remains sustain considerable postmortem damage. Interestingly, many of the skeletal elements recovered from the mainland were hand and foot bones that generally do not have a high rate of recovery. The recovery and identification efforts that have yielded the most positive results have been from the island of Coiba. In our efforts to locate the remains of Floyd Britton arrested in 1968 and who was sentenced to Coiba, others have been inadvertently identified who were not known to have perished there. The remains of Sergeant Sánchez Tenas who was killed in 1975 at the hands of another member of the military police and whose murder was covered-up by the military was identified via mtDNA analysis while testing the skeletal samples in hopes of finding Floyd. The identification of Jerónimo Díaz Lopez was made via dental comparison and traditional forensic anthropological techniques. Floyd Britton has yet to be identified. However, recovery and identification efforts will continue on Coiba as a result of these other identifications to search for others who are believed to be buried there.

Forensic Anthropology, Human Rights, Panama

H70 Truth, Justice, and Forensic Anthropology in Latin America

Clyde Snow, PhD, c/o ALAF and EAAF, 10 Jay Street #502, Brooklyn, NY 11201*

The author will introduce a new forensic organization dedicated to the application of forensic anthropology to human rights and judicial investigations in Latin America and present the experiences of some of the organizations' members.

Through introducing the Latin American Forensic Anthropology Association (ALAF) to a wider forensic community, we hope to expand the network of Latin American forensic specialists and supporters, encourage forensic work in judicial investigations and see the organization's objectives adopted more widely in the region.

This session presents the Latin American experience of applying forensic anthropology and archaeology to human rights and other judiciary investigations over the past two decades. The presenters will describe the origin of the application of forensic anthropology in Latin America, overviews of the state of forensic anthropology investigations in a number of countries and discuss major trends, challenges, and problems in their work. In February 2003, for the first time, forensic anthropologists from throughout Latin America, and Dr. Clyde Snow, who chaired the meeting, gathered at Austin College in Sherman, Texas to discuss national experiences, commonalities and differences in particular cases and possibilities for working together to further forensic work in judicial investigations. Following this meeting, ALAF, the Latin American Forensic Anthropology Association was established.

ALAF's founding members largely work for non-governmental organizations that were trained by Dr. Clyde Snow, and pioneered the application of forensic anthropology to human rights investigations in their own countries, including Argentina, Chile, Guatemala, and Peru. As a result, ALAF is sponsored by the Guatemalan Forensic Anthropology Foundation (FAFG), Human Rights Office of the

Archbishop of Guatemala; Center of Forensic Analysis and Applied Sciences (CAFCA), the Peruvian Forensic Anthropology Team (EPAF), and the Argentine Forensic Anthropology Team (EAAF). Founding members of ALAF from Colombia, Mexico and Venezuela work within national medical legal systems and in universities, enriching the background and membership of the association.

ALAF founding members from Argentina, Chile, Colombia, Guatemala, Mexico, Peru, and Venezuela have established objectives for forensics in Latin America that range from establishing ethical and professional criteria for the practice of forensic anthropology to concern with the access of families of the deceased to procedures and results of forensic investigation. ALAF is concerned with the promotion of professional accreditation, improving the training of professionals working in this field, promoting the adaptation of international forensic standards by national forensic institutes, and mechanisms of protection for ALAF members and families. Another ALAF objective is defending the scientific and technical autonomy of forensic anthropology investigations in Latin America and the Caribbean because these investigations are often lodged in state-run medical-legal institutes. Because forensic anthropologists and archaeologists in Latin America, whether working as independent experts or inside government institutions, often work on cases where state institutions are reportedly involved in crimes under investigation, this relationship is often a source of tension. Especially under these circumstances, in many cases in Latin America, forensic investigations are vital to truth and justice. Through the organization of ALAF, we hope to contribute to protecting the integrity of these investigations as well as enlarging a community for forensic practitioners.

This session, introduced and moderated by Dr. Clyde Snow, includes participants from Argentina, Colombia, Guatemala, Peru, and Chile who are ALAF founding members. They will discuss and share their national and international experience in forensic investigation both in their home countries and internationally. Through the introduction of ALAF to a wider forensic community, we hope to expand the network of Latin American forensic specialists and supporters, encourage forensic work in judicial investigations and see these objectives adopted more widely in the region.

Forensic Anthropology, Human Rights, Latin America

H71 Perspectives and Recommendations From the Field: Forensic Anthropology and Human Rights in Argentina

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The author will describe the work and goals of the Argentine Forensic Anthropology Team (EAAF), a non-governmental, non-profit organization dedicated to the application of forensic sciences- mainly forensic anthropology and archaeology - to the investigation of human rights violations.

The presentation examine the work of the Argentine Forensic Anthropology Team to the forensic community, including perspectives and recommendations that have emerged from almost two decades of field work throughout the world.

This paper describes the work and goals of the Argentine Forensic Anthropology Team (EAAF), a non-governmental, non-profit organization dedicated to the application of forensic sciences- mainly forensic anthropology and archaeology - to the investigation of human rights violations.

EAAF, founded in 1984 when democracy returned to Argentina, was created to recover the remains of people "disappeared" by the state during the preceding military regime and to address the failure of state institutions to provide knowledge and support to families and others searching for their loved ones. This paper briefly describes the legal, historical, psychological, and technical contexts the team arose from and confronted upon its creation, and how these have contributed to the team's methodology for working on human rights cases in Argentina and other parts of the world.

At the request of local or international tribunals, human rights organizations, and truth commissions, the EAAF has worked in most Latin American countries, as well as Africa, Asia and Eastern Europe. During this work, EAAF has developed a systematic approach for forensic investigations, including extensive preliminary work, archeological work and laboratory analysis. Because many members of the forensic community are familiar with the methodologies used in archaeological and laboratory work, this paper focuses on the particular details of EAAF's preliminary investigation, including the collection of background information, ante-mortem data, and information about and visits to reported killing and burial sites related to the case. EAAF often works at the invitation of local non-governmental organizations (NGO). Often at great risk to their members, they form an essential bridge between investigative bodies and witnesses, survivors and families of the victims. The team also advocates the central role of families of victims in the investigation process. Normally, after verifying that families are seeking a forensic investigation, EAAF involves members in the preliminary investigation and provide explanations of and access to forensic procedures and laboratory results.

Based on our experiences working as forensic anthropologists in the field and for truth commissions, special commissions of inquiry and national and international tribunals, EAAF has observed a variety of perspectives, issues and problems and developed a number of suggestions in response to investigating violations in the context of institutional bodies that are established for fixed periods of time. These include mechanisms to continue recovery and identification processes beyond the mandates of commissions or tribunals, witness protection programs, and counseling and psychological support for persons who testify and for families and friends of victims and staff members before, during and after exhumations. EAAF also advocates direct contact between forensic teams and local NGOs and with relatives of victims of human rights violations

Finally, this paper summarizes the main currents and future challenges currently confronting the EAAF. These include improving access to DNA analysis for human rights cases, training local teams and experts and the application of international forensic protocols into national forensic systems.

Forensic Anthropology, Argentina, Human Rights

H72 The Development of Forensic Anthropology in Chile

Isabel Reveco, Association for Latin American Forensic Anthropology, c/o EAAF, 10 Jay Street #502, Brooklyn, NY 11201*

From this presentation, attendees will learn about the development of forensic anthropology in Chile and how the discipline has contributed to ongoing human rights investigations in the country.

This presentation will impact the forensic community by examining the development of forensic anthropology in Chile, especially in relation to human rights cases.

Forensic anthropology in Chile arose in the context of systematic human rights violations carried out by the military dictatorship under Augusto Pincohet (1973-1990). The dictatorship killed more than 5000 political prisoners and "disappeared" another 2000.

In 1989, the Association of Relatives of Disappeared Political Prisoners (AFDD) invited Dr. Clyde Snow and members of the Argentine Forensic Anthropology Team (EAAF) to serve as forensic experts in a case of the discovery of remains that were thought to correspond with disappeared political prisoners. During this visit to Chile, Dr.

Snow spoke of the necessity of forming a forensic anthropology team independent from state organizations in order to guarantee the independence of scientific investigation not influenced by political pressures. AFDD convened a group of anthropologists and archaeologists who participated in the College of Anthropologists, the national association for this discipline. In 1990, an interdisciplinary group including anthropologists, archaeologists, odontologists and specialists in biochemistry formed the Chilean Forensic Anthropology Group (GAF) as a non-profit organization. Over the course of five years, this group participated in numerous discoveries of remains, mostly in relation to judicial investigations focusing on the search for and investigation of the disappeared. This work addressed a great void in the country with regard to human rights investigations. In 1994, the GAF dissolved and the Identification Unit of the Medical Legal System, a governmental organization under the Ministry of Justice, was formed. This multidisciplinary unit, staffed by medical doctors, odontologists, and anthropologists, is exclusively dedicated to the identification of disappeared political prisoners. In 1998, the Genetic Sample Bank of Families of Disappeared Political Prisoners was formed, the first governmental genetic sample bank of its type in Latin America. The bank maintains genetic samples from families of the victims for safekeeping so that, when necessary, remains may be tested against these samples.

Presently, more than 500 judicial investigations are underway that will ideally lead to the discovery of the disappeared, the identification of their remains and the determination of responsibility for their disappearance. Forensic anthropology is central to these goals.

Forensic Anthropology, Chile, Human Rights

H73 Forensic Anthropology in Guatemala

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The author will introduce the forensic community to the work of three organizations–the Guatemalan Foundation for Forensic Anthropology (FAFG), the Center for Forensic Analysis and Applied Sciences (CAFCA), and the Exhumations Team of the Guatemalan Archbishop's Office for Human Rights (ODHAG)– currently carrying out forensic investigations in Guatemala.

This presentation outlines the growth and development of forensic anthropology in Guatemala as a response to its contemporary social needs.

In February 2003, for the first time, forensic anthropologists from throughout Latin America responsible for pioneering the application of forensic anthropology to human rights and training in their own countries, and Dr. Clyde Snow, who trained and continues to support many participants, gathered at Austin College in Sherman, Texas. Participants discussed national experiences, commonalities and differences in particular cases and possibilities for working together to further forensic work in judicial investigations in Latin America. Representatives from three organizations currently carrying out forensic work in Guatemala–the Guatemalan Foundation for Forensic Anthropology (FAFG), the Center for Forensic Analysis and Applied Sciences (CAFCA), and the Exhumations Team of the Guatemalan Archbishop's Office for Human Rights (ODHAG)–were present. Following this meeting, ALAF, the Latin American Forensic Anthropology Association was founded. ALAF's founding members, including representatives of the three aforementioned organizations, work for non-governmental organizations that were trained by Dr. Clyde Snow.

This paper presents the Guatemalan context for the emergence of forensic investigations of human right cases, examines the current state of these investigations and discusses particular perspectives, trends and challenges that have emerged from our work over the course of more than a decade.

During the thirty-six years of internal armed conflict that Guatemala endured, the population was subject to many human rights violations. Most of these atrocities occurred in rural Mayan communities. The Historical Clarification Commission (CEH) reported that, as a result of the conflict, over 200,000 people perished or disappeared.

Even before the Peace Accords were signed in 1996, the victims' families began the search for their lost loved ones and began the struggle of uncovering the truth. However, Guatemala did not have organizations that could attend to these needs. Recognizing this pressing issue, teams (FAFG, ODHAG, CAFCA) were gathered and trained to carry out forensic anthropological investigations, with a focus on exhuming clandestine burials and analyzing the remains found.

The emergence of forensic anthropological teams in Guatemala dedicated to the application of forensic anthropology and archaeology to human rights and judicial investigations was stimulated further by the Historical Clarification Commission's recommendation that all cases of massacres and extrajudicial executions be investigated, giving back to the victims' relatives the right to know the truth about what happened to their family members and consequently strengthening the country's judicial system.

This presentation outlines the growth and development of forensic anthropology in Guatemala as a response to its contemporary social needs.

Guatemala, Human Rights, Forensic Anthropology

H74 The Peruvian Forensic Anthropology Team (EPAF) and the Memory of the Missing

Jose Pablo Baraybar, MSc, Aldo Bolanos, Carmen Rosa Cardoza, Mellisa Lund, Giovani Macciotta, and Juan Carlos Tello, Peruvian Forensic Anthropology Team (EPAF), c/o ALAF and EAAF, 10 Jay Street #502, Brooklyn, NY 11201*

The author will discuss the formation and work of the Peruvian Forensic Anthropology Team (EPAF) and the large-scale collection of antemortem information on missing persons in Peru as part of the Memory of the Missing project.

With this paper, the forensic community will learn about the activities of the Peruvian Forensic Anthropology Team (EPAF) and their campaign for the collection of ante-mortem information of missing persons.

Created in February 2001, the Peruvian Forensic Anthropology Team (EPAF), a non-governmental organization, advocates the search for missing persons in Peru through scientific methods of forensic anthropology and archaeology. Recent estimates by the Truth and Reconciliation Commission in Peru suggest that during the 1980s and 90s, the worst period of political violence, some 60,000 people were killed and of those, some 9,000 went missing.

It is EPAF's view that investigations aimed at determining the whereabouts of missing persons should be carried out by independent teams not involved with the State system. This is particularly true in the Peruvian case, where the state institutions were involved directly or indirectly in the disappearance of people.

Between 2001 and 2002, EPAF undertook five workshops at the national level to provide prosecutors, lawyers, human rights activists and archaeology students with the basic information regarding the use of forensic science in investigating human rights violations. In addition, EPAF and the Ombudsman's Office of Peru published a manual on effective forensic investigations of graves containing human remains. During this period, EPAF was also appointed as an expert group by the Public Prosecutor's Office and human rights organizations. They became involved in cases such as the storming in 1997 of the Japanese Ambassador's residence in Lima and other cases against Vladimiro Montesinos and the Fujimori regime (1990-2000). While working with the Truth and Reconciliation Commission (CVR) of the Peruvian

Government, EPAF conducted the first exhumation of missing persons in the Province of Ayacucho dating from 1983. In 2002, after a nine-month collaboration with the Truth and Reconciliation Commission (CVR) and following certain conditions that compromised its independence, EPAF returned to work as an independent organization.

The search for missing persons is not a forensic activity limited to the recovery and examination of human remains. It is rather a set of activities contributing to finding the remains of a missing person and restoring his/her identity. Paramount to the latter is the availability of antemortem data used to perform an individual identification. Considering the number of missing persons in Peru and the lack of antemortem records, EPAF has launched the Memory of the Missing, a project designed to gather antemortem information for missing persons as well as the details their disappearance. The combination these data provides information on the biological profile of the victim (age, sex, race, stature, handedness, individuating characteristics, dental chart) as well as information on the possible place where the body was disposed. Additional details include information about perpetrators and their *modus operandi* (Army, paramilitary groups, rebel organizations). All information is maintained in a specialized database that allows for complex searches to be performed.

The implementation of the project and the collection of antemortem data empower grassroots organizations and family associations. EPAF is providing technical support, supervising quality control and providing training by means of workshops throughout the provinces worst hit by the violence of the 1980s and 90s. EPAF is successfully building a network of local and regional family associations that participate in this process. The urgency of this project is demonstrated by the fact that a large number of relatives of those who went missing in the early 80s are dying of old age, disease or sorrow. Therefore, if this crucial information is not collected immediately it may be lost forever, further diminishing the chances to identify the remains of missing persons.

With this paper, the forensic community will learn about the activities of the Peruvian Forensic Anthropology Team (EPAF) and their campaign for the collection of antemortem information of missing persons.

Equipo Peruano de Antropologia Forense (EPAF), Gral. Canterac # 583-E, Jesus Maria, Lima-Peru.

Peru, Forensic Anthropology, Antemortem Data

H75 Forensic Anthropology in Colombia

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The authors will introduce the forensic community to the current state of forensic anthropology investigation in Colombia.

This presentation will impact the forensic community by demonstrating the development of forensic anthropology in Colombia and how it differs from other cases in Latin America.

In Colombia, forensic anthropology has developed as an applied science using tools from social anthropology, biological anthropology and archaeology to utilize scientific evidence in death and crime investigations. For over ten years, a small but growing group of anthropologists from different universities and government agencies has demonstrated to police authorities and medicolegal institutions that forensic anthropology is the backbone in the scientific process of determining not only identities from human skeletal or decomposed remains but also to provide important information in determining cause and manner of death. From the late 1980s to the present, many Colombian anthropologists have worked on many different kinds of cases, ranging from simple crime scenes to complex investigations concerning human rights violations.

In the 1980s, the sociopolitical situation, the civil conflict (including armed confrontation), and the lack of specialized analysis in some medicolegal cases contributed to an urgent need for forensic anthropologists. The siege of the Palace of Justice in Bogota in 1985 that resulted in many casualties and total destruction of the building, the terrorist bombings in urban areas and the Armero mudslide disaster all contributed to this need. In the same year, the participation of physical anthropologists in crime investigations grew, particularly in relation to specific cases, including the discovery of an apparent mass grave in a place named Cueva de la Trementina, located in northern Colombia.

With the Constitutional modifications in 1991, many official and government agencies were improved and others created, including the National Institute of Legal Medicine and the Attorney General's office. These agencies created specialized laboratories including forensic anthropology facilities and began to recruit and train professional crews with experience in the analysis of human remains. This training was made possible since 1994 with support from international groups and agencies such as the Argentine Forensic Anthropology Team (EAAF), the International Criminal Investigative Training Assistance Program of the US Department of Justice, the Federal Bureau of Investigation, the Armed Forces Institute of Pathology, the Deutsche Gesellschaft fur Technische Zusammenarbeit (Germany) and Universidad del Pais Vasco (Spain) since 1994.

Forensic anthropology as a formal discipline was introduced in Colombia at the National University in 1994. Since then, this university has established a postgraduate course and several workshops and training courses to reinforce academic training in this area, not only for students but also for officials and medical examiners.

Since the late 1990s, Colombia has established several forensic anthropology laboratories to support crime scene investigators and medical examiners. While in other parts of Latin America, forensic anthropology has grown mostly in relationship to non-governmental teams working in human rights. These teams are often constituted as nongovernmental organizations. Despite the internal conflict in Colombia that has also produced severe human rights violations, forensic anthropology has largely developed within government agencies. By developing within these agencies, forensic anthropologists have had access to a much wider range of forensic cases that included not only human rights cases but also mass disaster cases and more 'normal' criminal cases such as individual and serial murder cases. Since 1997, Colombian forensic anthropologists have also worked as experts and advisors in other countries.

In the near future, further modifications in the Colombian legal system will allow us to expand forensic anthropology's range and to meet new challenges. Lawyers and prosecutors as well as government agencies will employ experts such as forensic anthropologists in courts. Theoretically, this will improve academic and professional performance, provide for proper investigations of deaths and the implementation of the rule of law. However, forensic anthropology has many methodological and empirical difficulties to overcome.

Colombia, Identification, Forensic Anthropology

H76 Postmortem and Perimortem Fracture Patterns in the Long Bones of Deer

Bruce P. Wheatley, PhD, Department of Anthropology and Social Work, University of Alabama, Birmingham, AL 35294-3350*

After attending this presentation, attendees will have more information on fracture patterns of long bones in deer to help elucidate the interval between perimortem and postmortem.

Forensic anthropologists need to be cautious in their determination of perimortem vs. postmortem trauma. This study of deer long bones suggests that some of the fracture patterns utilized in making a determination of perimortem or postmortem trauma may not be "cut and dry."

If perimortem breaks have green bone response due to their greater moisture content and if it is possible to preserve this moisture content in a postmortem environment, then postmortem bone breaks may mimic "perimortem" breaks.

The perimortem interval is of great interest to forensic anthropologists and the line separating it from postmortem trauma can be unclear, Maples (1986), for example, called "the perimortem interval an elastic interval at best and a vague concept at worst." The moisture content of bone is said to be a major factor determining fracture patterns (Johnson, 1989). So called green or "wet" bone is more flexible; it contains fresh marrow and has a greater energy-absorbing capacity than "dry" bone before failure. It has also been stated that the biomechanics of fractures on whole bones is rather limited (Lyman, 1994). A bone trauma experiment was designed to test these ideas and to provide further information on fracture patterns.

There are three samples of sub-adult and adult white-tailed deer that were obtained from local deer processing plants and broken on Feb. 7, 2003. Group 1: Femora and humeri from 17 animals killed on the 15th or 16th of December, 2002. These bones were never frozen and they were put outside on a wooden platform on Dec. 24th for 44 days before they were fractured. The average low for that period was 32.5 degrees F. and the average high was 51 degrees F. The temperature went below freezing on 20 days. The postmortem interval is 52-53 days. Group 2: Femora and humeri from 8 animals killed on Jan. 20th were frozen and then thawed before they were broken. The postmortem interval is 18 days. Group 3: Femora and humeri from 5 animals killed on Jan. 31st, and from 2 animals killed on Feb. 7th, and from one animal killed on Feb. 3rd. These bones were never frozen and the postmortem interval is less than one week.

Measurements made before breakage include: total length, lateral and anterior-posterior width, and weight. Video of the breakage and photographs of the bones after breakage were recorded. A Dynatup 8250 Drop Weight Impact Test Machine applied a compressive force weighing 11.3 kilograms. The drop height varied and variables, such as load/velocity curves to impact, load to failure, time to failure, and energy to failure were recorded. The striking surface of the impactor is three inches by four inches. The proximal end of the bone was held in a vice and the other end was placed on a platform. The bones were cleaned and processed with Biz, baking soda and ammonia.

Fracture patterns of the proximal and distal ends of the long bones were examined. Only one bone in the sample broke in half and the features of this bone were only scored once. The following features that are sometimes said to indicate perimortem trauma were examined (Villa and Mahieu, 1991). Some of these are: fracture angle on the z axis, fracture surface morphology, fracture outline, sharp edges, and the presence of fracture lines. The attribute states recorded for fracture angle are 1) oblique (obtuse or acute); 2) right; 3) oblique and right (mixed). Fracture surface or edge morphology was classified as smooth or rough. Fracture outline was classified as: 1) transverse, fractures are straight and transverse to the long axis of the bone; 2) curved, spiral or helical fractures, and V-shaped or pointed fractures, and 3) intermediate, fractures have a straight or single plane morphology but are diagonal, and fractures with a stepped outline. Fractures on or near epiphyses were not considered. Fracture edges were classified as sharp or right angle and fracture lines were recorded as present or absent.

The results are as follows. In regards to the first feature, Group 1) bones exhibited 2 oblique fracture angles, 24 right angles and 6 mixed. Group 2) bones exhibited 3 oblique angles, 7 right angles and 6 mixed and Group 3) exhibited 9 oblique angles, 3 right angles, and 4 mixed angles. The fracture surface morphology of all three groups was rough. While some bones had a fine surface they also had uneven surfaces with crests and waves. In regards to fracture outline, Group 1) bones had 9 transverse, 7 curved, and 16 intermediate outlines. Group 2) bones had 5 transverse, 5 curved, and 5 intermediate outlines and Group 3) had 1 transverse, 15 curved, and 0 intermediate outlines. In regards to fracture edges, all 17 of the Group 1) bones had some sharp edges while 12 of the bones had some right angles. Eight of the Group 2) bones had some sharp edges and 6 of them had some right angles. All of the Group 3) bones had some sharp edges and 5 of them had some right angles. Fracture lines were present on 8 of the Group 1) bones and absent on 9 of them. Five of the Group 2) bones have fracture lines and 3 do not and all of the Group 3) bones have fracture lines.

The determination of perimortem or postmortem trauma is difficult based on the fracture patterns of deer long bones examined in this study. Some of the bones fractured almost two months after death exhibit patterns that are sometimes said to indicate perimortem trauma. These patterns are: oblique angles, curved or helical fracture outlines, sharp edges, and fracture lines. Further study of fracture patterns and their depositional environment is necessary.

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Deer Long Bones, Postmortem Fracture Patterns, Perimortem Fracture Patterns

H77 Healing Following Cranial Trauma

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After attending this presentation, attendees will understand the macroscopically observable osseous changes related to cranial healing for an historic skeletal sample with known time since injury.

The analysis of fractures in dry bone is of considerable medicolegal importance and can contribute significant information on cause and timing of death. Perhaps the most difficult task faced by the forensic anthropologist is in regard to fracture timing and distinguishing between perimortem and antemortem fractures. This study supports that many factors, both internal and external, promote or retard the fracture healing process. Even with numerous interacting components, some generalizations regarding fracture healing can be made. In calculating time elapsed since trauma, one can provide a minimal response time only, knowing that it takes at least a certain number of days for a response to occur. Some individuals will respond more slowly, but due to the physiology and pathophysiology of bone remodeling, individuals cannot respond more quickly.

The analysis of fractures in dry bone is of considerable medicolegal importance and can contribute significant information on cause and timing of death. Perhaps the most difficult task faced by the forensic anthropologist is in regard to fracture timing and distinguishing between perimortem and antemortem fractures. With the right sample, it is possible to be more definitive in estimating the time elapsed since injury in the cranium. This paper reports on the gross appearance of the initial osseous response following perforating and penetrating gunshot wounds and the course of this bony response over time.

The Civil War skeletal collection at the National Museum of Health and Medicine, Armed Forces Institute of Pathology, contains nearly 2,000 skeletal specimens showing disease and trauma. Detailed reports by physicians exist with significant case history information regarding the nature of the injury, time elapsed from insult to recovery or death, and the methods of medical treatment. From this collection, a total of 134 crania, calvariae, and cranial sections were analyzed for evidence of bony response following fracture. Each specimen was examined and scored for the presence or absence of four types of bone response: osteoblastic response, osteoclastic response, line of demarcation, and

sequestration around the site of fracture. Osteoblastic response was defined as the deposition of subperiosteal new bone typically seen in a periosteal reaction. Osteoclastic response was defined as areas of pitting affecting the existing cortical bone and occasionally exposing the diploë. A line of demarcation was seen as an "etched" line running adjacent to the fracture margin, appearing as a shallow depression or canal with sharp margins. Sequestration was noted when a segment of the bone was becoming necrosed and detached.

The patterns of osteoclastic and osteoblastic response to cranial fracture are similar. In general during the first week post-fracture, no blastic or clastic response was noted. Following this latent period, there is increasing incidence of expression, and by the sixth week post-fracture both osteoclastic and osteoblastic activity were scored for 100% of the sample. While this pattern appears to be straightforward, interpretation of the expression of the line of demarcation and sequestration are more difficult. The observations suggest that the line of demarcation establishes the boundary between the living bone and bone which will not survive the fracture due to a disruption in its blood supply. The resorption or exfoliation of the sequestrum appears to be a long-term event as sequestration is scored as present in the sample well past the eighth- week of healing.

In the specimens used in this study, the role of infection must be considered. During the U.S. Civil War nearly 100% of soldiers who survived gunshot injuries suffered from infection, and there is evidence that two of the osseous responses scored are most likely due to infection. In a 1946 study of cranial in adult rats, Pritchard observed that infection will cause widespread new bone formation under the periosteum of the skull. Similar response was observed in the Civil War sample with the formation of subperiosteal new bone formation at distances greater than 5 cm from the fracture margin. In addition, sequestration is rare when pyogenic infection is not present. Yet, sequestration was scored as present in over eight percent of all observations and in nearly twenty percent of the observations occurring after the third week post-fracture.

Many factors, both internal and external, promote or retard the fracture healing process. Even with numerous interacting components, some generalizations regarding fracture healing can be made. In calculating time elapsed since trauma, one can provide a minimal response time only, knowing that it takes at least a certain number of days for a response to occur. Some individuals will respond more slowly, but due to the physiology and pathophysiology of bone remodeling, individuals cannot respond more quickly.

Cranial Fracture, Trauma Healing, Time Since Injury

H78 Burning Observations of Decomposed Human Remains: Obscuring the Postmortem Interval

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After attending this presentation, attendees will be able to: 1) identify effects of heat to early, middle, and advanced stages of decomposing soft tissue; 2) compare and contrast features of the pugilistic posture between fresh and decomposed remains; 3) demonstrate characteristics used for recognizing burned remains of a decomposed body; and 4) define the hallmark decomposition stage when the pugilistic posture is compromised by degenerative tissue changes.

This presentation will define similarities and differences in how decomposed remains burn in an attempt to cremate human remains after death. Additionally, it will demonstrate how burning obscures the postmortem interval and why caution should be used when dealing with cases of intentional criminal incineration of human remains.

Intentional burning of human remains is often a secondary process done to obliterate physical evidence, personal identification, or evidence of trauma. Prolonged disposal may result from temporarily abandoning or purposely storing remains. This belated decision to destroy corporeal evidence by fire after days or months may also involve intentional removal to a location unassociated with the original crime scene. Complicating the investigation is the task of estimating the postmortem interval from decomposed and burned remains. Unless remains have been frozen or left in a cool environment they will experience some level of tissue breakdown from autolysis and decomposition processes. If the decision to incinerate remains takes days or weeks, then it is important to know if and how burning decomposed tissues produce discernible deviations from the expected burn patterns of fresher tissues. Currently only speculation exists regarding the effects burning on decomposed remains and its impact on the pugilistic posture, burn patterns to soft tissue and bone, and the signature differentiating immediate postmortem burning from delayed attempts to later destroy the body.

In an effort to better understand this process, burning simulations were conducted using portions of unembalmed human bodies from anatomical gift donations which were preserved as frozen specimens until removal for designated exposure times. For multiple studies cadaver materials were segregated into general anatomical groups according to type: heads, arms, and legs. At week long intervals specimens from each anatomical group were individually thawed and placed in plastic bins. The specimens were then left to decompose during the months of June and July with average daily temperatures ranging from 70-95 degrees F. The redundancy in the protocol created known times of postmortem environmental exposure and produced a reasonable range of early, middle, and late stages of decomposition.

After a representative range of decomposed material was generated for each anatomical group, each specimen was prepared for the burning process. Prior to burning, specimens were seriated according to intervals of decomposition (earliest to advanced stages), photographed, and had muscle tissue removed for histological analysis. Specimens were then separated and placed within the context of a low temperature radiant heat fire for photographic documentation of the burning sequence. Limbs of arms and legs were laid in fully extended positions to document changes in progressively decomposed tissues from the expected pugilistic posture. Photographic intervals captured variations in the rate and amount of muscular response to the effects of burning for each decompositional stage.

An independent series of specimens was allowed to progress to an advanced stage of decomposition to observe differences from the actions of anthrophagic insect activity, mummification, and features of preexisting trauma. One set of remains was allowed limited open access to insects to simulate exposed outdoor conditions. Another set was completely restricted by plastic and placed within a warm indoor environment to simulate secondary storage within an attic or shed. A third set was partially mummified in a dry indoor setting. Pre-existing ballistic trauma was created in a final set prior to decomposition and burning for the purpose of pattern analysis of soft tissue and bone.

This study relates the effects of heat to generalized decomposition stages and avoids specific time since death estimates due to regional climatic variations. Overall, morphological changes in early decomposing specimens were difficult to differentiate from the freshest control samples. During advanced stages of burning, middle to late stages of decomposition was indistinguishable from early stage specimens in terms of their ability to attain the pugilistic posture.

A photographic essay illustrating progressive stages of burning for decomposing tissue stages will be presented. In addition, information concerning the influences of alternative taphonomic conditions and the effects of preexisting trauma will be presented. This information will demonstrate how burning obscures the postmortem interval and interpretations of it should be approached with caution when dealing with cases of intentional criminal incineration of human remains.

Fire Investigation, Decomposition, Burned Bone

H79 Experimental Study of Fracture Propagation in the Human Skull: A Re-Testing of Popular Theories

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This presentation outlines the results of a study examining fracture propagation in the human skull and demonstrates the biomechanical forces behind blunt force trauma.

This research will impact the forensic community by demonstrating that highly regarded and cited fracture pattern theories regarding blunt force trauma and the human skull are incorrect and unsupported by experimental testing.

Trauma analysis is an ever growing area of forensic anthropology. In many cases, accurate interpretation of fractures in bone may be the only objective means of determining cause and manner of death (Berryman and Symes 1998). Postmortem trauma assessment is an essential tool for identifying the location of impact sites, sequencing blows, and establishing the characteristics of the object responsible for injury (Berryman and Symes 1998). In anthropological trauma analysis, one of the most complicated and confusing areas is blunt force trauma.

One of the key researchers to contribute to area of blunt force trauma interpretation was E.S. Gurdjian. Gurdjian and colleagues conducted research on cranial fractures, and extensively published on the topic. Today his work is still considered a standard reference for the fields of forensic anthropology and forensic pathology. However, recent evaluation of his predictions of fracture propagation patterns in the skull has led to questioning.

The theories of Gurdjian and colleagues (1945, 1947, 1950a, 1950b) describe how the cranial vault responds to blunt force impact. They state that when the cranium is impacted, an area of inbending is created at the point of force application, with an area of outbending occurring in other remote areas of the skull. Fracture propagation then begins in these areas of outbending (even on the opposite side of the cranium), then radiate back towards the point of impact, sometimes never reaching it (1947, 1950a, 1950b). This notion that fracture initiation begins *away* from the point of impact is heavily cited in both anthropology and pathology (Berryman and Symes 1998, Galloway 1999, DiMaio and DiMaio 2001, Knight 1996), and has led anthropologist to identify points of impact in locations other than the central area of fractures. Recent sentiments among practicing forensic anthropologists and pathologists working in the area of trauma analysis have expressed a strong concern that Gurdjian's theories are leading anthropologists astray (Symes 1989). Observed cases of blunt force trauma indicate that fracture initiation begins at the point of impact, not at a location remote to it. The conflicting opinions regarding the theories of Gurdjian and fracture propagation in the skull, has led to the need for further research.

Most of the current bone trauma research is taken from forensic specimens that are examined in a postmortem setting. While this type of research is crucial to the field, it is always after the fact. This study attempted to evaluate the theories of Gurdjian in a controlled, experimental setting. A study design was developed that would utilize new technology in the fields of industrial and biomedical engineering, while keeping with the needs of anthropology. Because of the unique biomechanical properties of the human skull, it was decided that a non-human substitute was not an option. Instead, five fully fleshed, un-embalmed cadaver heads were used. An engineering drop tower system was constructed to delivered calibrated, fully monitored blows to the left parietal region in each specimen. Five data acquisition load cells monitored the biomechanical response of the skulls for compressive and shear stress in the X, Y, and Z moments in millisecond intervals. With the data from the load cells, the forces through out the impact and fracture propagation were charted and analyzed. To help solve the question of how and where fracture propagation occurs in relation to the point of impact, a high speed film system was also designed. By filming at a speed faster than the fracture can travel through bone, it allowed the entire fracture event to be viewed and analyzed. After testing, each specimen was examined, with fractures charted and photographed. The experimental design allowed for complete monitoring throughout the impact event, and provided extensive data on how the cranium responds to blunt force trauma and fracture occur. The high speed filming allowed for the fractures to be observed as they traveled. The data from the test specimens was then compared to the original results from the Gurdjian studies and to known blunt trauma forensic cases.

The results from data analysis, high speed film, and examination of fracture patterns in the test subjects clearly show that fracture propagation initiates at the point of impact in the skull, then radiates out. High speed film clearly captured the fractures traveling from the point of impact in the parietal, posterior to the occipital. No fractures were observed to originate in locations other than the point of impact. These results are contrary to the theories of Gurdjian and colleagues, and substantiate recent claims from practicing forensic anthropologists and pathologists.

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Blunt Force Trauma, Fracture Patterning, Gurdjian

H80 The Use of Non-Unique Dental Characters and Non-Unique DNA Types to Estimate Probability of Identity

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This presentation will address issues regarding human identification. In particular, the attendee will learn how to statistically evaluate non-unique characteristics as part of the identificaiton process.

Specifically, dental treatment and mitochondrial DNA will be addressed. Case examples will be provided.

Forensic identifications using unique dental characteristics, such as those seen in most antemortem dental radiographs, generally allow the establishment of the identity of a decedent beyond doubt. Similarly, nuclear DNA profiles generated from recent or well-preserved human remains can also serve to establish identity without the need for extensive supporting evidence; it is generally claimed that the probability of a random match to a STR profile using the 13 CODIS loci is less than one in a trillion (Holt et al 2000).

In casework seeking to identify unaccounted for US military personnel, the Central Identification Laboratory, Hawaii (CILHI) usually encounters putative identifications where the biological remains are too old or degraded to produce reliable STR profiles under currently validated technologies. Also, suitable references for nuclear DNA comparisons may not be available. Regarding dental comparison, the antemortem treatment records associated with many of the CILHI cases lack dental radiographs. For these reasons, the CILHI commonly has to rely on other lines of evidence for comparison with an unidentified set of remains. One source includes antemortem narrative dental treatment records (or odontograms) that are part of an individual's medical history. Another avenue is the comparison of mitochondrial DNA family reference sequences for missing servicemen with evidence sequences obtained from the unidentified remains.

A consistent pattern of extraction and restoration between unidentified dental remains and an antemortem narrative dental record does not establish a positive identity. Similarly, mitochondrial DNA sequence matches cannot be used to establish a positive identification as many individuals within the population at large can share the same mitochondrial DNA type. Nevertheless, the recent publication of population databases for these two types of evidence allows the ready estimation of the probability of the evidence matching an individual at random (Adams 2003; Monson et al, 2002). The mitochondrial DNA evidence and the dental evidence can be considered as independent of each other and, therefore, the respective probability inferences can be combined using the product rule. The resulting random match probability provides an explicit quantification of the certainty with which an identity can be determined on the basis of the combined evidence (i.e., the probability of identity). Examples from casework will be presented to illustrate the utility of this approach in the identification process.

Forensic Odontology, Mitochondrial DNA, CILHI

H81 Reassociating Commingled Remains Separated by Distance and Time: The Tale of Simon And Steven

Debra A. Komar, PhD, Office of the Medical Investigator, University of New Mexico, MSC11 6030, Albuquerque, NM*

After attending this presentation, the attendees should understand the difficulty of reassociating human remains separated by great distances and time and crossing law enforcement jurisdiction boundaries. Also, the role seasonally controlled irrigation systems can play in the transport of human remains.

This case involves two men, three counties, five months, seven law enforcement jurisdictions and the reassociation of remains separated by over 60 miles.

On July 10, 2002, Steven, a 55-year-old Native American male, was released from the Santa Fe County Adult Detention Center in northern New Mexico. He is reported to have met with Simon, a 31-year-old Native American male. The two men were known associates and longtime drinking companions. Both men were residents of the San Felipe Pueblo in Sandoval County. Although family and friends reported phone calls or sightings of the men shortly thereafter, the whereabouts of the two men became unclear and they were subsequently reported missing to the Bureau of Indian affairs. Their disappearances were believed linked.

On October 12, 2002, a decomposed human torso was discovered in an irrigation ditch in Bernalillo County in the town of Corralles. The remains had been reported to law enforcement 10 days prior but had been dismissed as animal remains despite the presence of clothing. Subsequent searches revealed isolated bones scattered over six miles of the irrigation system. Problems in communication among law enforcement jurisdictions excluded Steven and Simon from the missing persons list. The remains were retained, unidentified, for several months by the medical examiner.

On November 29, 2002, a maintenance man working at the Ranch Viejo subdivision sewage treatment plant in Santa Fe County noticed his dog playing with a round object and investigated. The object was a defleshed human skull. The field deputy medical investigator and law enforcement on scene initially determined the skull to be that of a female. A thorough anthropologic analysis correctly identified the sex and age of the individual and the skull was subsequently identified as belonging to Steven. The skull was recovered 25 miles from the Detention Center (the last confirmed sighting of Steven) and more than 47 miles from the San Felipe Pueblo (where the two men were reported missing).

On December 19, 2002, an employee of the Rio Grande Conservancy was monitoring the irrigation system in Bernalillo County when he discovered a human skull trapped below one of the control gates. Searches of the irrigation canals and surrounding area produced no additional remains. The skull was identified as belonging to Simon. Simon's skull was recovered 57 miles from Steven's skull and 12 miles from the Pueblo where he was last seen. A medical examiner's deputy investigator recalled the headless torso recovered from the same irrigation system two months prior and suggested the postcranial remains may also belong to Simon. Comparisons of antemortem x-rays excluded Simon but examination of multiple AM radiographs confirmed the remains as belonging to Steven. The distance between the recovery sites for Steven's skull and his postcranial remains was more than 66 miles. The cause and manner of death for both men remains undetermined.

This case addresses several important issues: 1) the recognition of irrigation systems as significant vectors of transport; 2) the need for an anthropological consult at the scene; 3) the value of retaining partial, unidentified remains; and 4) problems inherent in cases crossing law enforcement jurisdictions.

Most importantly, this case illustrates the need to reexamine current protocols regarding identifications generated by partial remains. Present standard operating procedures call for the removal of an identified individual from the missing persons list, even in cases where a significant portion of the remains are absent. Matching elements discovered prior or subsequent to the identification relies solely on the recall of investigators. Remains separated by unusual distances, large expanses of time or jurisdiction boundaries are unlikely to be reassociated.

Physical Anthropology, Identification, Taphonomy

H82 Temporomandibular Joint Morphology and the Assessment of Potential Commingling

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After attending this presentation, the participant will understand the morphology of the temporomandibular joint and the correlation of osteometric variables of articulating structures of the cranium and mandible. The utility of correlated osteometric variables of articulating structures

of the temporomandibular joint (TMJ) in the association of disarticulated human remains or the identification of commingled remains will be demonstrated.

This paper has two objectives:1) to document the correlation between measurements of adjacent articular surfaces and structures, specifically of the temporomandibular articulation, and 2) to demonstrate the utility of correlated osteometric variables of articulating structures of the temporomandibular joint in the identification and association of disarticulated human remains, even when portions of the cranium or mandible are missing or damaged.

Background: In many forensic and archaeological contexts, an individual's remains may become scattered or commingled. Often, the forensic anthropologist is called upon to address the concerns of minimum numbers of individuals and the association of elements of a single individual. In those cases of disassociation, the relationship of the cranium to the mandible may be uncertain. When attempting to associate a cranium and mandible, several features are often observed which could indicate that separate elements are from the same individual: 1) proper occlusion of the maxillary and mandibular dentition, 2) close fitting articulation of both mandibular condyles into the glenoid fossae, and 3) overall similar physical appearance due to postmortem taphonomic activity. However, these assessments can not be made if the cranium and/or mandible have been damaged due to perimortem/postmortem trauma and scavenging damage resulting in the loss of dentition and/or skeletal structures. Differential weathering of skeletal elements can also confound the association efforts.

These confounding factors were manifested in a recent forensic case. Skeletal remains were discovered in the Muttontown Preserve, Long Island, New York, on November 10, 2001. The initial anthropological examination indicated extensive weathering and rodent gnawing on the cranium which resulted in the loss of the majority of the maxilla, maxillary dentition, the malars, zygomatic arches, glenoid fossae and articular eminences, mastoid processes and other cranial structures. The cranium and mandible also displayed differential weathering. The first anthropologists to examine the remains stated in their report that, "The bicondylar breadth formed by the mandibular condyles does not correspond to the breadth of the tempomandibular fossae indicating at least the possibility that the basicranium and mandible represent two individuals." They further state, "The best explanation for the poor fit of the mandible to the basicranium is that the mandible and skull have undergone considerable postmortem distortion caused by weathering and other factors." An anthropological reexamination was conducted on the skeletal remains on May 19, 2003. The reexamination revealed that the first anthropologists failed to take into account the extent of damage to the glenoid fossae produced by the rodent gnawing. If one were to extrapolate the original size and breadth of the glenoid fossae, the mandibular condyles would articulate quite well with the calvarium. The remaining portions of the glenoid fossae articulated well with the mandibular condyles. There was no evidence of warping or postmortem distortion of the mandible or calvarium due to weathering. These visual assessments raised two questions: 1) How much of the glenoid fossae and articular eminences had been removed due to rodent gnawing?, and 2) How consistent were the visual assessments/interpretations with the actual TMJ morphology?

This investigation is designed to determine the degree to which metric measurements of articulating TMJ structures of the cranium and mandible are correlated, and determine if a cranium and mandible can be associated through morphometric analysis. The study sample comprised 47 individuals form the American Museum of Natural History, New York; seven individuals from the documented anatomy collection with know age, sex and race, and 40 individuals from the Heidenheim Cemetery, Wurtenberg, Germany Collection. Fourteen measurements of the cranium and mandible were taken, measurements that were most likely to reflect joint congruence of the TMJ. These measurements document the morphology of the glenoid fossae, articular eminences, and mandibular condyles. All measurements were taken with a sliding and spreading caliper to the nearest 0.1 mm. A correlation analysis technique was utilized to investigate the relationship between the measurements of the bony structures of the TMJ. As expected, strong correlations exist between cranial measurements, mandibular measurements, and between the cranial and mandibular measurements of the bony structures of the TMJ. Of particular interest are the correlations between Biglenoid Breadth (BGB) and Biendoglenoid Breadth (BEB) (0.86707), and Biarticular Breadth (BAB) and Bicondylar Neck Breadth (BCN) (0.81645). These strong correlations indicate that individual cranial and mandibular variables could be utilized in regression analyses to predict missing or damaged variables. A test of their potential predictive value was made utilizing the forensic case discussed above.

Due to extensive rodent gnawing of the cranium, several measurements of the cranium and TMJ could not be taken with the exception of Biendoglenoid Breadth (BEB). All measurements of the mandible could be made. A regression analysis was conducted to predict Biglenoid Breadth (BGB) from Biendoglenoid Breadth (BEB), which resulted in a predicted breadth of 113.85mm. A regression analysis was conducted to predict Biarticular Breadth (BAB) from Bicondylar Neck Breadth (BCN), which resulted in a predicted breadth of 114.14mm. Biglenoid Breadth (BGB) and Bicondylar Breadth (BIC) were strongly correlated (0.82264), and possessed an average difference (BGB - BIC) of 3.7mm. The observed BIC measurement of 110mm and the predicted BGB and BAB measurements of 113.85 and 114.14 respectively clearly indicate that the mandibular condyles would have articulated completely with the original glenoid fossae and articular eminences.

Conclusions: When presented with disassociated or commingled skeletal remains, it is necessary for the forensic anthropologist to accurately reallocate those remains to specific individuals. Instigated by a recent forensic case involving a possible commingled cranium and mandible, this project investigated the congruence of the temporomandibular joint articulation and assessed the possibility of predicting the morphology of the missing skeletal element from the morphology of the adjacent skeletal element present. This research has proven the utility of articulation congruence in the prediction of missing element morphology and measurements of the TMJ, and illustrated the potential for allocation of disassociated skeletal elements. This research has also supported the visual assessments and interpretations made on the forensic case discussed above; that the cranium and mandible were from the same individual and that there was no evidence of warping or postmortem distortion of the mandible or calvarium due to weathering.

Cranial and Mandibular Measurement

Measurement	Definition
BGB	Biglenoid Breadth; Distance across the most lateral extension of the glenoid fossae
BAB	Biarticular Breadth; Distance across the most lateral extension of the articular eminences
BEB	Biendoglenoid Breadth; Distance between the left and right endoglenoid processes
BIC	Bicondylar Breadth
BCN	Bicondylar Neck Breadth

Temporomandibular Joint, Skeletal Element Association, Commingled Remains

H83 Using GIS Technology to Locate Clandestine Human Remains

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Attendees will learn the application of geographical information systems (GIS) technology to locating and predicting the location of clandestine human remains.

This study provides law enforcement and medical examiner personnel with a model and predictive tools to reopen "cold" cases where no remains were located and allow them the opportunity to re-examine and search for these remains.

GIS technology has contributed spatial analysis to the fields of geography, archeology, and epidemiology. Forensic anthropology can benefit greatly by the application of GIS to the location of clandestine human remains and to the mapping of missing and/or unidentified individuals to yield spatial patterns in the data. This paper presents two applications of GIS data to the location and mapping of clandestine human remains.

The first case study involved the use of GIS to locate scattered human remains. An article of clothing was discovered in a wooded area. The clothing matched an item belonging to a missing person who had been missing for three years. A grid matrix was overlain onto a 35 acre plot of land in a rugged hillside terrain. Grid lines were laid out and trained State Police searchers (Special Emergency Response Teams) were employed to cover, in "arm-to-arm" search style, 100% of the wooded terrain. The location of each article of evidence and any skeletal elements were added to the grid matrix using global positioning system (GPS) instruments. As more items were located, the resulting map began to indicate directionally, the source of the skeletal remains, which had been scattered over the hillside by a scavenging carnivore. After a period of three weeks, over 50 acres were covered and the site where the body had initially been deposited on the surface was located. The location of the original "drop" site allowed crime scene specialists to process the site for trace evidence allowing for the potential of linking the crime to a potential suspect. Approximately 40% of the individual was recovered using this location technique and 100% of the grid area was covered.

The second case study involved applying this location and recovery technique to cases of unidentified skeletal remains and missing individuals from the last twenty years in Massachusetts. The locations of unidentified clandestine remains were mapped using GIS and compared to sites where human material was recovered and identified. These data were analyzed using demographic and spatial variables including geographical landmarks, distance to roads, indoors vs. outdoors, buried vs. surface, etc. Interesting patterns in the data emerged that may be useful predictors in "cold" cases. Utilizing trends from previous scenes, a predictive model was developed that missing and abducted individuals could potentially have been deposited within a 5 mile radius of their abduction. Using the abduction site as the center, a five-mile radius was circumscribed and the following sequence of questions was applied: 1) Did the original search cover all of the localities presented in the five mile radius?; 2) What topographic landmarks exist within the 5 mile grid area and are these likely to have been areas where a body was deposited? and; 3) Reopen the "cold" case and implement a 100% grid search of all likely areas within the five mile radius, with special attention to surface scatters of skeletal material, material evidence, soil and ground disturbances, areas of subsidence, and construction that may have occurred in the intervening years.

This type of modeling has allowed researchers to revisit "cold" cases and apply these systematic testing techniques to ascertain if the original deposit of human remains was somehow missed or overlooked by searchers.

Geographical Information Systems, Clandestine Human Remains, Modelling

H84 Anthropological Review of Remains From Srebrenica as Part of the Identification Process

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This paper presents the procedures established by the International Commission on Missing Persons (ICMP) during anthropological review of Srebrenica remains as a part of large scale, DNA supported identification process. This unique approach to the problem of highly commingled remains may also be helpful in establishing standard procedures for resolving similar occurrences of mass identification in other post conflict areas.

This paper impacts the forensic community by combining an anthropological review and DNA testing results to produce accurate identifications and to reassociate skeletal remains.

During exhumations in the Podrinje area (eastern Bosnia and Herzegovina), led by the International Criminal Tribunal for the former Yugoslavia (ICTY) from 1996 to 2001 and the Bosniak Commission on Tracing Missing Persons from 1996 until the present, more than 6,000 cases were collected from surface and exhumed from single, multiple and mass graves (primary and secondary) that related to fall of UN Safety Zone of Srebrenica on July 11th, 1995. Due to number of missing persons coupled with the conditions of the recovered bodies, classical anthropological methods were not of great use in producing significant numbers of identifications. Therefore a DNA supported identification program was created in order to help resolution to families of missing persons.

The large-scale, DNA identification process of Srebrenica victims operated by the International Commission on Missing Persons at the Podrinje Identification Project required establishing and using new and specific anthropological procedures. Due to history of Srebrenica graves, the majority of cases exhumed in area of Podrinje represent highly commingled and very often incomplete remains. The majority of exhumed cases had already been examined by anthropologists and an autopsy performed by pathologists. However, in order to help ensure that not only as complete a set of remains as possible were returned to the family, but also that each set of skeletal remains consisted of only one individual, additional anthropological review procedures were established. The role of the forensic anthropologist in the process of identification was not limited to estimating sex, age at death, stature and defining antemortem trauma. It also required creating new types of "visual" body inventories during examinations and reassociating commingled remains. Furthermore, a system of exchanging information among DNA laboratories, morgue and forensic examination officials on the status of additional DNA samples collected from the remains, and the results of anthropological review for antemortem and postmortem comparison helped produce a highly efficient system for both reassociation and identification.

Commingling, Reassociation, Forensic Anthropology, Human Identification

H85 Exhumation... and What After? ICMP Model in Bosnia and Herzegovina

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This paper introduces a model for the entire process of exhumation, examination and identification in Bosnia and Herzegovina conducted by local authorities in cooperation with the International Commission on Missing Persons (ICMP). Since 2001 more than 2500 DNA supported identifications have been completed.

ICMP anthropologists are active participants in the exhumation, examination, reassociation, and review of remains for comparison of antemortem and postmortem data, as well as assisting families during the identification process.

In the second part of last century, armed conflicts around the world have taken the lives of millions of civilians. Among the countries impacted by these events are Argentina, Guatemala, Rwanda, the former Yugoslavia, and, recently, Afghanistan and Iraq. In some of these countries people were killed or "disappeared" because of their political views. Others were victims of ethnic cleansing. The problem of prosecuting the perpetrators of these crimes on the basis of recovered evidence and identified victims attracted many scientists and organizations involved in human rights issues.

The first exhumations for the purpose of collecting evidence for genocide took place in late 1990s in Rwanda, Croatia, and in Bosnia and Herzegovina by UN Crime Tribunals. The first exhumations for the purposes of victim identification began in Argentina and Guatemala in 1980s. Unfortunately, these exhumations were not done in continuous way nor conducted under the auspices of local authorities.

The war in Bosnia and Herzegovina took the lives of more 250,000 people. Many were killed during ethnic cleansing actions in the beginning of war in 1992, throughout 1993, and after the fall of Srebrenica in July 1995. After the war ended in December 1995, about 30,000 persons were unaccounted for and listed as missing. The first exhumation in BiH occurred in October 1995, and was conducted by local authorities in a northwestern area of Bosnia called Krajina. In the following year all former warring parties were performing exhumations for identification purposes. At this time, the ICTY initiated exhumations in the Srebrenica area in order to collect evidence for war crimes. Since then, the remains of thousands of victims have been exhumed. In eight years of exhumation activities by the ICTY and local commissions, about half of the exhumed cases (usually representing complete remains) were identified using traditional methods. The remainder could not be identified due to the lack of sufficient postmortem and antemortem data.

Since it was established in the summer of 1996, the ICMP has helped address the fate of missing persons in the former Yugoslavia through exhumations and victim identification. The ICMP became a pivotal partner in this process following the introduction of a new strategy focusing on victim identification using DNA.

Exhumation, DNA Identification, Examination

H86 Air-Drying as a Means of Preservation for the Unidentified and Unclaimed Remains From the World Trade Center

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After attending this presentation, attendees will understand the method of air-drying preservation utilized for the unidentified and unclaimed remains from the collapse of the World Trade Center, its theory, and the rationale for its adoption.

Participants will come away from the presentation with the knowledge and understanding of the air-drying method of preservation used for the unidentified and unclaimed remains from the World Trade Center (WTC). This method of preservation has not been previously attempted.

This paper presents the air-drying process used for the preservation of the unidentified and unclaimed remains from the September 11th, 2001, collapse of the World Trade Center towers. The human remains held in storage at the Office of the Chief Medical Examiner (OCME) in Manhattan were preserved using a method of air-drying that has not been previously attempted. These remains will be included in the permanent memorial to be constructed at the WTC site. Because the status of unclaimed remains may change in the future, and of the possibility of further identifications, the remains within the memorial must be easily accessible. The air-drying process was adopted as the best way to preserve the remains for permanent storage while avoiding the problems associated with other options for preservation.

The remains recovered from the site of the WTC were subjected to numerous taphonomic processes. The incredible forces involved in the initial impacts of the aircraft, the resulting unchecked fires, the eventual collapse of the towers themselves, in addition to exposure to water used for fire suppression, resulted in remains exhibiting extreme fragmentation, commingling, contamination and various states of decomposition. The condition of the recovered remains has made the identification process both extremely difficult and time- and resource-consuming. Many of the remains are unable to provide enough DNA to allow for identification. Some remains that yield significant amounts of DNA are unable to be identified because of unavailable reference samples. In addition, many of the identified remains are intentionally left unclaimed by families or because of legal reasons. The result is a large number of unidentified and unclaimed remains.

Three possible options were considered by the OCME for the preservation of the remains: freezing, chemical preservation, and drying. Freezing the remains was ruled out because it was deemed infeasible to maintain for the life of the monument. Formaldehyde, the best choice for chemical preservation, was undesirable because it is carcinogenic, has a strong odor, and degrades DNA. Drying of the remains was deemed the best option for a number of reasons. The removal of water reduces the weight of the remains, effectively halts decomposition (and its related offensive odors), and preserves DNA. The preservation of the DNA is important in the event the OCME has to resample the remains. Lastly, the environment needed to store the dried remains is relatively simple to maintain.

The drying process itself involves the placement of the remains in a specially designed room at a temperature of 150°F (66°C) and negligible humidity until the moisture is removed. 150°F was established as a temperature that, coupled with the dry environment, facilitated the rapid removal of moisture while minimizing further degradation of the specimen DNA.

The drying process was determined to be complete by using visual and physical inspection of the remains. Considerations were given to the portion of the body represented, elapsed time, and any taphonomic treatments that may have occurred (concrete dust, jet fuel, etc.). Upon completion of the drying process, the remains were sealed in airtight packages suitable for permanent storage.

When finished, the OCME will have successfully dried the over 14,000 unidentified and unclaimed remains from the World Trade Center. An assessment of the effect of the drying process on the genetic material held within the remains is currently underway, with details and results of the research to be published in the future.

Air-Drying/Dehydration, Decomposition, Preservation

H87 Preliminary Results on the Use of Cadaver Dogs to Locate Vietnam War-Era Human Remains

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The paper will examine some preliminary results of the use of cadaver dogs to search for missing American service members in Vietnam. Some issues associated with cadaver dog use will also be presented.

The location of clandestine burials is often a difficult task. The use of cadaver dogs is thought, by some, to be an effective tool for searching and ruling out large areas in the search for burial sites. However, the use of cadaver dogs has not been validated for a variety of environments and taphonomic scenarios. This paper will explore some of the issues related to cadaver dog use, particularly in Southeast Asia.

Cadaver dogs have, in some cases, proven to be useful for locating decomposing human remains. A dog search for buried remains can result in several outcomes: 1) the dog alerts and human remains are found, 2) the dog alerts and nothing is found, 3) the dog does not alert and there are no remains present or 4) the dog does not alert and yet remains are present. When a dog successfully locates remains the results are relatively easy to assess. However, when a dog does not alert in a given area the situation becomes more difficult to evaluate. In other words, did the dog miss buried bone or are there truly no human remains in the area? Conversely, if the dog alerts and nothing is found then it may be the case that external factors caused the false positive rather than the presence of actual human remains. These conundrums make it extremely difficult for an investigator to evaluate the efficacy of cadaver dogs. There have been only limited studies and case reports testing the validity of utilizing dogs for the detection of modern clandestine burials and surface deposition of decomposing human remains. One of the key issues explored in this paper is whether dogs who have been trained to find recently decomposed human remains can also detect the remains of individuals who have been exposed to the myriad of taphonomic processes presented by the Southeast Asian environment for over 30 years.

The Joint Task Force-Full Accounting (JTF-FA), in an effort to utilize new methods for locating the remains of fallen U.S. service members in Southeast Asia, chose to experiment with the concept of a Human Remains Dog Team (HRDT). To this end, JTF-FA enlisted the assistance of a Rhode Island State Trooper and his two cadaver dogs. From February 18 through March 20 2003, the HRDT (a team comprised of military and civilian personnel) surveyed sites associated with eight Vietnam War-era losses in the southern and central Socialist Republic of Vietnam.

The standard procedure for this investigation was as follows: The HRDT would interview witnesses who purported to have knowledge of a burial location. The witness subsequently pointed out a general area for the dogs to survey. The dogs would then search the area and if they alerted (the dogs were trained to sit down when they detected decomposing human remains) or showed interest (not a sit alert but expressed interest in an area as determined by the handler) the HRDT would conduct limited subsurface excavation based on the combined witness statement and dog responses. Exceptions to this protocol were two cases previously scheduled by JTF-FA to be excavated by full-scale recovery teams. The Investigators in Charge (IC) for their respective cases showed the dog handler where to search based on witness interviews. The dog handler then made recommendations to the ICs based on the dogs' reactions. Thus, the ICs were able to generate their excavation strategies based not only on witness statements and material evidence visible on the surface, but also by incorporating the dog handlers' input.

Of the eight cases investigated, the dogs alerted or showed interest at six of the locations. No human remains were found at any of the sites. Details of the investigation and the exploration of the cadaver dog alerts will be presented. General problems associated with the use of cadaver dogs will also be discussed, particularly in reference to their use in locating Vietnam War-era burials.

Forensic Archaeology, Cadaver Dogs, Taphonomy

H88 Genes, Nerves, and Bones: Neural Networks, Genetic Algorithms, and Forensic Anthropology

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Attendees will be provided with an overview of neural networks and genetic algorithms including a discussion of their strengths and weaknesses for forensic applications. Although forensic anthropological aspects will be emphasized, all attendees will leave with the basic information needed to begin exploration and implementation of neural network modeling and analysis of forensic data they encounter.

The presentation will encourage the forensic community to explore, exploit, and adopt neural networks and genetic algorithms in their area of interest. These approaches provide a powerful new tool that forensic scientists can use to improve modeling and to enhance their understanding of the large complex data sets and databases common to forensic science.

Multivariate statistical techniques are firmly entrenched in forensic anthropology, most visibly in the widely used FORDISC program. Neural networks, which are flexible, robust, and distribution-independent, can significantly enhance and supplement such traditional statistical methods. A comprehensive empirical approach to network modeling avoids the "black box" stigma often associated with nets, and can lead to valuable insights, particularly in revealing and studying complex, multivariate relationships among input variables. Additionally, the increasing reliance of the business community on data mining has led to the availability of affordable, PC-based neural network software which is often integrated into larger statistical packages. Numerous network architectures, including supervised and unsupervised algorithms, increases their utility as modeling and data analysis tools. They complement statistical methods, and when used in concert, nets and statistics provide a more complete understanding of anthropological data sets, as well as of other databases used in forensic science. Finally, the coupling of networks to genetic algorithms has dramatically improved network optimization, training, and variable selection procedures. As a result, neural networks have become a viable tool for forensic anthropology as well as forensic science generally. This presentation will focus on the anthropological data the Howells database, including crania from all over the world. Incorporated in this collection is data from Terry/Todd 19th century anatomical collections, recent American Whites, Blacks and Hispanics from the Forensic Data Bank (FDB). The FDB is perhaps the most familiar collection to forensic practitioners.

Prior to the mid 1980s, forensic identification criteria were based almost exclusively on the large anatomical collections (Terry and Hamann-Todd) containing individuals with mainly 19th century birth dates. Since modern documented skeletal collections are few in number, the FDB was conceived and launched in 1986 with a grant from the National Institutes of Justice as a way to obtain data from modern individuals. The FDB contains extensive demographic information for many cases, including place of birth, medical history, occupation, stature, and weight. The skeletal information in the database includes cranial and postcranial metrics, suture closure information, various aging criteria scores, and other information. Statistical analysis of this database has demonstrated that the American population has changed dramatically, presumably from the unparalleled environmental changes that have occurred over the past 100 years. Therefore, predictive models, both statistical and neural network created from the FDB typically aim to determine the age-at-death, sex, and status of the remains as historical (ca. 100 years old or more) or forensic. Such tasks are addressed by FORDISC; parallel neural network/genetic algorithm models were created for comparison here, using cranial measurement variables and the larger Howells/FDB collection.

This presentation will present a non-mathematical overview of neural networks and genetic algorithms which will lead into a review of findings from on-going work using different neural network topologies. The creation and characterization of the network models will be explained, as well as methods used to elucidate information and hidden structure from the underlying database of cranial measurements. Genetic algorithm approaches to determine variable importance and sensitivity will also be discussed. Comparison of performance and finding from statistical techniques will be shown to illustrate how the two techniques can work in concert. A short overview of available and affordably software packages will also be provided. It is hoped that this presentation will facilitate wider adoption of neural networks in the forensic anthropological community as well as the forensic community at large.

Forensic Anthropolgy, Neural Networks, Forensic Data Bank

H89 U.S. Army Identification Laboratories for WWII and Korea and the History of Forensic Anthropology

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This presentation will provide historical information about the development of forensic anthropology in the history of the effort to recover and identify our nation's war dead. Attendees will retain valuable examples of the interation between a developing forensic science and a bureacratic institutional setting. The pragmatic application of this knowledge may help anthropologists and other forensic scientists to navigate institutional support for forensic scientific work.

The history of forensic anthropology contributes much to our sense of the obstacles and challenges that the field has overcome over the course of the last 60 years.

This paper highlights the significant contributions of several anthropologists to the science of forensic anthropology through work identifying war dead. This paper documents the transition from a beginning with a few select scientists adapting their broader research interests to address problems in identification, to the establishment of a vigorous science with its largest institutional support from the US Army. As an application of scientific knowledge, forensic anthropology depends upon building both a growing base of data and a growing awareness of how to resolve particular identification and forensic problems. The massive war dead identification program presented challenges and opportunities that served to spur professional and scientific improvement to methods and research designs in forensic anthropology. The effort to meet these challenges and design pragmatic solutions to diverse problems is a hallmark of the efforts made by anthropologists working for the U.S. Army identifying recovered remains from WWII and Korea. The impact of this effort has been demonstrated as central to the development of modern forensic anthropology. Anthropologists involved in this work faced many similar challenges to basic research and overcoming institutional barriers that affect current development of the field. A closer examination of these historical efforts offers avenues for discussion and guidelines for addressing institutional and scientific obstacles.

The role of anthropologists and anatomists as essentially technical advisors in the World War II identification effort opened the eyes of the military to the scientific expertise of the day. But more importantly from the perspective of the developing science the large scale of the analytical and practical problems that faced the scientists spurred multiple lines of research. The challenges of pursuing these lines of research within the institutional structure and bureaucracy of the military focused the scientists' arguments for changed practices and proposals for research. This process is examined in the correspondence and documentary history of the WWII identification effort. The expansion of the technical role of the anthropologists in the to identify recovered remains from Korea presented new challenges and fostered the advance of significant new analytical tools. The impact of these experiences on the anthropologists that participated in the identification effort would provide significant shaping to the professional development of the applied science. In addition, the techniques developed in the course of the war dead identification efforts paired with continuing expansion of the knowledge base and successes of human identification science outside the military domain. The effort to identify war dead from Southeast Asia coincided with significant changes in the contributions that anthropologists could provide to identifying recovered remains. The basic process for identifying remains from Southeast Asia built on the technical role and expertise that anthropologists had established for WWII and Korea. The processes then in place did not take account of all of the recommendation that the scientists had proposed or the growth of the field outside of the military. Since that time the continuous effort to recover and identify war dead from WWII, Korea, and Southeast Asia has profited from increasing the roles and expertise of the anthropologist in the process and has faced several challenges of overcoming institutional barriers that resist the implementation of expert advice.

History, Forensic Anthropology, War Dead

H90 The ASCLD-LAB Accreditation of the Joint POW/MIA Accounting Command, Central Identification Laboratory

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The process leading to the ASCLD-LAB accreditation of the Department of Defense Joint POW/MIA Accounting Command Central Identification Laboratory, the first forensic skeletal identification laboratory so credentialed, and the issues addressed during the accreditation process will be discussed.

This presentation will impact the forensic community by demonstrating the lessons learned during accreditation of a forensic anthropology laboratory.

Accreditation of forensic laboratories by professional organizations has been a growing trend over the past decade. In August 2003, the Department of Defense Joint POW/MIA Accounting Command (JPAC) Central Identification Laboratory (CIL) became the first forensic skeletal identification laboratory to achieve American Society of Crime Laboratory Directors-Laboratory Accreditation Board (ASCLD-LAB) accreditation. ASCLD-LAB is a voluntary program in which any crime laboratory may participate in order to demonstrate that its procedures, casework, facilities, personnel, and equipment meet established standards.

On 5 September 2002, application for accreditation was submitted to ASCLD-LAB. During the ensuing compliance period, the Quality Manager and Inspection Team Chief solved a variety of problems prior to the inspection that threatened accreditation. In some ways, a forensic identification laboratory is starkly different than a typical crime laboratory. The CIL's mission, to identify war dead from previous conflicts and to lend recovery and identification expertise to military and civilian law enforcement agencies, means that the nature of the evidence is different, casework is more protracted, and the analyses conducted by individual analysts are more diverse. Further, the CIL's disciplines are non-traditional relative to ASCLD-LAB. Accordingly, the CIL's forensic anthropology, odontology and material (artifactual) evidence disciplines were treated as sub-disciplines under the trace evidence discipline and forensic archaeology was equated with crime scene processing. Additionally, the CIL initially sought accreditation for its mtDNA sampling procedures under forensic biology, however ASCLD-LAB declined this request since the CIL only samples teeth and bones for

mtDNA and conducts no on-site analysis. ASCLD-LAB later suggested that should forensic anthropology and odontology ever be incorporated as an ASCLD-LAB discipline then criteria could be established for mtDNA sampling procedures.

The inspection took place from 24-27 March 2003. The CIL was inspected against 109 pre-established criteria. Each criterion is designated by ASCLD-LAB as essential (E), Important (I) or Desirable (D). To achieve accreditation, all of the "E" criteria have to be passed, 75% of the "I" and 50% of the "D". The major inspection activities included examination of documentation and casework, staff interviews, and evaluation of evidence storage and security.

Examination of documentation was accomplished through criteria files supplied by the Quality Manager. Each file acted as an index by listing the relevant documentation used to support compliance for a particular criterion. Casework, and in particular note taking, came under intense scrutiny. Altogether, 200 suitable case files were presented to the inspection team. Interviews were conducted with the on-hand staff, approximately 25 people. Interviews focused on selected aspects of casework, the work environment, and knowledge of Laboratory programs and procedures, in particular safety, proficiency testing and other aspects of training. Laboratory Management was similarly interviewed. The results from both sets of interviews were then compared for consistency in order to gauge the communications flow in the Laboratory (bottom-up and top-down), overall morale, and the strengths and weaknesses in management policies. An examination of evidence storage and security, the most stringently enforced criteria, was conducted by one of the inspectors. The focus was the sealing, marking and labeling of evidence, and the physical security of the building.

The CIL passed 105 of the 109 criteria. The inspection team indicated that the four non-compliant criteria were those most often scored as deficient during initial inspections. Of the four criteria designated as non-compliant, two were essential and two were important. Our overall criteria scores were: Essential (E): 44/46 X 100 = 95.65%; Important (I): 41/43 X 100 = 95.35%; Desirable (D): 20/20 X 100 = 100%.

The two deficient essential criteria resulted in a 90-day remediation period. The first criterion, marking all evidence with a case number for identification, was deficient since the CIL did not normally mark biological evidence. The other deficient criterion, involved the definition and marking of analytical notes, too many of which were not up to ASCLD-LAB or CIL standards. After the inspection team accepted the remediation plan, a 90-day compliance period ensued. On June 30, 2003, a remediation report, largely containing copies of analytical notes and photographs of marked evidence documenting our compliance of deficient essential criteria, was forwarded to the original ASCLD-LAB inspection team. The team reviewed and approved the report, and recommended accreditation 2003, which was formally granted in August 2003.

Central Identification Laboratory, ASCLD-LAB, Accreditation

H91 Outside Traditional Skeletal Casework: A Forensic Anthropologist in a Medical Examiner's Office

Tom E. Bodkin, MA, Hamilton County Medical Examiner Office, 3202 Amnicola Highway, Chattanooga, TN 37409*

After attending this presentation, attendees will have a new understanding of the duties and responsibilities of a forensic anthropologist employed outside traditional skeletal casework.

An appreciation for the many ways an anthropologist can function in the medical examiner office environment, and a revitalization of the importance of case reports in forensic anthropology.

This presentation will relate the author's personal experience as a forensic anthropologist employed in a county government medical examiner office. It is hoped that this presentation will increase awareness that non-academic opportunities exist for those with forensic anthropology training. The roles and responsibilities of the author in the medical examiner office draw on all an anthropologist's skills, not only knowledge of human osteology, but also sociocultural and archaeological skills. The author's responsibilities that will be discussed include:

- Assisting the forensic pathologist at autopsy
- Managing the morgue and supplies
- Coordinating histology and toxicology laboratories
- Taking post-mortem x-rays
- Scene and morgue photography
- Computer maintenance and database management
- Processing of evidence
- Maintaining the bloodborne pathogen exposure control plan (OSHA)
- Coordinating scientific donations and managing a comparative skeletal collection
- Participating as an on-call death investigator
- Non-skeletal crime scene processing and investigation
- Meeting with families, law enforcement officers, and attorneys
- Delivering lectures to civic organizations, schools and universities, and law enforcement training academies
- Clerical duties (e.g., preparation of death certificates)
- Providing forensic anthropology consultations and reports. These consultations range from skeletal scene recovery with full-length reports to one-page diagrams or reports produced in the morgue at autopsy.

The largest contribution of the author is in the morgue, where verbal opinions regarding trauma and post-mortem interval can be given on-the-spot to the medical examiner.

The author feels there is a common perception in the discipline that "research presentations" have become more preferred than "case reports." This implies that a distinction exists between research forensic anthropology and applied forensic anthropology. When a distinction can be drawn between application and research, a feedback loop can be set up to compliment both. This loop consists of applied forensic anthropologists in medical examiner offices that generate research questions, and research forensic anthropologists that provide the tools for applied anthropologists to do their work. The future health of forensic anthropology will require constant and open lines of communication in this loop. This communication is mediated by the "case report" in various journals and/or conferences. Our discipline should work to rid itself of the idea that little can be learned case studies.

Most of the author's daily responsibilities were not part of the "traditional" forensic anthropology graduate training, but rather were learned on-the-job. Few forensic anthropologists have an opportunity to work on a daily basis with forensic pathologists. Although the training the author received in graduate school laid a solid foundation for working in a medical examiner office, it is proposed that forensic anthropology graduate programs expand their curricula to prepare students for careers outside traditional academic research. A curriculum designed to prepare one for work in a medical examiner office should include courses such as:

- Grief counseling
- Sociological aspects of crime
- Epidemiology and public health
- Evidence handling and curation
- Computer technology and database management
- Website authoring
- Legal processes and post-mortem laws
- Non-skeletal crime scene processing and medical history investigation
- Bloodborne pathogen/OSHA plan authoring
- Funeral home industry information
- Public and professional speaking instruction

Forensic anthropologists in the new millennium can offer more than osteological analysis to medical examiner offices. We are best suited to work within this type of system because of our holistic and comparative training.

Forensic Anthropology, Medical Examiner Offices, Forensic Training Programs

H92 Forensics and Television: A Learning Experience or Beguiling Obsession?

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This paper will examine how the recent influx of television programs with forensic science themes is changing the public awareness of the field.

This paper explores the recent increase in the popularity of forensic science on television. It will present the issues associated with the presentation of the field in the media, as well as a survey of a study group and their perceptions of the forensic science television programs.

On an average day in the Baton Rouge, Louisiana viewing area, approximately 45 hours of television programs with crime or law enforcement themes are broadcast on 26 channels. Some stations, such as Court TV, are almost entirely devoted to the subject. The programs range in reality from the fictional *Crossing Jordan* and *CSI* to those based on real cases such as the *New Detectives* and *Forensic Files*. *CSI* is currently one of the most watched drama programs on television with more than 8 million viewers per week. The new programs differ from the detective programs of the 1970s and 1980s such as *Dragnet* and *Hill Street Blues* in that forensic science has now become a major component of the programs. On programs such as *CSI*, *The New Detectives* and the *Forensic Files*, forensic science is the focus and often more details are revealed about the victims than the characters or individuals who investigate the crimes.

While the programs incorporate real science, liberties are often taken. The most common is a compression of time. Scientific tests and results may be simplified for the viewers. On the fictional programs, often the detectives may act upon their hunches or visions. Laws may be disregarded for the sake of the plot and the cameras. Finally, the limited number of characters are put in a variety of settings resulting in their being well versed in many different aspects of forensic science. It is not uncommon to see the same individual who examines blood spatter also examining a body or even interviewing suspects.

The increased interest in forensic science is in part the result of television. Major events in the past decade have focused on forensic science. The O.J. Simpson trial, the Bill Clinton and Monica Lewinsky scandal, and the terrorist attacks of September 11, 2001, were perhaps the three most widely chronicled of these events. In all three of the events, forensic techniques, particularly the use of DNA, were reported on regularly.

The popularity of television programs based on forensic science may be met with mixed feelings among those in forensic science fields. Questions to be considered include whether or not too many details are being revealed and what the effects of programs that take liberties with real scientific techniques are. Do these programs have the potential to create a new kind of criminal who can anticipate the investigation and prevent or contaminate evidence? Will individuals who watch these programs feel a greater competence and knowledge than they really possess and seek careers in forensic science or even attempt to be involved in a crime scene without the proper training?

A survey of university students enrolled in an introductory level anthropology class at Louisiana State University suggests that these programs are popular among this group. The students did not believe that the programs were completely accurate but a significant portion felt that the programs were 'somewhat realistic.' The majority of the students thought that they had a good understanding of the field of forensic science and that watching the programs had changed their perception of forensic science.

The popularity of these programs as evidenced by the survey of university students and the Nielsen ratings, suggests that the interest in forensic science and crime programs has become a noteworthy and influential part of popular culture, at least for the present. The use of consultants on many of the programs, both fictional and based on reality, gives the viewers the feeling of authenticity. But, as television executives bring more forensic science-based programs to the public, more liberties with the actual science may be taken to maintain the interest of the viewers. The end result may be programs that appear authoritative giving viewers a distorted picture of the forensic science profession.

Television, Forensics and the Public, Changing Perceptions

H93 Estimation of Living Body Weight Using Measurements of Anterior Iliac Spine Breadth and Stature

Jaime A. Suskewicz, BA, Louisiana State University, 2000 Brightside Drive, #722, Baton Rouge, LA 70820*

After attending this presentation, participants will understand the utility of anterior superior iliac spine (ASIS**)** breadth and stature measurements in predicting living body weight from skeletal remains.

This presentation will offer a technique that may facilitate accurate weight prediction in cases of missing or unidentified decedents. Body weight information may serve to enhance search criteria and present a more accurate biological profile.

The purpose of this study is to assess the utility of bi-iliac breadth and stature measurements in weight estimation. The focus of the project is on predicting living body weight of deceased individuals from a skeletal sample of modern Americans.

The primary objective of the forensic anthropologist is to provide information useful in obtaining positive identifications of deceased persons. Standard identification criteria for creating a decedent's biological profile include ancestry, sex, age, and stature, but not body weight. The inclusion of body weight in the biological profile could introduce an additional component to the identification criteria and may serve to augment a search image.

Several attributes of body weight, however, may depreciate its use as a profile characteristic. For example, body weight information is often underreported and may only be reliable from limited records, such as medical documents. Body weight is also subject to drastic fluctuation in short periods of time. In addition, obesity and malnutrition may be factors lending to inconsistent prediction results.

Despite these apparent shortcomings body weight is nevertheless an undeniable aspect of a decedent's identity. The forensic anthropologist must take care to maximize the available information so that the chances of identification are increased. Body weight information may not only assist in creating a more complete biological profile but may also provide insight into other forensic considerations such as body transport, body disposal, and other taphonomic processes (Stubblefield, 2003). What occurs during the postmortem interval may be strictly dependent on the body mass of the decedent.

Few studies pertaining to body weight prediction of modern humans have been carried out. In fact, most literature relevant to the prediction of body weight from skeletal remains is concerned with reconstructing hominid biology. Many paleoanthropological studies involve comparative analyses between modern human and primate remains and the fossilized bones of early humans. Research on the issue of body mass has generated prediction techniques based on both cranial and postcranial measurements. The results of paleoanthropological endeavors have provided us with a few viable options regarding techniques for estimating body weight in modern humans.

This study is comparable to earlier methods established by Ruff (2000) in the estimation of body weight based on measurements of bi-iliac breadth and stature. Ruff's goals were to examine the feasibility of predicting hominid body mass with the use of multiple regression equations. The body mass estimation equations were derived from 56 sex/population-specific sample means broadly representative of the world's living populations. However, Ruff's data were collected from literature sources dating from 1951 to 1989 and did not include any modern American samples. In order to test the accuracy of the equations, Ruff applied the technique to two very different modern human samples. Included in the sample were New Guinean Karkar Islanders and a group of U.S. Marine Recruits, all of which were young adults. Ruff's results indicated that body weight of modern individuals could be estimated with reasonable accuracy in cases of known stature and bi-iliac breadth.

For the purposes of hominid body mass estimation, Ruff also applies the equations to a sample of Olympic athletes. Ruff bases this rationale on the likelihood that extreme athletes may have a body type more representative of the degree of physical conditioning characteristic of earlier populations. Results revealed only an average 3% prediction error, indicating the body mass equations may be useful in estimating the weight of early hominids.

Although Ruff's results indicate low prediction error when stature is known, the technique may also be useful in situations of estimated stature, as is usually the case in forensic situations. The potential of Ruff's equations for great accuracy makes it worthwhile to test a similar method to on a modern American population of average fitness and various ages. In this study ASIS breadth was substituted for bi-iliac breadth because the relationship between the two measurements in proportion to overall body breadth is not significantly different, and ASIS breadth is easily located and measured in both skeletal remains and living humans. The ASIS technique may serve to facilitate weight estimation when sacrum, both pelves, and at least one long bone are present for an individual.

All data for this project were collected using the William K. Bass Donated Collection at the University of Tennessee, Knoxville. Various measurements were performed on skeletal material from 92 individuals. The individuals chosen for measurement were those in the collection with weight and stature records. The sample consisted of 2 black females, 13 black males, 15 white females, and 62 white males. The age range was between 25 and 84, with 60% over the age of 50. Information obtained from all subjects included age, weight, height, race, sex, ASIS breadth, and maximum lengths of the humerus, tibia, and femur. The sacrum and pelves were rearticulated with the use of a large rubber band so that ASIS breadth could be assessed. All ASIS measurements were taken with spreading calipers to the nearest 0.1 cm. Humeral, tibial, and femoral lengths were established with the use of an osteometric board to the nearest 0.1 cm. Stature calculations were performed for each individual using standard formula based on maximum long bone length (Buikstra and Ubelaker, 1994). Although stature was known for all cases, the process of height calculation was necessary in order to determine the usefulness of body weight equations in forensic circumstances. Stature estimations and ASIS breadth were then inserted into regression equations for estimation of body weight.

The preliminary results of this study are not comparable to Ruff's results. Percent prediction error exhibits a value too high to be considered useful in forensic investigations. Several explanations for these results are possible. The inclusion of estimated stature as opposed to actual stature in the equations decreased prediction accuracy. Certain attributes of the Bass collection may have contributed a high prediction error as well, such as questionable weight records, the ages of the deceased, and the under-representation of women and African Americans in the collection. Additional data on younger adults and equally represented racial typologies are needed in order to more accurately formulate such equations.

[1]Buikstra JE and Ubelaker DH, editors. Standards: For Data Collection From Human Skeletal Remains. ayetteville, Arkansas: Arkansas Archaeological Survey, 1994.

[2]Ruff CB. Body Mass Prediction From Skeletal Frame Size in Elite Athletes. *American Journal of Physical Anthropology*, 2000 (113):507-517.

[3]Stubblefield PR. Body Weight Estimation in Forensic Anthropology (abstract). American Academy of Forensic Sciences Annual Meeting Abstract Handbook. #H2: 262-263. Chicago, Illinois. February, 2003.

Forensic Anthropology, Weight Estimation, Bi-iliac Breadth

H94 Preliminary Observations of Vertebral Centra Retraction and Its Relationship to Age

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After attending this presentation, attendees will a understand the degenerative process of vertebral centra retraction, first described by Drukier et al. (2003), and how it relates to aging as well as its consideration for use in age estimation, particularly if key skeletal age markers such as pubic symphyses and or sternal ends of right fourth ribs are absent or damaged.

This presentation will impact the forensic community by sharing preliminary findings and reporting on the continued development of a new age estimation for unknown skeletons

The goal of this beginning study was to explore the relationship between a recently observed degenerative phenomenon of the vertebral centra with age at death from a known sample for purposes of assessing the efficacy of its future use as an age estimation method for unknown skeletons.

Specifically, the degenerative phenomenon, first described by Drukier et al. (2003) as a "sucking in" of the superior and inferior vertebral centra, occurs in adults after vertebral centra maturation is complete (i.e., after epiphyses of the superior and inferior vertebral centra—the "ring" epiphyses—are fully fused to the centra). The "sucking in" occurrence takes place when the central portion of the surface of the vertebral body begins to pull away or retract from the perimeter, where what was once the vertebral ring epiphysis has fused to the centrum, and sinks inferiorly, leaving a "sucked in," concave appearance that we refer to as "retraction." Drukier et al. (2003) have hypothesized a possible link between vertebral centra retraction and age at death, based on observations and skeletal analyses of decedents from recently exhumed mass graves in Europe.

To test Drukier et al.'s (2003) hypothesis, the retraction phenomenon and its relationship to known age at death was studied using a sample from the Robert J. Terry Skeletal Collection, housed at the Smithsonian Institution in Washington, DC. Superior and inferior centra of the thoracic vertebrae (T1-T12) and the first two lumbar vertebrae (L1-L2) of 63 known individuals (16 black females, 9 white females, 19 black males, 19 white males), ranging in age at death from 23 years to 78 years, were examined.

Gross morphological observations of vertebral centra retraction were documented using a newly developed numerical scoring system based on progressive stages of retraction observed. Stages of retraction were coded as 4, 5, 6 or 7 for each centrum, inferior and superior, of each vertebra used in the study—T1 through T12, L1 and L2. Stage 4 was the least retracted, whereas Stage 7 was the most retracted. Stages of retraction were designated as 4 through 7 to represent that this process occurs after epiphyseal union of the superior and inferior centra is complete (Stages 0-3, according to the Albert and Maples method, 1995). Thus, similar numbers for the stages between the two methods (i.e., 0-3

for both epiphyseal union and retraction) would not be confused between the two differing processes—one a maturation process (epiphyseal union), the other a degenerative process (retraction).

Descriptions of vertebral centra retraction in Stages 4 through 7 are as follows: Vertebral centra showing no retraction or a slight, beginning depression or concavity in the center of the centrum, with no separation along the perimeter, were designated as Stage 4. Stage 5 comprised either of two scenarios: 1) slight to moderate depression or concavity in the center of the centrum, or 2) retraction occurring along the perimeter of the centrum, or along the anterior border where what was once the epiphyseal ring separated or retreated from the centrum, where the centrum was depressed at these loci. In this case, the center of the centrum appeared slightly convex relative to the periphery of the centrum. Retraction in Stage 6 was moderate to advanced, occurring both at the center of the centrum radiating outward, as well as along a greater area of the perimeter of the centrum, where what was once the epiphysis was further separated (retracted) from the centrum along the anterior, lateral, and posteriolateral borders (with the posterior aspect of the perimeter of the centrum the last to retract, during Stage 7. Separation or retraction during this stage encompassed a greater surface area of the centrum, which was sunken in. The perimeter of the area retracted sloped inward, declining slightly, forming somewhat of a "V" shape. In the last stage, Stage 7, vertebral centra retraction was advanced, appearing noticeably more depressed or concave than in previous stages. The perimeter of the area retracted no longer sloped inward at an angle ("V"shape); rather, there was a vertical drop along the entire perimeter of the centrum (i.e., anterior, lateral, posteriolateral, and posterior aspects), forming somewhat of a "U" shape. Retraction was extensive over the surface of the centrum, where the centrum was clearly concave relative to the perimeter, which appeared to "wall in" or "rim" the central portion of the centrum. How these stages best relate to chronological age will be discussed.

Gross observation results of vertebral centra retraction revealed a distinct and predictable pattern in its progression as related to increasing age. Retraction along the perimeter of the centrum begins posteriolaterally and progresses anteriorly, with the posterior aspect the last portion to retract. Further, the centra of the middle thoracic (T5-T8) and the first two lumbar vertebrae (L1-L2) frequently showed more advanced retraction than the centra of the superior (T1-T4) and inferior (T9-T12) thoracic vertebrae.

Quantitative analyses involved calculating a mean value for vertebral centra retraction for each individual in the sample, which represented the overall extent of the retraction phenomena for each person. Results of preliminary statistical analyses showed no significant correlation between overall mean retraction values and age. There were no statistically significant differences between overall mean retraction values of the superior vertebral centra when compared to the inferior vertebral centra. Mean values for vertebral centra retraction were also calculated separately for superior thoracic vertebrae (T1-T4), middle thoracic and first two lumbar vertebrae (T5-T8, L1-L2), and inferior thoracic vertebrae (T9-T12); these values showed no statistically significant correlation with age. When the data were analyzed separately by sex and ancestry, however, some interesting findings emerged. F-tests for the variance between the superior thoracic, middle thoracic and lumbar, and inferior thoracic vertebral centra retraction mean values showed that the superior thoracic retraction mean values differed significantly from the inferior thoracic retraction mean values ($p<0.02$). There were no statistically significant differences between middle thoracic and first two lumbar retraction mean values compared to either superior or inferior thoracic retraction mean values for females, males, or whites when tested separately; however, results for blacks were significant ($p=0.00$). Further, F-tests for the variance in retraction means when vertebrae were separated into the three groups (superior, middle and lumbar, and inferior) showed that superior thoracic retraction mean values significantly differed from inferior thoracic retraction mean values for females (ancestry combined; $p<0.006$) and whites (sexes combined; $p<0.01$) but not for males (ancestry combined) or blacks (sexes combined).

Sample size effects and or the challenge of quantitatively measuring patterns of degenerative change observed grossly may very well have influenced the results of statistical analyses. Thus, it may be more useful to consider qualitative assessments when using vertebral centra retraction as an aid in estimating age. Information regarding how the appearance and pattern of retraction of vertebral centra may be useful as a corroborative, supplemental method for the estimation of adult age of unknown skeletons will be addressed. As this research was a seed project surveying the relationship of vertebral centra retraction and age, future research on this topic will test the accuracy of the use of the stages of vertebral centra retraction to estimate age at death.

Drukier P, Sarajlic N, Klonowski EE. Age-related changes in the adult male vertebral column. *Proceedings* of the American Academy of Forensic Sciences; 2003 Feb. 17-22; Chicago. H21:249-250.

Vertebral Centra Retraction, Age Estimation, Degenerative Changes

H95 Epiphyseal Closure Rates in the Srebrenica Youth

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This presentation will examine the rates of epiphyseal closures in Srebrenica sub-adults. By developing a population-specific standard for aging, anthropologists working in Bosnia can more accurately sort commingled remains, thus ensuring accurate identifications in situations where families lost multiple sons.

Gathering data on the rates of epiphyseal closures will assist in the identification process of those killed during the fall of Yugoslavia. This study will present histograms for each stage of epiphyseal closure. Using this data, the anthropologist can compare remains with these standards. These histograms will also be of aid when sorting commingled remains.

It is estimated that up to 40,000 people are unaccounted for from the armed conflicts in the former Yugoslavia from 1991 to 1999. The International Commission on Missing Persons (ICMP) has assumed the task of assisting in the identification of these individuals by performing large scale DNA analysis in conjunction with anthropological analysis. One important aspect this work is the accurate age estimation of skeletal remains. This is particularly true when identifying remains from the July 11-15, 1995, fall of Srebrenica in which an estimated 8000 Bosnians lost their lives. Srebrenica presents a particular problem for anthropologists because a majority of the male inhabitants of the town were killed. Not infrequently, a family will be missing two sons, whose age difference is minimal. If neither of these sons had any children, a DNA match is not sufficient to distinguish between them. As a result, the anthropologist must utilize all available skeletal data to correctly identify each son.

Anthropological standards that provide age range data based on various epiphyseal closures are widely available and easily attainable. However, none of these standards have been developed using skeletal samples from the Balkans. Balkan youth may age differently than data from non-Balkan standards, especially considering the effects of food deprivation and others stressors that were endured during an individual's critical physical growth periods. Because of the need for such accuracy, aging standards must be tested on the Bosnian youth and either noted as accurate, or a new standard based on this population must be devised.

This study considers only those youth who were killed in the Srebrenica massacre, thus mitigating variation in malnutrition and other stressors. Epiphyses in individuals between the ages of 14 to 30 were observed and assigned a score between zero and four. These scores denote open (0), beginning (1), active (2), recent (3), and complete union

(4), following the method described by McKern and Stewart. Epiphyseal closures that were difficult to observe after eight years of taphonomic changes, such as the medial border and inferior angle of the scapula, and the transverse and spinous processes of the vertebrae, were not recorded. Age data were obtained once a DNA match was made and the identification completed.

Of 72 cases collected, results suggest that a majority of the epiphysis are completely fused two years earlier in the Bosnian population than those Americans killed in the Korean War as observed by McKern and Stewart. From these results, it would appear that the Srebrenica youth are maturing at an accelerated rate as compared to the American youth and that the age ranges offered by McKern and Stewart can be narrowed to address the growth rates of this population.

Epiphyseal Closures, Aging, Sub-Adults

H96 An Evaluation of the Greulich and Pyle Skeletal Aging Standards for the Hand and Wrist in a Contemporary Multiethnic Population

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The objectives of this pilot study are two-fold: 1) to evaluate the accuracy of the Greulich and Pyle (1959) hand and wrist development standards when used to estimate the age of subadult individuals of diverse ethnic backgrounds and, 2) to measure the direction and magnitude of error in in different age and ethnic subgroups. Attendees will gain an awareness of the limitations of the Greulich and Pyle standards when applied as an age-determination technique and how to best utilize the existing standards when estimating the age of individuals from different ethnic backgrounds.

The contribution of this research to the forensic community is the awareness of the magnitude and direction of error in applying the Greulich and Pyle standards for hand and wrist development when determining age-at-death for contemporary subadults of various ethnic and socioeconomic backgrounds and the need for further research to develop new standards for skeletal age assessment of the hand and wrist.

Forensic Anthropologists apply age-determination techniques in a wide variety of contexts. They are frequently asked to provide age estimates for unidentified individuals, applicants seeking asylum in the United States, and to reconcile various records that report conflicting ages. The reliability of the techniques applied is, of course, of utmost importance and unreliable techniques can have significant consequences, including delaying identification of an unknown individual, denial of asylum, and an erroneous conclusion as to an individual's probable age. The research presented here reports the results of a pilot study conducted to assess the accuracy of the Greulich and Pyle (1959) standards for the development of the hand and wrist when applied to a contemporary multiethnic sample of children from an urban medical examiner's office.

The impetus for the current research was a case involving legal documents that reported two different birth years for in individual accused of homicide. The county attorney's office responsible for prosecuting the case requested an age-assessment in order to determine if the accused should be tried as an adult or juvenile. The individual was born outside of the United States and is of Southeast Asian descent. Given that the individual was still living, the age determination techniques applied were limited to an evaluation of dental development and eruption and epiphyseal union. Skeletal radiographs were taken of numerous sites of the skeleton. The skeletal development exhibited by the individual necessitated heavy reliance on the stage of development of the hand/wrist.

A literature search conducted during the case indicated that the Greulich and Pyle (1959) standards of development were the most recently published standards for the hand and wrist. These standards were devised from a sample of radiographs from the Brush Foundation collection housed at Western Reserve University School of Medicine. This collection consists of a longitudinal sample of x-rays taken between 1931 and 1942 of children from families described as "above average in economic and educational status." The sample utilized by Greulich and Pyle is comprised of from two to 21 hand/wrist films of 1000 healthy, American-born "White" children, most of Northern European ancestry, from the Cleveland area of Ohio. The literature search also identified recently published articles that concluded the Greulich and Pyle standards of development might not be accurate for healthy individuals of non-White ethnic backgrounds.

In order to assess the accuracy of the Greulich and Pyle hand/wrist standards of development in a contemporary multiethnic sample of individuals from varied socioeconomic backgrounds, the medical examiner case files of all children between the ages of birth and 19 years of age autopsied by the Hennepin County Medical Examiner's Office between 1974 and 2001 were reviewed. Case files containing recorded demographic data, including date of birth, date of death, sex, and ethnicity and the existence of x-rays of sufficient quality to reasonably assess hand/wrist development and the presence of Harris lines were selected for analysis. The research sample consists of 359 individuals, 231 males and 128 females. The sample is further subdivided into four ve age-categories (Early, Middle, Late Childhood, and Adolescence - per Loder et al. 1993) and six ethnic groups (American Indian, "Black," Asian, Hispanic, "White," and multiethnic). Country of birth and antemortem health status were not recorded in the case files. Following definition of the sample, each author evaluated the radiographs of each individual and assigned a skeletal age using the standards defined by Greulich and Pyle. Degree of agreement of the three observers was calculated and indicated only a moderate degree of agreement between the three observers reflecting, most likely, differences in level of experience. For this reason, differences between recorded chronological age and the estimated bone age of each observer were calculated. A Paired-Samples T-test was performed to evaluate the null hypothesis that the mean difference between the chronological and skeletal ages was zero. Mean differences were compared between subgroups defined by sex, age, and ethnicity. Statistically significant differences between chronological and skeletal age exist for both males and females variously by age category and ethnicity. The results of our study support the need for the development of new standards for hand/wrist development to accurately assess the age of subadult individuals from a variety of ethnic backgrounds.

Greulich WW, Pyle SI. *Radiographic Atlas of Skeletal Development of the Hand and Wrist*, 2nd ed. Stanford, CA: Stanford University Press, 1959.

Loder RT, Estle DT, Morrison K, Eggleston D, Fish DN, Greenfield ML, Guire KE. Applicability of the Greulich and Pyle skeletal age standards to black and white children of today. *Amer J Diseases Children* 1993;147:1329-1333.

Age Determination, Hand/Wrist Development, Accuracy Assessment

H97 A Quantitative Study of Morphological Variation in the OS Coxa for the Purpose of Estimating Sex of Human Skeletal Remains

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After attending this presentation, attendees will understand skeletal variability and forensic anthropological application.

This presentation will impact the forensic community by demonstrating the contribution of further data to the understanding of skeletal variation.

The study of sexual dimorphism in the morphology of the *os coxa* has long been core of osteological analysis and essential to forensic anthropological investigation. Past research clearly documents the *os coxa* to be one of the most suited elements for the estimation of sex in human skeletal remains. Although not exclusively, previous studies have focused primarily on qualitative assessments of pelvic shape and few have proposed specific quantitative dimensions to substantiate observed qualitative patterns of variation. This study addresses past observations of size and shape variation in male and female pelvic morphology by documenting sexual dimorphism in the *os coxa* by the application of alternative measurements. The study also examines the possibility of further characterizing and testing shape variation in the *os coxa.*

Twenty-two measurements were recorded on a calibration sample of 80 females and 80 males from the Robert J. Terry Osteological Collection housed at the Smithsonian Institution, Washington, D.C. The data represent members of varied group affiliations and ranging in age from 25 and 50 years. In addition to standard length and breadth dimensions, alternative measurements specifically developed to quantify qualitative observations include, among others, the sub pubic angle, size of the rami, shape of the obturator foramen, and dimensions of the auricular surface. Other measurements characterizing the pelvic basin shape and size are also recorded. All measurements were taken with standard equipment including spreading, coordinate and sliding calipers and an osteometric board.

Summary statistics were generated for the purpose of univariate assessments and a stepwise discriminant procedure with a MAXR option was applied to the data to generate a multivariate assessment of the sex discriminating ability of the proposed recording protocol.

The results derived from the calibration sample were applied to two independent test samples, including a separate sample of 20 males and 20 females from the Terry collection and 18 males and 15 females from the WSU-BAL Cadaver Collection housed at Wichita State University Biological Anthropology Laboratory.

The results of our study provides promising insight to quantifying sexual dimorphism in the *os coxa* and concludes that measurements can be applied to better characterize overall shape differences between the sexes which have previously been mostly limited qualitative assessments. We further conclude that traditional observations of sexual dimorphism in the *os coxa,* especially those commonly used in non-metric assessments, are not be as distinct as sometimes expressed. Finally, the results presented here provide an added contribution to the estimation of sex in skeletal remains in both forensic and archaeological settings.

Os Coxa, Sex Estimation, Skeletal Variation

H98 A Review of Age Estimation Using Rib Histology: Its Impact on Evidentiary Examination

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The goal of this research is to show that the forensic specialist must perform more rigorous scientific trials on new and existing methods, especially if the method is being used: 1) well outside of the reference sample, 2) on an element other than the one for which the method was developed, or 3) if the method has been altered on the premise of specialized knowledge that has not been adequately tested.

The main impact of this research is to bring attention to assessing the precision and accuracy of methods that are being utilized by forensic specialists, particularly if those methods have been altered without further testing. Often, in the literature, the terms "precision" and "accuracy" are confused or entirely ignored. More rigorous testing must be performed before publishing new methods or they could run the risk of failing the *Daubert* or *Mohan* criterion when utilized in forensic casework.

Research has shown that the use of rib histomorphometrics for the estimation of adult age at death can provide precise and accurate age estimates. Current methods require histological thin sections from the middle third of the sixth rib. Human ribs have thin cortices and are less resilient to destructive taphonomic processes than other skeletal elements. Therefore when human remains are recovered, the ribs are often severely damaged or absent. In these circumstances it may be difficult or impossible to identify a specific mid-thoracic rib. If the sixth rib is unavailable or cannot be positively identified, closely associated mid-thoracic ribs (namely the 5th and 7th) or a suspected sixth rib are often deemed adequate for use due to similarities reported in bone remodeling kinetics. The affect that slight remodeling deviations have on histologically derived age estimates has not been reported. The goal of this research is to record the amount of variation in osteon population densities of the middle third of the mid-thoracic ribs and determine if age prediction equations developed for the sixth rib can be applied to non-sixth ribs with similar reliability. The potential rate of error must be explored in order to meet the *Daubert* and *Mohan* criterion, which established general guidelines for admissibility of scientific evidence in U.S. and Canadian courts.

The sample consists of ribs taken from twenty cadavers (eleven males and nine females) from two university teaching facilities in Ontario. Ages range from 59 to 89 years. Thin sections were removed from the middle third of ribs three through eight. A total of 120 thin sections were analyzed and osteon population densities (OPD) calculated. Results show that osteon population density values for ribs three, four, seven, and eight were consistently below the OPD values of the sixth ribs indicating that the sixth rib may possess a different remodeling environment. Intra and interperson results indicate that the eighth rib is the most variable of the non-sixth ribs. The large variance demonstrated in some of the intraperson OPDs indicates that remodeling may be occurring at different rates between ribs of the same person. The difference between values may not appear to be significant until they are figured into the age prediction equations.

Overall, all the non-sixth ribs produced significant correlations with the sixth rib OPD values. This was expected considering that previous research has demonstrated that rib tissue is less biomechanically active, and has minimal variability in bone remodeling. However, regardless of which non-sixth rib is used intraperson OPD values may vary sufficient

that age estimates would be significantly different than those from the sixth ribs. Factor analysis and regression analysis indicate that ribs five and seven are better predictors of the sixth rib OPD values than ribs three, four, and eight and therefore should be used if the sixth rib is unavailable. Due to differential OPD values within the ribcage, error ranges developed from this research for non-sixth rib OPD values should be used when the sixth rib is unavailable or unidentifiable.

Because of the guidelines established from the *United States Supreme Court in Daubert v. Merill-Dow Pharmaceuticals, 113 S.Ct. 2786 (1993)*, and from the Canadian courts in *R. v. Mohan, 89 C.C.C. (3d) 402 (1994)*, and in the wake of the *United States v. Plaza, Criminal NO. 98-362 (2002),* methods utilized or altered by forensic anthropologists may soon be challenged. The forensic specialist must perform more rigorous scientific trials on new and existing methods in order to meet the *Daubert* and *Mohan* standards.

Histomorphometry, Osteon, *Daubert*

H99 Distinguishing Between Human and Non-Human Secondary Osteons in Ribs

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After attending this presentation, attendees will understand new criteria helpful in distinguishing human from non-human bone.

This presentation will impact the forensic community by presenting new criteria for distinguishing human from non-human bone in cases where only minute quantities of bone are available. It also demonstrates a need for more research on the histomorphology of non-weight bearing bones in a wider range of species.

This paper will present rib histomorphology research being conducted at the Michigan State University Forensic Anthropology Laboratory. One of the first questions a forensic anthropologist answers is whether a bone is human or non-human. Under normal circumstances, this can be done using gross morphological features. However, this task becomes more difficult when the bone samples are extremely small or fragmentary. In this case, microscopic examination of the histomorphology of the bone tissue may be necessary. Most human compact bone is characterized by cylindrical structures known as primary and secondary osteons. Non-human bone has other distinctive arrangements of bone tissue not commonly found in humans. For example, plexiform bone has a regular "brick wall" appearance that may be briefly seen in human fetal bone tissue, but is commonly found in weight-bearing bones of non-humans. Histological arrangement of bone tissue is not consistent. It varies within the same bone, between bones of the same individual, and between individuals of the same species. In addition, the distinctive non-human forms of bone are all primary in nature; as bone remodels it can be replaced with secondary osteonal bone. As a result, while the presence of plexiform bone, for example, can be used to classify a bone as non-human, the presence of only osteonal bone does not mean that the bone is human. How do we tell human osteons from non-human osteons? Past research has primarily examined this question using weight-bearing bones such as femora. However, this study examines rib histomorphology since secondary osteons have been documented in this non-weight bearing bone in a much wider range of non-human species than in femora.

Rib samples of adult humans (n=10), adult dogs (n=10), beef cattle (n=10), and bear (n=1) were obtained for this study. These samples were cleaned, dried, and then thin-sectioned using a diamond blade saw. Each sample was then mounted and examined under a stereomicroscope. The images were digitally captured and measured using SigmaScan software.

Secondary osteons were found in the canine, bovine, and ursine samples as well as in the human samples. Measurements of the diameters of the osteons found that humans, cows, and bear were not reliably distinguishable based on the size of the osteons. However, the sizes of the secondary osteons in dogs were significantly smaller compared to that of humans. The size of the central, or Haversian, canal proved more useful. Both cows and dogs had significantly smaller Haversian canals compared to humans. The central canal was also smaller in the bear rib, but not significantly. Osteonal banding was also observed in most of the bovine samples and a few of the canine samples. These bands were found between plexiform bone and less organized arrangements of secondary osteons. This suggests that osteonal banding may be a transitional developmental feature, with the bands developing as secondary osteons replace the organized plexiform tissue.

Anthropology, Bone Histology, Osteons

H100 Species Identification of Small Skeletal Fragments Using Protein Radioimmunoassay (pRIA)

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This presentation will demonstrate how protein radioimmunoassay can be utilized in the forensic analysis of small skeletal fragments to distinguish human from non-human animal and determine non-human animal species.

This presentation will make the forensic community aware how protein radioimmunoassay (pRIA) can be used in the analysis of small bone fragments to identify human vs. non-human origin and animal species.

With increased awareness of the potential for positive identification through molecular analysis of skeletal remains, fragmentary evidence is frequently submitted for forensic examination. Prior to DNA analysis it is usually desirable to determine if remains are of human origin and if not, on occasion, to determine the species represented. When specimens are too small or taphonomically compromised for conventional morphological diagnosis, investigators can use SEM/EDS to help determine if bone and/or tooth is represented. Histological examination may reveal a distinct non-human pattern but usually is not diagnostic for human since the human histological pattern is shared with some non-human animals. In addition, preparation of histological sections may preclude DNA analysis in cases involving very small particles. In such cases, protein radioimmunoassay can be utilized to distinguish human from non-human animal and to identify the species. In addition to identification of modern, well-preserved specimens, pRIA has been shown to make correct determinations on cremated specimens and on archaeological specimens as ancient as 11,000 years.

Analysis by pRIA consists of three phases: extraction of sample bone material from the specimen, isolation of the protein, and pRIA to identify species.

Extraction of the sample material consists first of removing and discarding the outer one-two mm of the surfaces to remove any significant external protein contamination.

Protein is isolated by placing 20-200 mg of bone matter into a 10 ml vaccutainer and capping it. A syringe is then utilized to first add a solution of 1M EDTA and then to create a partial vacuum within the vaccutainer. Subsequently, the solution is gently shaken and rotated for two to five days at room temperature to dissolve the bone.

The pRIA species identification is obtained using solid phase double antibody radioimmunoassay. The EDTA protein extract is placed in polystyrene microtiter plates to allow the protein to bind to the plate (thus in a "solid phase"). Various samples of antisera (raised in rabbits) of albumins or sera of various species are then added to the wells containing the extracted solid phase protein (antigen), allowing the antibody

to bind to the antigen. After cleansing, radioactive (iodine-125) antibody of rabbit gamma globulin (produced in donkeys) is added and radioactivity of the wells is quantified in a scintillation counter. Species is determined through evaluation of the measure of radioactivity uptake which represents the extent of binding of species specific antisera.

As a demonstration of the applicability of this technique, six bone samples were submitted for blind analysis. Each weighed less than 1.8 grams and was too small for morphological determination of species. Three of these samples had been removed from known human remains and three from known non-human animal bones. In addition, one of the non-human specimens was known to represented a deer (Odocoileus virginianus). pRIA analysis correctly differentiated the human from non-human samples and correctly identified the known deer sample, given the choice of five possible non-human animals (cow, deer, dog, goat and pig) using 200 mg or less of each specimen.

pRIA, Bone Fragments, Species Identification

H101 Developing the "Isotope Fingerprint" in Human Skeletal Remains

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After attending this presentation, attendees will have an increased knowledge of the potential for isotope based analysis of human skeletal remains, which will assist in the identification of the post-mortem interval, and may further provide information which will suggest country, or region, of origin of the deceased, and even age estimations at death.

The authors consider that the analytic method will be of great benefit in investigations, providing information that will assist in identifying an individual, and provide additional information that, until now, had not been available to those examining skeletal remains.

With increased global transportation and movement of individuals, notably those gaining entry illegally into countries, any such method that can aid in identifying a deceased based upon isotope concentrations would be of great importance.

Forensic pathologists are often requested to examine remains that have been unearthed during excavations and building developments, particularly in light of the publicity surrounding recent criminal cases. Once it has been established that the remains are indeed human the question of period of internment arises. Despite the extensive literature published upon this subject it remains notoriously difficult to quantify with the majority of cases relying heavily upon the "experience" of the investigating pathologist.Whether such experience yields correct answers is questionable; corroborating evidence is often absent and therefore the pathologist is unable to recognise any errors in judgement.

It is generally accepted that remains should be no more than 75 years old to warrant police interest. Therefore any reliable dating method should distinguish bones from within this interval accurately from those lying outside of it. Previous work has focused upon the physiochemical properties of bone or its organic constituents, though the results have failed to produce a workable calibration system. Several papers have also suggested the measurement of specific radionuclides which, unlike methods that depended upon chemical changes, are affected less by alterations within the physiochemical environment to which bones have lain exposed.

Radiocarbon (14C) has proved a valuable tool for dating archaeological samples for over 50 years now. However, with a half-life of 5730 years, the accuracy of this technique within a narrower time frame has yet to be verified.

Previously the concentrations of 210Pb and 210Po have been determined in human bone mainly to evaluate the contribution to internal radiation doses. Little work has been undertaken into the potential for using these isotopes as detection tools for dating human skeletal remains, despite appropriate radioactive half lives (notably 22.3 years and 138.4 days for 210Pb and 210Po, respectively). The research is therefore examining the potential for using such isotopes as predictable biological clocks; ones that are activated at death and through analysis of which can provide the investigators with an accurate and reliable indicator of the post-mortem interval.

Though used in archaeology the use of radionuclide mapping has yet to be developed in forensic science. The theory is based upon the knowledge that in life an individual incorporates its environment into its body over time. The food we eat, the water we drink, the air we breathe all contain small quantities of isotopes and trace elements that, once ingested, enter our skeletal system to a varying degree. These quantities alter between geographical regions and countries, depending upon the underlying geology of the areas. It should therefore be possible, through the analysis of material, to confirm the region that the individual lived within when they died.

The forensic applications of both such systems would be of great benefit to both police forces and international organizations by narrowing search parameters down greatly. In cases where no documentation has been found to suggest where they lived, such a test would be invaluable to investigating officers who possess relatively limited resources.

Our initial results would appear to confirm these hypotheses and have proved useful in on-going investigations.

Isotope, Fingerprint, Postmortem Interval

H102 Skeletal Manifestations of Non-Hodgkin's Lymphoma and Multiple Myeloma: A Differential Diagnosis

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After attending this presentation, participants will understand the criteria for differentially diagnosing non-Hodgkin's lymphoma (NHL) from multiple myeloma (MM) when presented with forensic skeletal material exhibiting multiple osteolytic lesions.

The primary purpose of this paper is to determine whether a differential diagnosis based solely on skeletal remains is adequate for identifying NHL from other disease processes producing multiple osteolytic lesions. The impact of this research in forensic anthropology is clear; it identifies the potential for and possible limitations of pathological diagnoses based on skeletal changes. This information helps in identification and may provide the cause of death for unidentified individuals in future forensic casework.

Lymphomas represent any neoplastic growth occurring in lymphoid tissue and are categorized into one of two subtypes; Hodgkin's or non-Hodgkin's. The incidence of NHLs is three times more likely among whites than blacks, with a slight predilection for males. Primary lymphoma of bone (PLB) represents 7-25% of NHLs and predominantly produces "moth-eaten" osteolytic lesions. Diffuse histiocytic lymphoma (DHL) accounts for 68% of all PLBs and 1/3 of all childhood NHLs. Lesions are characteristically lytic; however, mixed lytic and sclerotic reactions are common. Lesions resulting from DHL are primarily distributed in the axial skeleton but often appear in long bone diaphyses.

Multiple myeloma is a disorder of white blood cells causing an over stimulation of osteoclasts while simultaneously suppressing osteoblastic activity. This aggressive disease is the most common primary malignancy of bone. It is characterized by numerous, completely osteolytic

lesions that are primarily distributed in the axial skeleton and long bone metaphyses. Radiographically, the lesions have a distinctive "punched-out" appearance, especially in the cranial vault; these defects may also produce a scalloped endosteal margin in long bones. No reactive new bone is associated with the lesions. The incidence of MM is two times more likely among blacks than whites, slightly favoring males over females. Less than 1% of cases occur in individuals less than 40 years of age.

The Maxwell Museum of Anthropology at the University of New Mexico houses a large collection of skeletal remains with documented age, sex, biological affinity, cause and manner of death, and medical history. A DHL patient drawn from this collection was used to illustrate typical bony changes resulting from NHL; this individual was directly compared to the remains of an unidentified woman exhibiting similar skeletal lesions of unknown etiology.

In 1962, a 36-year-old male was diagnosed with multifocal diffuse histiocytic lymphoma. Recurrent lesions developed later that year, and his left leg was amputated distal to the femoral midshaft. Twenty years later, he developed skull lesions; this recurrence was treated with radiation. In 1986, the lymphoma returned, affecting the soft palate and right ankle. Full body and local radiation was administered, but three months later, he died of sepsis secondary to diffuse histiocytic lymphoma.

In this case, the individual's skeleton exhibits pathognomonic lesions for non-Hodgkin's lymphoma. Numerous lytic defects and areas of sclerotic deposition are present on the cranium. The left femur has osteolytic lesions, which are permeative and have a "moth-eaten" appearance. A resorptive lesion is present on the proximal fibula that has destroyed the trabeculae and created a granular appearance to the medullary cavity. Lesions on the distal half of the right tibial diaphysis have a "moth-eaten" appearance.

The remains of an unidentified woman were brought to the Office of the Medical Investigator in Albuquerque for autopsy and identification. The individual (Jane Doe) was between 20-25 years of age and of Caucasian ancestry; her skeleton exhibited multiple permeative lesions. Purely osteolytic lesions were observed on the centrum of the third lumbar vertebra and the sternum. Destruction of the sternum was marked. Three small discrete lytic lesions perforated the inner table of the calvarium affecting the diploë. Sclerotic bone addition was also noted on the parietals and occipital. The sternal end of the right first rib consisted solely of a lace-like cortical structure; no cancellous bone remains in this area. The lesions are characteristic of a rapidly progressing pathological condition spread via hematogenous or lymphatic dissemination. Diseases presenting similar skeletal changes include lymphoma and multiple myeloma.

Although she has relatively few lesions, Jane Doe's remains exhibit similar skeletal changes to those of the man diagnosed with DHL. Mixed sclerotic and lytic reactions observed on her cranium are extremely rare for patients with MM and are more diagnostic of NHLs. Radiographs also fail to show the distinctive "punched-out" and scalloped lesions of MM; instead the lesions are "moth-eaten," indicative of NHLs. The differences observed between Jane Doe and the documented individual (specifically the number of lesions) are likely related to survivorship and treatment. In addition, Jane Doe is a young Caucasian adult; this profile favors a diagnosis of DHL, a subtype of NHL that often affects younger individuals. In general, NHLs are three times more common among whites. In contrast, MM affects blacks twice as often as whites and its occurrence is extremely rare in individuals less than 40 years of age.

In conclusion, both lymphoma and multiple myeloma should be considered when assessing a skeleton exhibiting multiple lytic lesions. However, the skeletal lesion morphology and demographic distribution should provide adequate criteria for a differential diagnosis between DHL and MM.

Multiple Myeloma, Non-Hodgkin's Lymphoma, Multiple Osteolytic Lesions

H103 Computer Assisted Facial Reconstruction Technique

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The objective of this paper is to present the methodology of two-dimensional (2D) facial reconstruction used at the Forensic Sciences Laboratory of the French Gendarmerie and the subsequent results. Secondly, a research project examining computerized three-dimensional (3D) reconstruction will be shown.

Identifying skeletal remains can be difficult. Facial reconstruction techniques may be required to provide information regarding the facial characteristics of the unknown remains. The process of computerized 3D reconstruction can offer additional information about the real face of the victim and can assist in the identification process.

Among the activities of the Forensic Medicine Department of the Institut de Recherche Criminelle de la Gendarmerie Nationale, facial reconstruction often represents the ultimate solution for the identification process of a body. This method is employed only when more traditional methods of identification do not allow for a positive identification.

The basic approach of the method is based on the principle of the facial sketch, which traditional was applied to cases where a crime victim would describe the facial features of a perpetrator. In the case of skeletal remains, it is the skull that describes the facial features of person and helps ascertain its shape and proportions. The technique used in the Laboratory is relies on the method of 2D image warping. Since 1996, it has aided in the identification of victims who would otherwise remain unknown. At the request of paleoanthropologists, this method has also been applied to reconstruct facial features of crania from historic and prehistoric sites.

At the present time, the Laboratory is involved with a research project along with a local computer sciences university. This project will further our goals of developing an application software for 3D reconstruction. Using tridimensional anatomical data, this new approach will restore the relief of a face according to the underlying anatomy with a numerical data bank of muscles and soft tissue thicknesses of the face. As a result, the face can be presented in front, profile, three-quarter view. This anatomical and tridimensional approach of facial reconstruction is interdisciplinary and involves the specialties of anatomy, anthropology, plastic surgery, computer science, forensic pathology, and radiology. The results of this project have the potential to draw in other disciplines, such as aesthetic and reconstructive plastic surgery and facial and maxillary surgery.

Facial Reconstruction, Computer, Identification

H104 Testing the Reliability of Frontal Sinuses in Positive Identification Using Elliptic Fourier Analysis

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This paper will examine the EFA coefficients of digitized frontal sinus outlines to estimate the probability of a correct identification and discuss the reliability of the technique. Further, the research will discuss when EFA comparison of frontal sinus outlines can provide quantitative substantiation for a forensic identification based on these structures.

This presentation will demonstrate the importance of considering *Daubert* guidelines when conducting research in forensic anthropology,

as well as provide the community with a new method for frontal sinus radiograph comparison.

The use of frontal sinus radiographs for confirming the identity of human remains dates to 1925. Traditionally, such identifications involve comparing antemortem and postmortem radiographic records and are usually conducted by a forensic anthropologist, pathologist, or radiologist. The expert makes a visual assessment as to the agreement between the two radiographs (or lack thereof), making a largely subjective judgment as to whether the two belong to the same individual.

Despite the fact that the comparison of frontal sinus radiographs for positive identification has become an increasingly applied and accepted technique, it is exceedingly rare that an expert's opinion goes unchallenged by other experts and/or opposing council. Moreover, recent rulings concerning admissibility of scientific evidence in court require more than credibility, persuasion, and manifest experience of the scientific expert. The current method of frontal sinus radiograph comparison by visual assessment fails to meet evidence admissibility guidelines as set forth in the 1993 case of *Daubert v. Merrell-Dow Pharmaceuticals, Inc*. Specifically, there has been no evaluation of the probability of misidentification using the technique, and there are no standards for confirming or rejecting a putative identification. Even though identifications based upon frontal sinus radiograph comparisons have been routinely accepted by scientists, medical examiners and law enforcement officials, these shortcomings could pose serious problems if forensic scientists were called upon to testify regarding such an identification at trial.

In response to these shortcomings, a study was conducted to assess the reliability of frontal sinuses in forensic comparisons using a geometric morphometric approach called Elliptic Fourier Analysis (EFA). In this study, the shape of a frontal sinus was represented by digitized points along its outline as seen in a standard anterior-posterior radiograph. EFA fits a closed curve to the ordered set of data points, generating a set of coefficients that can be treated as shape descriptors and can be used as variables in discriminatory or other multivariate analyses.

EFA coefficients were generated from 808 digitized outlines of frontal sinuses. Likelihood ratios (the probability of the evidence supposing a hypothesis is true, divided by the probability of the evidence supposing it is false) and posterior probabilities (the probability that the identification is correct assuming that the identification is as likely to be correct as incorrect) were calculated based on these coefficients. The average likelihood ratio in this study was remarkably high (about 1.09E+84 to 1), indicating that the odds of a match given the correct identification are significantly higher than the odds of a match from the population at large. The posterior probability for most cases was 1 or very near 1 indicating that the probability of a correct identification given a match would be nearly 1 in most cases, and about 96% on average.

Thus, for individuals with sufficiently remarkable frontal sinuses, using EFA coefficients of digitized outlines to estimate the probability of a correct identification, and thereby confirm or reject a presumptive identification, is a reliable technique. The technique has also been effectively applied to forensic comparisons. Given these results, EFA comparison of frontal sinus outlines is recommended when it may be necessary to provide quantitative substantiation for a forensic identification based on these structures.

Forensic Anthropology, Frontal Sinuses, *Daubert*

H105 Markers of Mechanical Loading in the Postcranial Skeleton: Their Relevance to Personal Identification of Human Remains

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This study offers a new assessment of a methodology for measuring degrees of postcranial muscular-skeletal robusticity (MSR) that can benefit the forensic anthropologist in personal identification of human remains. The "Femoral Robusticity Index," and some other commonly taken postcranial indices, are demonstrated to be less reliable indicators of robusticity than examination and recording of multiple markers of occupational stress (MOS).

Preservation of muscular tissue from victims of mass casualties resulting from assaults by terrorists, accidents, or acts of nature may allow the forensic anthropologist to assess a hitherto commonly overlooked observation in cases of personal identification - measurement of degrees of postcranial muscular-skeletal robusticity (MSR). This variable refers to degrees of skeletal massiveness, strengthening or structural buttressing of a skeletal element by addition of bone tissue as a response to high mechanical loading, observable girth or "heftiness" of a living individual or a well preserved body, general thickness of long bones, and bone strength relative to body size. Gracile body forms and skeletal elements reflect the reduction of factors contributing to robusticity, but absence or reduced expression of MSR is also critical to positive identification of human remains.

When bodies are taphonomically degraded, their skeletal remains allow a more accurate estimation of this variable from morphometric and radiographic examination of enthesopathic lesions at loci of muscular and ligamentous attachments. Under conditions of intensive mechanical stress, muscular contraction produces on attachment loci rough patches, tuberosites, crests or tubercles with an enlargement or hypertrophy of these attachment areas. While these features of bone remodeling are recognized today as markers of occupational stress (MOS) (the responses of osteological tissue to a range of habitual activities in life) the traditional method to assess MSR has been the calculation of the ratio of the length of a long bone to its mid-shaft diameter or circumference. The "Femoral Robusticity Index" has been regarded by many biological anthropologists for over a century as the diagnostic measure of total skeletal massiveness or gracility. Both forensic anthropologists and palaeoanthropologists have observed that marked cranial robusticity and molar crown tooth sizes are not necessarily correlated with postcranial robusticity for a given individual or a population.

Notation of "robusticity" has been included in protocols of sex determination of skeletal remains, males usually exhibiting more pronounced features and larger body sizes than females in prehistoric and modern human populations. Apart from sexual dimorphism, markers of postcranial muscular-skeletal robusticity have been attributed by some bioarchaeologists to geographical and climatic adaptations to habitats (lower degrees of muscular-skeletal robusticity in hot-humid Tropical regions; higher in peoples of northern latitudes under conditions of cold-stress), to athletic activities, socioeconomic patterns, nutrition and pathology, inheritance, secular trends, and locomotion over rough terrains.

It is argued here that bone remodeling as a consequence of habitual patterns of behavior-markers of occupational stress (MOS) - is the major determining factor in the expressions of MSR. This hypothesis was tested by comparing values of the "Femoral Robusticity Index" in three human skeletal samples: modern European males who had been prisoners subjected to hard labor over many years (N = 15), modern males from India who had spent their lives in manual labor and in pulling rickshaws (N = 16), and prehistoric South Asian males from Middle Holocene burial deposits on the Gangetic Plain of India (Sarai Nahar Rai and Mahadaha) who were hunter-gatherers (N = 24).

Multivariate and bivariate analyses indicate that comparative values of the Femoral Robusticity Index are insignificant in measuring muscular-skeletal robusticity in this male sample from the Temperate and Tropical Zones or Europe and Asia respectively. Rather, where MSR are pronounced in femora and other postcranial bones, MOS are the most obvious aspects of bone remodeling under contrasting conditions of habitual stress-related adaptations.

The protocols of the investigation of human remains by forensic anthropologists can be supplemented and advanced by an understanding

of the dynamic relationship of MSR to MOS in cases where personal identification is the focus of investigation. Although no single factor can account for degrees of muscular-skeletal robusticity in modern and prehistoric human populations, the effects of habitual patterns of activity imposing stress upon the integrity of the muscular-skeletal system provide another and critical component of the forensic anthropologist's protocol in achieving a positive personal identification of human remains.

Muscular-Skeletal Robusticity, Forensic Anthropology Methodologies, Femoral Robusticity Index

H106 Rapid Responses to International Incidents: To Go or Not to Go (or When to Go and How to Go)?

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Attendees of this roundtable discussion will gain an understanding of the factors involved in both assessing the advisability and evaluating the implementation of a forensic response to an international incident where the abuse of human rights is suspected.

This presentation will impact the forensic community by demonstrating differing views on the advisability of launching rapid forensic investigatory responses to international incidents of suspected human rights abuses. Panelists will debate past responses and explore their aftermath in terms of both legal and humanitarian ramifications.

Over the past 20 years, forensic personnel of various disciplines have become involved increasingly in rapid response deployments to international incidents where crimes involving breaches of international humanitarian law or human rights are suspected of having occurred. The nature of the responses and of the responsibilities of the international forensic community varies tremendously in organizational structure, quantity of personnel involved, and duration of the response. This roundtable discussion brings together professionals from several disciplines (forensic scientists, psychosocial professionals, and human rights specialists) in order to explore the lessons they have learned during participation in these incidents, with particular emphasis on the planning and implementation of large international forensic investigations of human rights abuses and the responsibilities of the international forensic community. Each panelist in the roundtable has considerable experience at the organizational level in either rapid response, or the aftermath of rapid response, deployments in reaction to human rights catastrophes. The target audiences for this discussion are students and junior personnel who have been, or who may become, members of such teams; experienced practitioners are also encouraged to attend and participate.

Responses to human rights catastrophes are organized and run by non-governmental organizations, national governments, and international forums (e.g., the United Nations special commissions and truth commissions, ad hoc tribunals, etc). The hierarchical organization of these bodies has meant that forensic scientists participating in large international investigations or humanitarian responses are often detached from the responsibility for the consequences of their work. From a forensic practitioner's perspective this has meant that international responses to such humanitarian catastrophes are characterized by the rapidity of their implementation and consequent *ad hoc* planning. Numerous questions – to which there are no single answers – arise from responses of this kind:

1. Given that the passing of time leads to the deterioration of material evidence and witness recollection, when should any investigation by the international community be launched? What issues and concerns must be addressed prior to this response?
2. Are the methods used in criminal investigations internal to a nation-state applicable to international investigations of large-scale human rights abuses? Is the issue really one of methods, or is it rather perceptions of standards? What conflicts of interest exist?
3. Does the apparent urgency of a forensic response by the international community warrant the absence of communication and liaison with other involved non-forensic organizations?

In the context of this discussion, a response is defined as the initial deployment of civilian experts into a region where human rights violations are suspected of having taken place and the actual investigation of crimes using the techniques available to forensic scientists. Although this definition excludes secondary responses, which may take place and continue over subsequent months or years, rapid response teams or organizations are frequently responsible for setting the parameters and conditions under which subsequent teams and organizations must conduct their work. Thus, the legacy of rapid response deployments lingers far beyond the initial time spent at the scene/morgue and, to a certain extent colors (if not dictates) the mandate of every organization electing to participate subsequently in human rights work in the same region.

The goals and mandates of the primary stages of forensic investigations into large-scale human rights abuses appear deceptively simple. Usually they are set too narrowly (e.g., documentation of criminal activities through witness testimony, grave construction, and cause and manner of death) so that primacy is given to the logistics of the immediate forensic investigatory and documentary processes (e.g., archaeological, crime scene, investigatory, anthropological, pathological). The long-term ramifications of these types of activities often seem to be ignored so that exhumations and autopsies are provided for, but the positive identification of the exhumed and autopsied individuals and the issuance of death certificates are not. Witnesses to criminal events are interviewed, but family members of the missing are not asked to provide antemortem information and DNA samples that may aid in the identification process.

Examples where rapid responses to gross human rights abuses have affected subsequent activities by forensic scientists and human rights organizations include:

- The initial work of International Criminal Tribunal for the former Yugoslavia (ICTY) teams in Bosnia and Croatia in 1996 and the subsequent work of Physicians for Human Rights (PHR) and the International Commission on Missing Persons (ICMP) in the former Yugoslavia from 1997 to the present.
- The deployment of *ad hoc* forensic teams in Kosova under the direction of the ICTY in 1999 and the subsequent work of the Organization for Security and Cooperation in Europe (OSCE) and ICMP in 2000.
- The initial work of the International Forensic Center of Excellence (INFORCE) in Iraq in May-June 2003 and any organization which may subsequently conduct work in Iraq.

Although the desire to investigate immediately is valid, many reasons to hold off are equally valid. Security concerns - both for members of response teams and potential witnesses to events - must be addressed. The logistical capability of putting a team into the field must be evaluated. The not inconsiderable expenses of such a project must be

funded. Unsurprisingly, these concerns are often addressed preeminently, but the issues pertaining to the efficacy and legacy of the initial response seldom garner the attention they merit. It will be argued that the role of the forensic scientist in large international human rights abuse investigations must be expanded to provide for a holistic response, one that includes not only technically and legally sound methods of investigation, but provides for the humanitarian consideration of the needs of surviving families and communities. Only in this way will rapid responses become appropriate responses.

Human Rights Violations, Assessment, Holistic Responses

I1 Delusional Disorder and the Criminal Law: Multidisciplinary Session of Psychiatry and Behavioral Science and Jurisprudence

Alan R. Felthous, MD, Chester Mental Health Center, Southern Illinois University School of Medicine, 1315 Lehmen Drive, PO Box 31, Chester, IL 62233; Anthony Hempel, DO*, Vernon State Hospital, 108 Pompano Avenue, Galveston, TX 77550-3130; Angeline Stanislaus, MD*, Chester Mental Health Center, 1315 Lehmen Drive, PO Box 31, Chester, IL 62233; Georgy Koychev, MD, PhD*, Medical University of Sofia, Psychiatric Clinic, G Sofiisky Street 1, Sofia 1431, Bulgaria*

After attending this presentation, attendees will become aware of the history, concept, and manifestations of delusional disorder.

- guidelines for distinguishing fantastic but true stories from delusions.
- the clinical and legal issues in effectively treating pure delusions.
- constitutional limitations in involuntarily medicating deluded defendants to restore them for competency to stand trial.
- on a case-by-case basis whether mental health professionals view therapeutic medication in the criminal setting differently than legal professionals.

This presentation will impact the forensic community and/or humanity by clarifying the nature of critical clinical and legal issues presented by deluded criminal defendants. In turn this should provide direction for improved clinical care, useful clinical research, and avoidance of legal pitfalls in achieving justice when defendants suffer from a delusional disorder.

A delusional disorder consists of a system of fixed false beliefs that are logically reasoned and not bizarre. In some cases the delusions can cause the afflicted to harm him/herself, attack others, and violate the law. Competence to stand trial can be compromised by false, persecutory delusions. Yet, because other mental processes remain intact, the individual otherwise functions adaptively and may not appear mentally disturbed to the untrained observer. Similarly, the deluded defendant may be found not guilty by reason of insanity, but, depending on jurisdictional law, fail to meet criteria for court enforced medication. Without effective, voluntarily accepted treatment, the individual could then be involuntarily hospitalized for an extended period.

Professor Koychev will discuss the historical background and phenomenology of delusional disorders. He will present research results in which the paranoia of patients fell into one of the following three categories: 1) Slowly progressive schizophrenia, which is first manifested by pure delusions and then only 15 to 20 years after onset develops into a thought disorder; 2) Paranoid delusions associated with an affective disturbance; and 3) Paranoia with a pre-morbid personality disorder characterized by rigidity, hostility, and assertiveness. Ten case examples of people mistakenly diagnosed with delusional disorder will be presented by Dr. Hemple, who will offer guidelines on distinguishing fantastic but true stories from authentic delusions. Dr. Stanislaus will discuss the challenges of providing effective treatment for deluded individuals, given the dearth of scientific data on treatment and the various legal restrictions. The insufficient consensus among psychiatrists about the efficacy of psychotropic medications in the treatment of delusional disorders poses a significant dilemma when psychiatrists consider petitioning the court to enforce medication. The criminal law attorneys will examine relevant jurisprudence including the recent U.S. Supreme Court decision, Sell versus the United States (2003), which delineated constitutional limitations in the treatment and restoration of competence to stand trial.

Case-by-case review to allow both the lawyers and the clinicians to make a determination as to whether or not (a) therapeutic reasons, or (b) legal reasons, and/or (c) a combination of both, would mandate the forcible medication against the will of a criminal defendant in order to be involved in a courtroom proceeding. The panel will discuss specific cases and request audience participation in the review and analysis of individual fact patterns.

The panel will also explore the relationship between medicating and inmate in order that the inmate does not propose a danger to himself/herself and whether or not there could be a bright line between therapeutic medication and the medication of a criminal defendant in order to render the criminal defendant competent to stand trial.

The panel will outline the specific issues posed by the deluded, but otherwise cognitively intact, criminal offender from the criminal act to arraignment, competency to stand trial, the determination of guilt and sentencing, or, alternatively, insanity acquittal and hospitalization.

Delusional Disorder, Court-Ordered Medication, Competency to Stand Trial

I2 Developing and Testing a Behavioral Coding System for Hostage Negotiations

Bryan U. McClain, BA, Demetrius O Madrigal, BA*, Georgie A Unwin, MS*, Mark Castoreno, and Glenn M. Callaghan, PhD, San Jose State University, One Washington Square, San Jose, CA 95192-0120*

After attending this presentation, attendees will understand potentially effective crisis communication strategies for hostage negotiators.

Multiple variables within crisis situations have been hypothesized to contribute to lethal and non-lethal outcomes. Verbal behaviors are one of the key factors in crisis situations that directly affect outcome; an analysis of that communication can help predict outcomes, guide future crisis interventions, and assist with training hostage negotiators. This poster presents data on the assessment of communication processes during crisis situation interactions, specifically hostage negotiations. Previous researchers have attempted to predict outcomes of these crisis situations by examining behaviors using descriptive and frequency analyses defined by formal or topographical features and aggregated across many different situations and negotiator-hostage taker dyads.

This methodology prevents the analysis of the specific individual behaviors that contribute to specific outcomes. An analysis of the assessment of individual behaviors at a micro-analytic, or process, level may help to more accurately predict the resolution of these crises. This poster presents data from of a behavioral coding system, the Crisis Communication Rating Scale that assesses verbal behaviors in hostage negotiations. The CCRS was designed to determine the communicative behaviors that contribute to lethal outcomes in hostage situations. Data from the evaluation of this coding system are presented for both training coders to use the CCRS and analyses of hostage negotiations using lag sequential methodology, a method of determining the serial dependency of verbal interchanges.

Data regarding the amount of time to train raters to accurately code transcripts of hostage situations and kappa values as an index of inter-rater agreement are presented for raters. Empirical analyses of several

series of coded interactions were conducted using lag-sequential analysis. This data analytic strategy helps determine, for example, whether a hostage taker reduces threatening behavior following the use of empathy by the negotiator. The 21 codes of the CCRS were applied to five transcripts coded by four raters. Non-parametric statistics used to relate the process variables in the CCRS to actual outcome (e.g. violent or nonviolent resolutions) are described. The poster concludes with a discussion of the potential use of the CCRS manual for the assessment and analysis of hostage negotiation interactions, domestic violence interchanges, and suicide threat interventions.

Hostage Negotiation, Crisis Communication, Empirical Coding

I3 The Dangerousness of Shared Psychotic Disorder

J. Arturo Silva, MD, PO Box 20928, San Jose, CA 95160; Gregory B. Leong, MD, Western State Hospital, Center for Forensic Services, 9601 Steilacoom Boulevard SW, Tacoma, WA 98498-7213*

After attending this presentation, the participant will understand the basic diagnostic aspects of shared psychotic disorder; and understand the role of shared psychotic disorder in aggressive behaviors.

This presentation will impact the forensic community and/or humanity by signaling awareness in clinicians of the potential harm posed by individuals suffering from shared psychotic disorder.

In shared psychotic disorder, as defined by the *Diagnostic and Statistical Manual of Mental Disorders*, Fourth Edition, Text Revision (DSM-IV-TR), the inducer (primary case) harbors a delusion that the inducee (secondary case) also adopts. The inducer and inducee are involved in an affectively close relationship. The inducee, however, has not previously suffered from a psychotic disorder. Lasegue and Farlet originally described shared psychotic disorder in 1877. They named this condition, "folie-à-deux," a term that remains in common use to designate this condition.

Shared psychotic disorder has been studied from phenomenological, diagnostic, biological, epidemiological, and therapeutic perspectives. Although several articles in the anglophonic literature have mentioned that individuals with shared psychotic disorder have demonstrated aggressive behaviors, little attention has been given to the psychiatric-legal issues surrounding this unusual psychiatric disorder. In this presentation, we describe the case of a married couple with this condition. We follow with an overview of the anglophonic literature on shared psychotic disorder and its forensic implications.

Mr. D is a 38-year-old man who was involuntarily hospitalized as a danger to others on a locked psychiatric unit after threatening to harm others who he delusionally believed were conspiring to kill him. Mr. D's history of delusional thinking and auditory hallucinations began seven years prior to admission. One year prior to admission he had been living in a Midwestern city where he reported to the police about suspected drug trafficking by his neighbors. Mr. D soon developed the delusion that one of the putative drug traffickers was plotting to kill him and his wife. In response, they moved several times to different cities during the year. Mr. D stated the gangsters knew his whereabouts as he identified them by the way they would stare and follow him. During the index and previous hospitalizations he identified several patients who he thought belonged to the nationwide conspiracy against him. He could offer no explanation as to the reason such extensive resources were expended to harass but not attack him.

Mr. D endorsed a history of significant alcohol consumption as well as heroin, marijuana, and cocaine use. He had a three-day history of coma following a head injury sustained at age 27 while working in a construction job. On mental status examination, Mr. D's abstraction ability and memory were within normal limits. Mr. D's physical examination was within normal limits. His serum chemistries, complete blood count, and urinalysis showed no abnormalities. After his initial evaluation he was given a DSM-IV-TR diagnosis of paranoid schizophrenia.

Mr. D and Mrs. D had been married for five years. She had no history of mental illness. Nonetheless, she believed and corroborated his delusional explanations despite prior attempts by mental health professionals to point out the logical inconsistencies in the delusional system. Mrs. D was diagnosed as a suffering from shared psychotic disorder with Mr. D as the inducer.

Shared psychotic disorder can be associated with the perpetration of aggressive and harmful behaviors, including homicide. Dangerous shared psychotic disorder can be divided into three types depending on whether the inducer, inducee, or both act aggressively. Type 1 involves aggression by the inducer and Type 2 involves aggression by the inducee. Type 3, involving aggression by both parties, is the most frequently reported type and thus the best known of the three types of aggression associated with shared psychotic disorder. The case of Mr. D corresponds to Type 1 since only he was involved in enunciating the threats and was the recipient of psychiatric hospitalization.

Shared Psychotic Disorder, Aggression, Violence

I4 Kava Intoxication and Psychiatric Manifestations: A Case Report

Marc A. Colon, MD, Louisiana State University Health Sciences Center, Department of Psychiatry, 1501 Kings Highway, PO Box 33932, Shreveport, LA 71130-3932*

The goal of this presentation is to present to the forensic community a case of psychiatric complications from Kava intoxication requiring hospitalization and a review of the respective literature.

This presentation will impact the forensic community and/or humanity by publishing findings in the literature as kava, much like ephedra, remains one of the more controversial herbs available on the supplement market. It has already been linked to hepatotoxicity and the author presents another documented case of psychiatric complications from its use.

This poster will present a specific case report and pertinent review of the literature documenting suspected psychiatric manifestations from kava intoxication. The patient is a female in her early forties with prior diagnoses of polysubstance dependence and bipolar disorder for which she was being treated with carbamazepine and sertraline. She reported taking kava to aid in sleep and on initial presentation exhibited paranoia and mood lability. Her medical history was pertinent for hypothroidism treated with the medication, Synthroid, and a current urinary tract infection. A carbamazepine level was mildly elevated at 11.1 mcg/ml (4.0 mcg/ml-10.0 mcg/ml) upon admission. The patient reported that she took Baclofen and clonazepam as needed for chronic back pain and urine toxicology was reported as presumptive positive for benzodiazepine. The patient was discharged within 72 hours.

Kava, an herbal product, was widely used in the 1990s to promote relaxation. It was sold as a dietary supplement and marketed to treat anxiety, occasional insomnia, premenstrual syndrome, and stress. Eventually it was linked to greater than 70 cases of hepatotoxicity in Great Britain and Europe and was subsequently banned there in 2002. In the United States, the Food and Drug Administration is investigating any links between kava and liver damage.

Kava is considered to have additive effects when used in combination with benzodiazepines. One case report documents the combination of kava and alprazolam possibly contributing to a self-limiting symptom cluster of disorientation and lethargy that also resolved with a three day admission to the hospital. In fact, kava may actually interact with benzodiazepine metabolism. Research has shown a possible synergism between kavapyrones (the active constituent extracted from the root of kava plants) and gamma- aminobutyric acid (GABA)-active

sedatives. These pyrones are considered centrally acting skeletal muscle relaxants and anticonvulsants and have been shown to have weak effects on GABA or benzodiazepine receptors in vitro. Cytochrome P450 metabolism may also play a role when kava is consumed with conventional medications.

Kava, Drug Interaction, Affective Liability

I5 Blackouts: An Update — Causes and Consequences

Donal F. Sweeney, MD, 1170 High Road, PO Box 3276, Santa Barbara, CA 93108*

After attending this presentation, attendees will understand the causes, results, and consequences of the severe memory disruption of the Alcoholic Blackout, along with suggestions on dealing with it.

This presentation will impact the forensic community and/or humanity by discussing a blackout which is not well defined by those involved medically. A clear and agreed-on understanding of the causes of this memory disruption and its consequences is needed by the Forensic Community. Knowing what it is will help to avoid and prevent it and to deal with a person in a blackout until it passes. This is the purpose of this presentation.

I presented at the February 1990 AAFS Annual Meeting a talk outlining new knowledge and forensic implications of the Alcoholic Blackout. Since, in the past 14 years, I have closely surveyed the progress, new knowledge and changes in the thinking – from the multiple scientific disciplines involved. These include neuroscience and memory research, addiction medicine, psychiatry, psychology, neurology, brain imaging, anesthesiology, and some legal cases. Books, journals, papers, patient stories, and the Internet, were some of the sources used. Long thought to be common only in alcoholics, blackouts are now known to occur in moderate, weekend, and even naïve drinkers. College binge drinking is felt by some to have as high as a 25% incidence. How alcohol can disrupt the brain's memory system and the consequences of that disruption will be presented. With the current knowledge - the opportunity to avoid or prevent the blackout, suspect it in a drinker, and suggested care of that person until the blackout ends – is now possible. Slides, handouts, references, and other source material will be available.

Amnesia, Blackout, Consciousness

I6 Risk Factors Associated With Violence In Adolescents

Waqar Waheed, MD, St. Vincent's Hospital-Manhattan/New York Medical College, 321 West 54th Street, Apartment 303, New York, NY 10019; Stephen B. Billick, MD, New York Medical College, 11 East 68th Street, 1B, New York, NY 10021*

After attending this presentation, attendees will have an improved understanding of how multiple risk factors should be taken into consideration when making a determination of violence risk.

This presentation will impact the forensic community and/or humanity by enhancing the awareness of risk factors associated with adolescent violence and stimulate further research in this area.

Adolescent violence is an increasingly problematic phenomenon facing today's society. A limited number of studies have been published linking specific predisposing factors to an increased risk of violence in this population. This study reviews the existing literature in an attempt not only to present the available data in a cohesive manner but also to underscore a need for further research in this area.

Adolescent, Violence, Risk Factors

I7 Substance Abuse Among Incarcerated Young Males in the South of France

Emmanuel Margureritte, MD, Julien Legourrierec, MD, and Eric Baccino, MD, Service de Medicine Legale, Hospital Lapeyronie, University Hospital of Montpellier, 191 Avenue du Doyen Giraud, Montpellier, Cedex 5 34295, France*

After attending this presentation, attendees will become familiar with substance abuse among incarcerated young males in four French detention centers.

This presentation will impact the forensic community and/or humanity by showing a possible relationship between cannabis consumption and psychiatric disorders.

Natur of Study: Descriptive study

Population and Methods: Between June and December 02, 103 males under 18 were incarcerated in four detention centers in the south of France (Montpellier, Tolulouse, Nîmes and Perpignan). Among this young population, 51 were questioned and included in the study. Interviews were performed by a resident and data registered by means of a standardized questionnaire. Data collected were age, socio-demographic variables, medical history, consumption of licit and illicit substances according to the DSM IV criteria and psychological disorders (suicidal ideation, insomnia…).

Results: The study concerned only males; the mean age was 16.25 and the age range 13 to 17. 66.6% had used tobacco, 54.9% had used cannabis and 11.8% had used alcohol. 9.8% were still smoking cannabis while in jail. Prior to jail 9.8% were regularly using all together tobacco, cannabis and alcohol. According to this population, their cannabis consumption is mostly due to stress and the seeking of pleasure.

Other substances used were not significant enough to be mentioned in this study. Suicidal ideation was reported in 11% among those who never smoked cannabis and in 42.8% among those who were dependent. There might be a potential relationship between these 2 factors (depression due to weaning in jail or an even more important intoxication among depressed abusers) According to others French studies, it seems that compared to the same age range population, incarcerated young people had a higher level of substances use before going to jail.

Conclusion: In this study, it seems that cannabis consumption and suicidal ideation could be related. On a whole, among incarcerated young people, very few ask for a psychological care. A longer study period with a larger sample would be necessary to assess the need of an early detection of psychiatric disorders in order to provide the psychological support and care.

Substance Abuse, Prisoners, Cannabis

I8 Addiction Psychiatry for Forensic Psychiatrists

Richard Rosner, MD, 140 East 83rd Street, Suite 6A, New York, NY 10028; Abraham L. Halpern, MD*, 720 The Parkway, Mamaroneck, NY 10543; Robert Weinstock, MD, 10966 Rochester Avenue, Suite 4-C, Los Angeles, CA 90024*

The attendee will understand where the role of addictive disorders are pertinent in the legal assessment of adolescents and adults.

This presentation will impact the forensic community and/or humanity by educating the community to the special problems of assessing addictions in judicial proceedings.

Addiction psychiatry has been of a confounding nature for legal proceedings. Dr. Halpern will present the reasons that addiction psychiatry is important to forensic psychiatrists. The issues of voluntariness and diminished capacity are exceedingly important to understand. Addictive psychiatry is important in the pre-arraignment phase and may

impact on the capacity to stand trial. It may also impact on the degree of criminal responsibility and capacity to stand responsible for the crime that has been charged. Finally, it can play an important role in the judicial disposition at sentencing. Addictive treatment can take place in the community setting or in correctional institutions. Dr. Weinstock will discuss addict's motivational level. Addicts' motivation for treatment in the face of repeated failures needs to be evaluated. There are special considerations for the application of an addictive psychiatry assessment in adolescents because of their ongoing developmental status. Dr. Rosner will present the adolescent material. The audience will have ample time to participate in discussion.

Addiction, Adolescents, Capacity

I9 Mental Retardation and the Death Penalty: Responding to the U.S. Supreme Court's Landmark Decision in Atkins vs. Virginia

Daniel A. Martell, PhD, Park, Dietz & Associates, Inc., 537 Newport Center Drive, #200, Newport Beach, CA 92660*

Attendees will learn the current case law on mental retardation in capital litigation, and issues that arise in the clinical evaluation of empirical IQ scores and assessments of adaptive functioning in this unique class of criminal defendants.

Marking the most significant legal development for mental health professionals working in capital litigation in the past decade, the United States Supreme Court's landmark decision in Atkins v. Virginia made it unconstitutional to execute persons with mental retardation. This presentation will review the Court's decision in this case, and explore the unique clinical issues that arise in conducting these evaluations.

Professional standards for Akins evaluations will be suggested, with emphasis on the selection of appropriate I.Q. tests; problems encountered with the assessment of adaptive functioning and approaches for confronting them; and issues arising in cross-cultural evaluations and non-English speakers.

Distinctions will be drawn between evaluations performed at various stages in the procedural history of these cases, including the decision to seek the death penalty, evidence presented in the guilt or penalty phases of trial, issues rising in Federal Habeas proceedings, and evaluations of competency for execution. Material from recent Federal and state cases will be used to illustrate the clinical contours of these unique cases.

Mental Retardation, Death Penalty, Atkins vs. Virginia

I10 A Contemporary Review of Discriminatory Practices in the Implementation of Capital Punishment in America

Rahn K. Bailey, MD, Bailey Psychiatric Associates, 2116 Bissonnet Street, Houston, TX 77005*

This presentation will impact the forensic community and/or humanity by discussing issues concerning fairness in the implementation of capital punishment.

Capital punishment can be a stern, and certainly final response to violent criminal behavior. Professionals and political leaders have struggled with this process for centuries. As a society, in recent years, we have begun to address these concerns in both medical and legal settings. Although some of these determinations have been helpful in focusing the perspective of this entire process, clearly, discrimination against the mentally ill and ethnic minority group members remains a significant feature in this entire endeavor. This presentation will attempt to delineate many of those forms of discrimination and will address key rationale for and against the use of the death penalty for capital offenses.

Capital Punishment, Death Penalty, Discrimination

I11 Insanity Acquitees and Their Victims

Jason E. Hershberger, MD, NYU School of Medicine, Kirby Forensic Psychiatric Center, Wards Island, NY 10035*

After attending this presentation, attendees will understand the diagnostic and demographic characteristics of insanity acquitees; understand the method of violence most commonly used by insanity acquitees; and understand the common relationships between the insanity acquitee and their victims.

This presentation will impact the forensic community and/or humanity by assisting the forensic community's conception of characteristics of individuals that have met the legal criteria of Not Guilty by Reason of Insanity.

Insanity acquittees are a very specialized subset of violent offenders, and this research attempts to identify the diagnostic, demographic and behavioral differences between insanity acquittees and the large population of violent offenders. The literature on this topic is reviewed, and data from a New York State Forensic Hospital is presented.

Insanity Acquitee, Victims, Personality Disorders

I12 Characteristics of Defendants Charged With Stalking: Preliminary Look at Referrals to the Forensics Psychiatry Clinic Three Years After the Passage of NY State Stalking Laws

Marilou B. Patalinjug, MD, 14 Presidio Pointe, Cross Lanes, WV 25313; Ronnie Harmon, MA, Bellevue Hospital Forensic Psychiatry Clinic, 100 Centre Street, Room 500, New York, NY 10013*

After attending this presentation, attendees will gain information regarding demographic, clinical and psychosocial profiles of defendants referred to the Bellevue Hospital Forensic Psychiatry Clinic since the implementation of the NY Anti-Stalking Laws in 1999.

This presentation will impact the forensic community and/or humanity by providing updated information relevant to the understanding of the crime of stalking.

The first anti-stalking law was passed in California in 1990. It took nine years before New York passed its own stalking law, becoming the last state in the union to do so. Prior to this, when stalkers were arrested, they faced charges such as Harassment, Menacing, Trespassing, and Criminal Contempt. Since then more studies have focused on this problem. Harmon et.al. (1995 & 1998) conducted some of the earliest researches in this field. It has been three years since New York finally passed its anti-stalking laws and there has been note of an increasing number of referrals for psychiatric evaluations to the Bellevue Hospital Forensic Psychiatry Clinic where the defendant carried a Stalking charge. This study looks into the demographics, diagnoses, violence profiles, and stalker-victim profiles of the defendants with Stalking charges seen in the last three years. Furthermore, a comparison will be made to the 1998 study by Harmon et.al., to determine whether the creation of Stalking as a crime has changed the characteristics of the population referred for psychiatric evaluation. This will accomplished through chart reviews of the twenty-seven defendants referred from January 2000 to December 2002. Statistical analysis is still ongoing and results are pending.

Stalking, NY Anti-Stalking Laws, Forensic Psychiatric Evaluation

I13 Improving Medication Compliance to Decrease Institutional Violence

Elizabeth A. Hogan, MD, 20 Tamar Court, Pueblo, CO 81005*

After attending this presentation, attendees will become familiar with administrative and clinical (psychiatric) methods used in a correctional setting to improve medication compliance. This includes interventions with the correctional administration, within the departments of psychiatry, nursing, and pharmacy, and with inmates. The impact that these changes had on violence within the system will also be reviewed.

This presentation will impact the forensic community and/or humanity by describing methods used by psychiatric administration to work with correctional administration in order to improve medication compliance. They will also learn clinical psychiatric methods used with inmates to increase their adherence.

In order to improve medication compliance in a correctional setting, the psychiatric administration worked in concert with the correctional administration. Three primarily administrative changes were made in addition to changes in clinical care.

Administration, Correctional, Medication Compliance

I14 Tattoos and Antisocial Personality Disorder

William Cardasis, MD, 202 East Washington Street, Suite 208, Ann Arbor, MI 48104; Kenneth R. Silk, MD, and Alissa Huth-Bocks, MA, 1500 East Medical Center Drive, Ann Arbor, MI 48109*

After attending this presentation, attendees will understand how the presence of tattoos on inpatients in a forensic psychiatric setting can alert clinicians to the diagnosis of antisocial personality disorder.

This presentation will impact the forensic community and/or humanity by deriving a better understanding of the relationship of tattoos and the presence of antisocial personality disorder in forensic psychiatric inpatients could positively impact treatment of this population by assisting clinicians anticipate potential problematic affective and behavioral states and by serving as a starting point for developing rapport and obtaining historical information from individuals who are frequently distrustful of psychiatric treatment.

Objective: The relationship of tattoos to the diagnosis of antisocial personality disorder was explored in a forensic psychiatric inpatient setting. It was hypothesized that a greater proportion of forensic inpatients that possess tattoos have antisocial personality disorder. Method: Forensic psychiatric inpatients (N=36) were administered a semi-structured interview to determine the presence of a tattoo or other forms of decorative body marking (i.e., body piercing other than ear lobes or branding). Antisocial personality disorder was determined by criteria on a DSM-IV antisocial personality disorder checklist and by DSM-IV admission diagnosis. Demographic characteristics of the patients were also assessed.

Results: Significantly more forensic psychiatric inpatients who endorsed having tattoos had the diagnosis of antisocial personality disorder. These patients, compared to those with tattoos but without the diagnosis of antisocial personality disorder, had a significantly greater number of tattoos and a significantly greater percentage of their body surface area tattooed. They were also significantly more likely to have a history of juvenile delinquency and family members with tattoos.

Conclusions: The presence of tattoos on forensic psychiatric inpatients may be predictive for the diagnosis of antisocial personality disorder and may inform the clinician of possible affective and behavioral states that may develop in treatment.

Tattoo, Antisocial Personality Disorder, Forensic Psychiatric Inpatient Setting

I15 How to Provide a Comprehensive Sex Offender Program in Civil and Forensic Psychiatric Centers?

David Schaich, PsyD and Kostas A. Katsavdakis, PhD, Kirby Forensic Psychiatric Center, Wards Island, NY 10035; Samuel Langer, MD, Chief of Psychiatry, Manhattan Psychiatric Center, 6 Joyce Lane, Simsbury, CT 06070*

The main objective of this presentation is to provide the necessary components for the development of a sex offender program within a psychiatric center.

The contribution to forensic sciences and humanity has to do with the modification of current sex offender program protocols for correctional populations to meet the growing number of sex offenders being identified in psychiatric centers. With enhanced program development centers can better serve this population by providing an effective treatment protocol; better serve the courts by proving more informed opinions regarding the risk of re-offending; and better serve the community by safeguarding the inappropriate discharge of individuals who are likely to re-offend.

Over the last decade, there has been an increased demand to identify and treat sexual offenders in forensic and civil psychiatric settings. Currently, approximately 34 states have civil commitment laws for sexual offenders. In others states, sex offenders are identified in the correctional system and upon their release from prison are psychiatrically hospitalized due to their potential dangerousness. They are subsequently mandated to Psychiatric centers where specific sex offender treatment is not necessarily mandated, and the criteria for discharge remains vague. Moreover, the majority of the literature and research for sex offender risk assessment instruments and treatment protocols is based upon non-psychiatric and/or correctional populations. There is a need for establishing guidelines for sex offender risk assessments and treatment with civil and forensic psychiatric populations.

At Kirby Forensic Psychiatric Center and Manhattan Psychiatric Center we identified a large number of patients, who although involuntarily committed, had not received adequate assessment and treatment for their sexual offenses. Without a specific compressive assessment and treatment program, there was little chance that these individuals would be released to a less restrictive environment. For example, in order to establish criteria for release, the courts request opinions on whether these patients would re-offend. In the absence of a comprehensive risk assessment and treatment protocol, it was difficult to adequately respond to the court's request. To respond to these concerns, which are shared by many other institutions throughout the country, Kirby Forensic and Manhattan Psychiatric Center developed a comprehensive risk assessment and treatment program for sex offending.

The fundamental component of the workshop is to present guidelines for creating a sexual offender program in a psychiatric setting that includes assessment, treatment, and outcome measures with patient's who have sexual offending histories and an Axis I diagnosis. Since the development of many sex offender risk assessment tools and treatment protocols were focused primarily on correctional populations, modifications and suggestions are offered for psychiatric settings and non-mandated populations. This presentation further focuses on helping clinicians and administrators develop a sex offender program in which a number of relative issues will be addressed. The selection and limitations of the sexual offender risk assessments will be reviewed from a clinical and ethical perspective.

The participants will be introduced to modifications of current sex offender treatment programs that target a psychiatrically disturbed population. This includes administration of medications, seeking medication treatment over objection, and the right to refuse medication. Similarly, ethical considerations such as the right to refuse treatment and the patient's right to understand the potential consequences of

assessment instruments will be discussed. From an administrative perspective, training requirements, supervision models and obstacles to program implementation will be carefully reviewed.

Finally, the presentation will include a method of establishing and documenting outcome data, including providing case examples. Preliminary outcome data from Kirby Forensic Psychiatric Center and Manhattan Psychiatric Center will be presented.

Sexual Offender, Risk Assessment, Program Development

I16 The Sexual Predator's Inability to Control Concept

Bradley D. Grinage, MD, University of Kansas School of Medicine at Wichita, 1010 North Kansas, Wichita, KS 67214-3199*

After attending this presentation, attendees will become familiar with the most current U.S. Supreme Court ruling on volitional impairment and the sexually violent predator; become familiar with the mental health community's current understanding of volitional capacity and how that applies to the sexually violent predator; and gain recommendations to advance an understanding of an "Inability to Control" concept with regard to the sexually violent predator laws.

The major impact of this presentation should help to advance an understanding of a difficult and ill defined concept in the forensic community, namely volitional capacity. Some mental health investigators have suggested that there is no scientific basis for measuring a person's capacity for self-control or for quantifying any impairment of that capacity. Still others indicate that volitional impairment is as easily tested with a structured instrument as cognitive impairment. Just as the emergency psychiatric literature has suggested, the forensic community has a similar need to operationalize and research this 'inability to control' concept that is frequently used but poorly understood. By impacting the operationalization of a volitional capacity concept, this presentation would help create a useful tool for the general psychiatrist, better define mental health evaluation limitations, and advance understanding and communication across the forensic and legal professions.

Recent U.S. legal opinion maintains that proof of serious difficulty in controlling behavior upholds the constitutionality required for civil commitment of a sexually violent predator. Lack of legislative definitions and judicial guidance has left lower courts to turn to mental health professionals and the Diagnostic Statistical Manual (DSM) for clarification of specific legal terminology. Elements of volition may be psychiatrically evaluated in a way that contributes to the Court's understanding of that capacity. However, further study is needed to operationally define an Inability to Control concept and address issues of assessment validity and reliability.

Forensic psychiatry is defined as the application of psychiatry to the law. Conflicts inherent in this application stem from fundamental philosophical differences between medical and legal professions. Psychiatry, and medicine in general, is a deterministic science. Principles of law, on the other hand, presume behavior to be the product of free will such that the individual is held accountable for his or her behavior. This fundamental difference between legal and medical philosophies highlights the controversy of an Inability to Control issue surrounding sexually violent predator laws.

The Court's utilization of the term volitional impairment as a means for civil commitment has reignited debate within the mental health community. This article reviews two legal opinions critical to sexually violent predator case law (Kansas v. Hendricks and Kansas v. Crane) to elucidate problems inherent in applying vague concepts of behavior control to legal contexts. This article further attempts to summarize available psychiatric information pertaining to volitional impairment and suggests that if volitional capacity is indeed the linchpin for civil commitment of the sexually violent predator, the limiting factor is our understanding of that capacity.

The field of psychiatry does not have a valid or reliable means to describe a patient's volitional capacity, as no uniform clinical definition exists. Difficulties inherent in attempting to operationalize a concept of volitional capacity stem from problems associated with our current psychiatric nosology, vague legislative constructs, and a history of political and clinical dispute associated with the valid assessment of impaired behavior. Techniques such as actuarial tests and plesthmography may help with risk assessment for dangerousness, but they have limited value in addressing an inability to control concept.

The medical literature supports a rudimentary understanding of volitional impairment through concepts such as impulse control and compulsive behavior, and suggests that elements of volition may be psychiatrically evaluated in a way that contributes to the Court's understanding of its impairment. According to emergency psychiatry literature, the focus of psychiatry should be on the frequently used but less reliable concepts such as impulse control problems. Building a consensus on the meaning of these key concepts would be a process to increase reliability. Three distinct clinical concepts to approach an understanding of a volitional capacity construct are presented. First, the ego dystonic nature of compulsive behavior and impaired self-regulation can be utilized to address the problem of acquiescence. Second, advances in self-assessment and laboratory evaluation of impulsive behavior approach a quantification of an inability to control. And finally, recent attempts to define and categorize an inability to control concept suggest the need for a dimensional nosology.

This article concludes that a clinical concept of volition has potential usefulness. However, further study is needed to operationally define volitional capacity, to facilitate valid and reliable research, and to improve effective communication across professional fields.

Forensic Psychiatry, Sexually Violent Predator, Volitional Impairment

I17 Psychological Repercussion of the Collective Damage

Florent Trape, MD, Pierre Andre Delpla, MD, and Daniel Rouge, PhD, MD, Service of Forensic Science, CHU Rangueil TSA 50032, Toulouse 31450, France*

After attending this presentation, attendees will learn into their practice of evaluation of collective damage.

This presentation will impact the forensic community and/or humanity by providing a means by which victims could obtain more fair compensation for body damage after accidents.

On September 21th, 2001, the explosion of the chemical factory Grande Parish of Toulouse shook the whole of the population of the city, thousands of casualties were dealt with, as well on the physical level than on the psychic one.

In the French common right, the compensation for the body damage (integrating the psychic disorders) is prone to the realization of an expertise which makes it possible to fix stations of damages such as partial permanent disability corresponding to the functional after-effects, damage of the pain and aesthetic damage which are evaluated on a scale from 1 to 7, and damage of approval corresponding to the activities of leisure or sport.

The evaluation of these stations of damage is subjected to the settlement of the date of consolidation (i.e., the non evolution of the physical and psychic after-effects).

It appeared to us that certain elements specific to this collective catastrophe couldn't have been taken into account neither in the partial permanent disability nor in the endured sufferings, such as the durable repercussion related to the collective damage which we propose to integrate in the damage of the pain.

Such a specific damage had been already set up within the framework of the evaluation of the damage of the victims of acts of terrorism, it was evaluated to 40 % of the permanent disability partial with a minimum of 2287 euros.

We will detail the elements to be taken into account to justify this collective damage as well as the specific proposals for compensation that were proposed.

The whole of the population of the city will not be able to profit from this collective damage, items were proposed by medical experts who had taken part in the expertises on the protocol set up for this catastrophe.

The evaluation was divided into two parts, one corresponding to the collateral effects of the catastrophe on the level of the residence, of the family and professional surrounding, of the professional or school environment, the everyday life in any vicinity of the place of the explosion and the other part more specifically studying the psychic disorders presented by many victims but non-likely to make it possible to evaluate a partial permanent disability but not representing a true functional after-effect like would be a syndrome of post traumatic stress or a generalized anxious disorder.

Each item is evaluated in three levels of gravity, it is by making the sum of the whole items that one can determine if it is necessary to fix this collective damage.

This specific damage was thus integrated into the total compensation like an additional suffering due to the collective aspect of the disaster.

The families plunged into mourning will profit from it in a systematic way as well as the casualties of which endured sufferings or the aesthetic damage are higher than 3/7 and those whose partial permanent disability is higher than 20%.

The whole of the victims presenting endured sufferings higher or equal to 1/7 will see their file examined by a medical commission, which will ask for the realization of a complementary expertise if the elements of the initial expertise do not make it possible to evaluate this collective damage. As well as for acts of terrorism, an industrial catastrophe concerning almost the whole of a population seems to us to justify the installation of a specific damage.

This reflexion appeared to us as the operations of expertise went by after a dialogue with the parts concerned whether they were the representatives of the insurance of the factory, the representatives of the justice or the associations of victims.

The taking into account of these collective industrial catastrophes would make it possible to bring to the victims a more complete and fair compensation.

Collective Damage, Compensation, Collective Aspect

I18 Study on the MAOA-uVNTR for Criminal Population in Taiwan

Chung-Ming Tsao, MS and Chang En Pu, MS, Ministry Justice Investigation Bureau, PO Box 3562, Hsin-Tien 231, Taiwan*

After attending this presentation, attendees will pay attention that abnormal DNA may have strong relation to committing a crime.

This presentation will impact the forensic community and/or humanity by providing a study on criminal population for preventing the crime.

Monoamine Oxidase (MAO) A and B exist in the outer mitochondrial membrane, where they play an important role in regulating levels of the oxidative metabolism of catecholamine and indoleamine neurotransmitters. MAOA differs from MAOB in its higher activity toward serotonin and norepinephrine. MAO activity has been suggested to association with certain psychiatric disorders or behavioral traits. MAOA and MAOB are encoded by two tightly linked genes that are arranged adjacently on the short arm of the X chromosome between bands Xp 11.23 and Xp11.4. A functional MAOA-uVNTR (variable number of tandem repeats) polymorphism, which is located 1.2kb upstream of the MAOA coding sequence, consisting of 30bp repeated sequences has been proven to have a significant effect on gene transcription.

Sabol et al. reported that, by performing genes fusion and transcription experiments of MAOA-uVNTR in three different cell lines, alleles containing 3.5 or 4 repeats (allele 2 and 3) of the 30bp sequence are expressed significantly more efficiently than alleles containing either 3 or 5 repeat (allele 1 and 4) sequences in MAOA promoter activity. Recently, the interesting finding of MAOA-uVNTR has been provoked several reports on the correlation of personality, aberrant behavior and psychiatric disorders. For example, Deckert et al. found that the longer MAOA-uVNTR allele (allele 2 and 3) were significantly more frequent than control samples in female patients with panic disorder in Germany and Italy. They suggest that increased MAOA promoter expression may be a risk factor for panic disorder in female patients. In a similar study, Schulze et al. evaluated the association of MAOA-uVNTR with major depressive disorder in unrelated patients of German descent. Their data suggest that an excess of high activity MAOA gene promoter alleles resulting in an elevated MAOA activity is a risk factor for major depressive disorder in females. Therefore, MAOA-uVNTR in the MAOA gene would be good candidates to consider the association between gene and violence.

The aim of the study was initially to investigate the role of MAOA-uVNTR as a biological marker in Taiwan's criminal population. Our results indicate the MAOA high activity promoter alleles appear more frequently in criminal population (N=286, allele 1: 49.65%; allele 3: 50.34%), comparing with control group (N=225, allele 1: 63.1%; allele 3: 36.9%).

Furthermore, it has been reported that Klinefelter's syndrome is not a rare sex chromosomal abnormality occurring with approximately the same frequency as Down's syndrome in the general population (one in 1000 male offspring) . Although they have normal male characteristics, the defects of infertility, gynecomastia, a tendency to be tall and thin with long legs, and some degree of mental deficiency are found in persons with Klinefelter's syndrome. Especially, they are found in relatively large numbers among the criminal population due to social maladjustment. Another aim of our study was to evaluate the frequency of appearing Klinefelter's syndrome in Taiwan¡¦s criminal population. We have examined 753 cases of criminals and found 3 probable cases with Klinefelter's syndrome (47, XXY) by using X-STR technique. The ratio of Klinefelter's syndrome in criminal group is higher than normal population (1/600~1/800) in Taiwan, but it shouldn't be regarded as that the persons with Klinefelter's syndrome are prone to commit crimes. We still need more investigations to sustain this hypothesis.

Monoamine Oxidase(MAO), MAOA-uVNTR, Klinefelter's Syndrome

J1 Hollywood Handwriting 2

Karen Chiarodit, Los Angeles Police Department, SID Room #413, 150 North Los Angeles Street, Los Angeles, CA 90012*

The sequel to Hollywood Handwriting presented at a previous AAFS meeting, this DVD presentation pokes fun of the absurd way the entertainment industry portrays our profession.

Questioned Documents, Handwriting, Movies and Television

J2 Investigation of Class Characteristics in English Handwriting of the Three Main Racial Groups — Chinese, Malay and Indian — in Singapore

Nellie Cheng, BSc, 20 Descanso Drive, #1108, San Jose, CA 95134; Gek Kwee Lee, MSc, Bei Sing Yap, MSc, Lee Tiang Lee, Sock Kim Tan, BSc, and Koon Puay Tan, BSc, Health Sciences Authority, 11 Outram Road, Singapore 169078*

After attending this presentation, attendees will understand the class characteristics in English handwriting of Chinese, Malays, and Indians in Singapore.

There are lots of people who are proficient in one or more language other than English. This presentation will impact the forensic community and/or humanity by arousing the interest in the forensic community to investigate class characteristics of English handwriting made by different racial group, of which the findings might be useful in investigative work in law enforcement agencies.

The three racial groups, Chinese, Malays and Indians in Singapore learn their mother tongue as a second language: Chinese children learn Chinese, Malay learn romanised Malay in school and Arabic in mosque and at home, and Indians learn Tamil. As the letter or character formation of the second languages is different, the possibility of the presence of class characteristics in their English handwriting was investigated. 152 handwriting exemplars were collected and features such as letter designs, pen-lifts, word and letter spacing and embellishments were studied. A procedure, based on statistical methodology, on the determination of class characteristics in English handwriting of the three major racial groups has established. Six class characteristics were identified, and their habitual influence from writing in their own native language. The findings from our study could be useful in providing indications and investigative leads to the possible racial group of the writer of an unknown document.

Document Examination, Class Characteristics, Statistical Methodology

J3 Nielsen v. Nielsen: Advances in the Linguistic Analysis of Questioned Authorship

Gerald R. McMenamin, PhD, California State University, Fresno, 5245 North Backer Avenue, MS #92, Peters Building 383, Fresno, CA 93740*

The purpose of this presentation is to examine two complementary methods for the stylistic analysis of language data as applied to cases of questioned authorship. This particular case will provide participants a hands-on review of, first, the process of qualitative identification of style-markers, and second, the quantitative analysis of identified markers in specific cases.

Program participants will follow and participate in the process of style-marker identification, the analysis of the relative frequency of occurrence of each marker, and finally the determination of the joint probability of occurrence of all markers in a writer. This presentation will impact the forensic community and/or humanity by demonstrating insight into the methodology and more reliable results produced by combining both qualitative and quantitative approaches to forensic analysis.

Introduction: Nielsen v. Nielsen was a divorce matter wherein the division of property was contested. A typed agreement and other writings that reduced one party's share of property were in Question.

Qualitative Analysis: Style markers appearing in the Questioned writings matched those in the Known writing of one of the litigants. These markers included the following:

TYPING
Format: All text typed in CAPITAL LETTERS
Format: Zip code placed under state in address
Format: Space after open-parenthesis and before close-parenthesis

LANGUAGE
Spelling: DOSE [DOES]
Word Form: CAN NOT, WHAT EVER, ANY THING [CANNOT, WHATEVER, ANYTHING]

Quantitative Analysis: The quantitative analysis included four steps: 1) Determination of the relative frequency distribution of each style marker in a corpus of 800 Southern California writers, 2) Calculation of the additive (conservative) joint probability of occurrence of all style markers in any single writer, 3) Calculation of the multiplicative (less conservative) joint probability of occurrence of all style markers in any single writer, and 4) The explanation and correction for the possibility of odds inflation.

Questioned Authorship, Linguistic Stylistics, Methods of Analysis

J4 An Update on the Study of the Randomness of Smith Corona Typescript Defects

Patricia A. Manzolillo, MSFS, and Robert J. Muehlberger, BA, U.S. Postal Inspection Service, Forensic Laboratory, 22433 Randolph Drive, Dulles, VA 20104-1000*

After attending this presentation, attendees will understand results from tests on the randomness of typescript character defects caused by the improper insertion of monoplastic printwheels in Smith Corona electronic typing systems will be presented.

This presentation will impact the forensic community and/or humanity by demonstrating the use of statistical tools to evaluate the results of a common forensic document examination that can result in typewriter identifications.

During the 1999 American Academy of Forensic Sciences meeting in Orlando, FL, the authors presented the primary results of their study *An Empirical Study of the Randomness of Smith Corona Typescript Defects*. This work examined the character defects produced in monoplastic printwheels after incorrect or backwards insertion. The study attempted to determine if the incorrect insertion of the printwheels into the Smith Corona typing systems resulted in predictable or random placement of defects. The following tests were performed using four (4) Smith Corona typing systems and seven (7) Smith Corona and GP Technologies printwheels:

Test I - The effect of correct printwheel insertion on the alignment spin prior to typing.
Test II - The effect of incorrect (backwards) printwheel insertion on the alignment spin prior to typing.
Test III - The relationship of the character struck on the keyboard and the printwheel character struck by the typing system hammer after incorrect printwheel insertion.
Test IV - The maximum number of defects that can occur with one incorrect printwheel insertion.

The tests were performed and the data collected was subjected to chi-square analysis. The predictability of defects and activity of the typing system on the incorrectly inserted printwheels was examined. Conclusions that were presented at the 1999 meeting included:

- correct printwheel insertion lead to consistent performance
- in 75% of the testing incorrect insertion affected the alignment spin and could have produced random defects
- striking a key for a character 180„a away from alignment char acter after incorrect insertion produced defects in a limited number of characters
- one incorrect insertion can lead to many defects

Based upon a study of the original results additional work will be performed in the following areas:

- Testing to study the correlation of the starting position to the final character after alignment spin
- Testing to calculate the frequency of defects in specific characters

Test II (effect of incorrect printwheel insertion on the alignment spin prior to typing) will be repeated with additional printwheels and possibly additional typing systems. Previously only four (4) characters were used as starting positions for the incorrect insertions. The additional work will use a random selection of starting characters to examine the effect on the alignment spin. Previously data was recorded by dividing the printwheel into quadrants (each containing 24 characters). In the new tests, specific data (i.e., the character or smaller groups of characters) will be used to determine the correlation between incorrect insertion, starting position and final printwheel character.

Test III (relationship of the character struck on the keyboard and the printwheel character struck by the typing system hammer after incorrect insertion) will be repeated using additional printwheels and possibly additional typing systems. Previously, keys corresponding to four (4) characters at fixed positions on the printwheel were struck after incorrect insertion. The keys were always struck in the same order. The new work will strike random keys in a random order to more closely study the correlation between the key struck, the starting position and final printwheel character. The frequency of defects in specific characters will also be calculated.

Data will be analyzed using similar statistical tests and compared to the previously recorded data. The additional work should provide a clearer picture of the nature of the Smith Corona typing systems and predictability of typescript defects caused by incorrect insertion of printwheels.

Typewriting, Smith Corona, Identification

J5 A Technique for Authentication of Digitally Recorded Information

William B. Campbell, PhD, Thomas P. Wood, BS, MSEE, MBA, Zachariah Gibson, MS, and Chadwick Cox, BS, Accurate Automation Corporation, 7001 Shallowford Road, Chattanooga, TN 37421*

After attending this presentation, attendees will be given a detailed description of a technique that enables the use of digitally recorded information as evidence.

This presentation will impact the forensic community and/or humanity by demonstrating a technique which will reduce the reluctance of organizations to use digital recordings, such as digital images, where that information may become legal evidence.

Digitally recorded information, such as an image, can be easily altered, and therefore may be difficult to offer or accept as legal evidence. A technique has been developed whereby digital recordings can be offered and accepted as legal evidence without concern of alterations. The most difficult rule of evidence for digital recordings to meet is authentication. Authentication is the means to prove, first, the conditions under which the recording was made, and, second, that the recording is offered in its original, unaltered form. The conditions under which the record was made may include date, time, location, people present, and other relevant conditions. This technique adds information to a digital recording that includes the context in which the recording was made and also includes an encrypted digital signature of the recording and context information. The authentication encode function may be integrated with the device capturing the digital information, such as a surveillance camera. This is an example of a "tightly coupled" authentication process. Alternatively, the authentication encode function may reside on a data server and add the authentication information when the records reach their final storage destination. This is an example of a "loosely coupled" authentication process. This technique produces authenticated digital records that permit unrestricted usage. Recordings such as authenticated digital images may be used with standard commercial image viewing and editing software utilities. But at any time, an authenticated digital recording may be tested to see if it has been altered. Any alteration of the recording or the context information will be definitively detected. The use of strong public key encryption processes permits widespread distribution of the public key encode process and controlled usage of the private key decode process with maximum security. Further, strong digital signature techniques based on large random numbers ensures near-certainty that any modification will be detected. This authentication technique does not alter the original recorded information in any way, as compared to techniques such as digital watermarks that alter the original data in a way that is supposedly imperceptible. This technique for the authentication of digitally recorded information may be applied to any digital information such as still images, audio recordings, full motion images, and service records. It has been implemented for standard recording formats such as JPEG, TIFF, MPEG, and WAV. It can be implemented in proprietary formats and databases for such records as maintenance or service information, telephone usage and billing records, and human resources records. Forensic science has focused great attention on "questioned documents" where most documents traditionally originated on paper. Business practices have transitioned to a point where many documents originate as digital information. This patent-pending authentication technique addresses the forensics of "questioned digital documents."

Authentication, Digital Recording, Evidence

J6 To Identify and Classify Questioned Paper by Using FT-IR, Reflectance Spectrophotometer, Pyrolysis GC/Mass Spectrophotometer

Chuan-Hui Chang, MS, Kuei Liu, BS, Li-Su Lang, BS, Hsing-Yung Hu, BS, and Chia-Hsien Cheng, BS, Forensic Science Laboratory, Ministry of Justice Investigation Bureau, 74, Chung-Hua Road Hsin-Tien, Taipei, Taiwan, ROC, Taipei 231, Taiwan, ROC*

The goal of this presentation is to improve the accuracy of forensic paper analysis.

This presentation will impact the forensic community and/or humanity by demonstrating that experimental results not only can offer the investigator to trace the source and the manufacturer of paper

evidence, but also can be regarded as an effective crime evidence for the justiciary to judge.

The result of paper examination, either by physical or chemical analysis, is always much beneficial to the paper evidence or other related questioned document forgery investigation work. Currently, most questioned document examiners can distinguish the physical difference between the faked and genuine paper evidence by using the traditional physical method, such as measure the thickness of the paper, optical microscopy examination, UV-examination¡K¡K¡Ketc. But recently, our laboratory was often been asked by the law enforcement agencies not only to identify the authenticity of the questioned paper evidence, but also to identify the origin of the paper, or whether the origin of the paper was came from the same origin by comparing it with the other specific faked paper evidence or other specific questioned paper. In such condition, traditional physical examination method may not be able to offer a satisfactory result.

It is therefore necessary to invent a better chemical analysis method to solve the problem, we collect extensively the paper evidence which are came from some document criminal cases. In addition, ten brands of printing/copier papers will also to be gathered. The objective of this research is to discriminated paper, so we will establish systematized analysis methods for examining surface chemical composition of paper via analysis of inorganic fillers and coating pigment and/or additives using Fourier transform infrared spectroscopy (FT-IR), reflectance spectrophotometer, and pyrolysis GC/Mass spectrophotometer. The experimental results not only can offer the investigator to trace the source and the manufacturer of paper evidence, but also can be regarded as an effective crime evidence for the justiciary to judge.

Paper Evidence, Fourier Transform Infrared Spectroscopy, Pyrolysis GC/Mass Spectrophotometer

J7 Ultraviolet Microspectral Characteristics of Gel Inks

Paul Martin, PhD, CRAIC Technologies, 2400 North Lincoln Avenue, Altadena, CA 91001*

After attending this presentation, attendees will learn the UV spectral characteristics of gel inks. In addition, the attendee will also learn a simple and novel method for preparation of inks for transmission microspectroscopy.

This presentation will impact the forensic community and/or humanity by discussion information on the major UV characteristics of gel inks. A new method for sample preparation of inks for transmission microspectroscopy.

The examination of writing inks has been an integral part of Questioned Document Examination since its inception. The types of inks and writing instruments of concern have progressed from pencil and nib pen to ballpoint and porous point pens. The most recent development in both ink and writing instruments has been the Gel Pen. This instrument is a marriage of the ball pen with polymeric gel ink containing both dyes and pigments as colorant and water based gel.

The standard examination protocol for writing inks consists of both physical and chemical procedures. The physical procedures, such as microscopy, near infrared reflectance and luminescence, and the use of various filters, are still applicable to gel inks. The chemical procedures, such as spot tests and chromatography, are not entirely applicable to the examination of gel inks due to the inks intrinsic lack of solubility and the nature of the colorant used.

This work shows a novel and simple method for sample preparation for transmission microspectroscopy. It also discusses some of the advantages of performing microspectral analysis in the transmission mode. I examined 7 different black gel inks in the ultraviolet spectral region. Additionally, 2 blue gel inks of the same manufacture with several of the black inks were also examined. Results of these examinations indicate the ability to differentiate, to varying degrees, the black gel inks, and consistency between those inks of common manufacture (blue and black). The major features are described for use by other examiners in their casework.

Microspectroscopy, Gel Ink, Ultraviolet

J8 The Analysis of Volatile Organic Compounds in Ballpoint Inks Using Gas Chromatography/Mass Spectrometry

Gerald M LaPorte, BSc, MSFS and Jeffrey Wi, BS, MSF, United States Secret Service, Forensic Services Division, 950 H Street NW, Washington, DC 20223*

After attending this presentation, attendees will understand the GC/MS procedure for the analysis of ballpoint inks.

This presentation will impact the forensic community and/or humanity by showing that GC/MS is a valid analytical tool for the analysis of ballpoint inks. With such a large population of inks, this study may help reveal class characteristics with respect to certain ballpoint ink manufacturers.

The United States Secret Services and the Internal Revenue Service maintain the largest known collection of writing inks in the world. The reference collection consists of over 8000 samples of ink dating back to the 1920s and is often utilized to determine the date a questioned ink(s) was first commercially available. This information can be used to determine if a document was produced on the purported date. Since there are a variety of writing ink manufacturers, and ink formulations are occasionally changed within the same manufacturer, oftentimes there are inherent differences in the dye composition and solvents used in the vehicle portion. Thin layer chromatography (TLC) is the preferred method of analysis for databasing because its efficient and provides an effective profile of the colorant components present in writing inks. Gas chromatography coupled with mass spectrometry (GC/MS) is a suitable analytical tool for the analysis of volatile organic compounds (VOC) that are used by various manufacturers.

A study was previously conducted by this group of authors on 633 ballpoint inks to examine the occurrence of 2-phenoxyethanol (PE), a common (VOC) found in ballpoint inks that has been proven to evaporate as ink ages. A total of 279 and 354 black and blue ballpoint inks, respectively were examined and the results have been reported. PE was identified in 85% of the black and 83% of the blue ballpoint inks. During the PE study, GC/MS profiles were generated for each of the ballpoint inks. This new study will examine other VOCs that are present in ballpoint inks as a means to aid in the identification of inks when two or more inks cannot be further differentiated. Furthermore, GC/MS profiles will be compared to determine if there are differences in the types of VOCs used by various manufacturers, and/or if the same manufacturer has changed their formulation over time with respect to the vehicle portion.

Ballpoint Inks, Volatile Organic Compounds, Phenoxyethanol

J9 Thermal Gradient Mechanism of Line Crossing Anomaly

James R Daniels, BS, Chemistry, James R Daniels, 12 Greenway Plaza, Suite 1100, Houston, TX 77046*

After attending this presentation, attendees will gain an enhanced ability to interpret line crossings involving laser printing and moderately embossed handwriting by their microscopic glare-angle behavior.

This presentation will impact the forensic community and/or humanity by demonstrating recognition of a previously unrecognized mechanism underlying the appearance of certain line crossings.

A. In a recent case, intersections of laser printing with a moderately embossed fluid ink signature (e.g., rolling writer genre), I noted what appears to be a dark path or band across the surface of the fused laser toner.

B. This path is anomalous with respect to normal ink-writing-over-laser appearance in that no burnish-sheen or ink-film sheen is present, despite observing the signature to have been written with sufficiently firm writing pressure to emboss the paper.

C. To test the hypothesis that this dead-black surface anomaly is a function of substrate topology rather than brightness differences, test printings were made and studied.

D. In order to separate (1) influences of (underlying) ink on the surface of laser printing from (2) influences associated with the embossment furrow, I laser printed over (a) unembossed ink strokes, and (b) uninked embossments made with various styli including empty ball-point pens.

E. I observed (1) no apparent dark band or any other visible effect on the fused-toner surface of laser printing applied over unembossed ink writing, but (2) the same anomalous darkened and sheen-free path on the surface of laser printing applied over uninked writing embossments.

F. Due to the method employed by this type of printer to fuse the electrostatically-adhering black powdered toner to the page permanently, i.e., pressure exerted by a hot top roller and a cold bottom roller, I used the terminology "thermal gradient" to describe the loss of effective thermo-mechanical contact between the surface of the powdered toner due to physical sheltering inside the embossment "furrow," the effect increasing from the edges to the center of embossment.

G. Insofar as using these observations and experiments to aid examinations involving intersections of moderately embossed writing and laser printing, the paper contains a step chart.

H. The demonstrative tests clearly separate the purely topological cause of the observed effect from ink-related influences such as visibility of underlying writing through an integuous toner layer by Kubelka-Munk processes, visibility through gaps in the toner layer, leaching of ink components to the surface of the toner layer, or any earlier ink-induced irregularities in the electrostatic transfer stage of laser printing.

Crossing Strokes, Thermal Gradient, Embossment Sheltering

J10 Removal of Opaquing Solutions From Documents

Bonnie L. Beal, BS, U.S. Postal Inspection Service, 225 North Humphreys Boulevard, 4th Floor, Memphis, TN 38161-0003*

After attending this presentation, attendees will understand a technique on removal of opaquing solution from paper with the least amount of damage.

This presentation will impact the forensic community and/or humanity by demonstrating a technique that is less detrimental to the evidence when removing opaquing solutions.

An item was submitted to the Indiana State Police Laboratory with the request to decipher what was written under an opaquing solution. Due to the thickness of the opaquing solution and a toner printing process on the reverse of the document the Document Examiner was unable to definitively decipher what was under the opaquing solution using non-destructive examinations. A request was received from the contributor giving permission for the Document Examiner to remove the opaquing solution. An experiment was conducted to determine the best technique in removing opaquing solutions with the least amount of damage to the document. Three methods for deciphering and/or removal were conducted on ten different opaquing solutions which covered writing written in five different inks. The best removal method for most opaquing solutions was found to be the use of a Xylene substitute followed by scraping with a scalpel.

Obliterations, Opaque Correction Solution, Wite-Out®

J11 Development of a Graduate Level Course of Academic Study in the Forensic Examination of Questioned Documents

James F. Larner, MSEd, U.S. Treasury (TIGTA), Forensic Science Laboratory, 8484 Georgia Avenue, Suite 830, Silver Spring, MD 20910*

Due to recent focus of the updated Federal Rules of Evidence (702 & 703) the field of Forensic Document Examination has been challenged regarding a number of *Daubert/Kumho* issues.

This paper addresses the area of Academic Acceptance of the Field of Questioned Document Examination through the proposal and acceptance of a 12 Graduate credit hour Course of Academic Study in the Forensic Examination of Questioned Documents (QD/GCAS), to be taught entirely on the Internet, as a part of the existing Forensic Science Program at Oklahoma State University. The author has recently been designated as the Lead Adjunct Instructor for the QD Course of Academic Study.

The QD Course of Academic Study:

- Would allow certified Forensic Document Examiners to gain valuable field related updates, especially in specialized areas such as color copier and fax identification.
- Would provide trainees or intern valuable instrumental and specific specialized training and updates not available in most training laboratories.
- Would provide a competitive advantage for laboratory Interns who are interested in being hired as entry-level document examiner trainees.
- Would provide academic standing in the forensic and academic communities. This program will be the first of its kind, nationally and internationally. There are no other Courses of Academic Study at the Graduate University level, regarding Questioned Document Examination.
- Would support U.S. Federal Rules 702 & 703 regarding reliability and relevance of expert witness testimony.
- Would provide a centralized source for uniform training in support of apprenticeship journeyman training and preparation for American Board of Forensic Document Examiners certification.
- Would develop a lifelong learning philosophy. Participants could re-enroll and earn the certificate more that once, as all courses would be updated and infused each year with the most recent technical information.
- Would provide ongoing continuing education through seminars in support of re-certification preparation.

This paper will also include a live online demonstration of a representative "Course Lecture," "Online Chat," "Discussion Board Assignment," and "Weekly Quiz." The student course project requirement will also be discussed. The presentation will make use of a new software tool called "Visual Communicator," which provides the instructor with a CD video vehicle to explain "PowerPoint®" presentations and lectures.

Graduate Study, Questioned Documents, Forensic Document Examiners

J12 Some Observations Regarding Usage of the Bayesian Method for the Assessment and Reporting of Questioned Document Examinations

William J. Bodziak, MSFS, Bodziak Forensics, 1281 Cunningham Creek Drive, Jacksonville, FL 32259*

After attending this presentation, attendees will acquire some basic knowledge of the Bayesian method of analysis and reporting.

This presentation will impact the forensic community and/or humanity by describing some basic knowledge of the Bayesian method of analysis and reporting.

Over the past years, a number of articles have been written advocating the usage of the strict Bayesian Method of both analysis and reporting in many areas of forensic science, including the field of document examination. The complexity of the application of the Bayes formula for forensic use, the lack of data necessary to use the strict method, the unfamiliarity of most examiners with the statistical field in general and a number of other potential problems has created some division among examiners regarding its usage. In the United States, most examiners are still not aware of this method. This presentation will not serve to explain how to use the Bayesian method, but rather to simply discuss some of the controversy and obstacles that would suggest it is not a good choice for document examiners.

Document, Bayesian, Reporting

J13 Questioned Documents Research

JoAnn Buscaglia, PhD, Federal Bureau of Investigation Laboratory, FBI Academy, Building 12, CTFSRU, Quantico, VA 22135*

The examination and comparison of questioned documents has been well accepted in the field of forensics and in court for almost 100 years. However, recent *Daubert* challenges have focused new attention on the underlying scientific principles that govern this discipline. In light of these challenges, forensic document examiners have expressed an interest in learning how to conduct the needed research that will withstand scrutiny by both the scientific community and the courts. This presentation will provide some user techniques for achieving this goal. Additionally, the FBI Laboratory has expanded its research effort for questioned documents to address some of these challenges by using a statistical approach. Several research projects related to the chemistry of inks, visualization methods, and spectroscopic examination of documents are also being conducted. This presentation will provide an overview of the ongoing and planned questioned documents research projects. A brief discussion of the FBI Laboratory's Research Partnership Program, which provides state and local examiners the opportunity to actively participate in these research efforts, will also be presented.

Questioned Documents, Research, *Daubert*

J14 Twenty-First Century Document Examinations

Lorie L. Gottesman, 2501 Investigation Parkway, Room 2171, Quantico, VA*

After attending this presentation, the attendee will learn how easily documents can be created or changed due to modern technology. Because of this technology, a document examiner must be cautious when examining non-original evidence, especially when the "original" does not exist.

This presentation will impact the forensic community and/or humanity by demonstrating numerous methods of creating bogus or altered documents in which document examiners will be more aware of the limitations associated with examining non-original evidence.

Before desktop publishing became affordable, it was not too difficult for the forensic document examiner to detect forgeries and manipulations. The traditional methods of tracings, simulations, and cut-and-paste left telltale signs to the trained eye. Today, however, with affordable computers, photocopiers, and digital cameras, as well as high quality scanners and printers, detecting forgeries and manipulations is no longer simple for the fully-trained document examiner.

Twenty-first century document examiners must take special care when examining non-original questioned documents, including photographs and carbon copies. Depending on the equipment and software available, an opportunist can create or recreate virtually any document in a short period of time.

This workshop will include a number of practical problems for the document examiners to examine for any signs of manipulations. The examiners will also observe many of the techniques utilized by criminals and opportunists to create bogus documents. Finally, issues will be discussed concerning what information should be relayed to the investigators and/or the court with regard to non-original evidence.

Manipulation, Non-Original Documents, Forgery

J15 Development and Enhancement of Shoe Impressions on Paper Found at the Crime Scene by Using the ESDA Machine and Adobe® Photoshop® 7.0

Ramses Alvarez, MA, and Ramon O. Diaz, MA, Forensic Science Institute of Puerto Rico, PO Box 11878, San Juan, Puerto Rico 00922-1878*

The goal of this presentation is to present to the Forensic Community the use of the ESDA (Electrostatic Detection Apparatus) in the development and enhancement of shoe impressions on paper found on different surfaces such flooring, rubber mat and on a textile rug. Also, crime scene investigators will work closely with the forensic document examiners.

This presentation will impact the forensic community and/or humanity by demonstrating an ESDA instrument which can by utilized in capturing other types of surface impressions such as shoe impressions on paper that can reveal class and individual characteristics and lead the investigation and possibly link a suspect with a particular crime scene.

The Electrostatic Detection Apparatus, commonly called ESDA, is an instrument manufactured by Foster & Freeman of England and primarily used in the development of indented writings, marks, finger and palmprint impressions usually found on paper.

By utilizing the ESDA instrument we can develop shoe impressions on paper stepped on when found on a hard surface, rubber mat or textile carpet.

In a simulated crime scene case, several pieces of paper were found on the floor, on a rug and on a living room floor textile carpet. Since it was a breaking and entering case of a private home committed by one or more individuals, the paper evidence was collected by evidence lab technicians and sent to the criminalistics lab for examination and analysis.

The ESDA results demonstrated faint shoe impressions appearing on the evidential paper surfaces. To enhance the faint shoe impressions on said paper we used Adobe® Photoshop® 7.0, where it was enchanced, demonstrating clearly class and individual characteristics of shoe impressions found at the crime scene.

Criminalistics, Shoe Impressions, Evidence

J16 An Introduction of the Current Forgery Chinese Seals in the Digital Age

Kun-Chi Cheng, MSc and Hwang Liu, PhD, Forensic Science Laboratory, Ministry of Justice Investigation Bureau, PO Box 3562, Taipei, Taiwan, ROC; Hu-Sheng Chen, PhD, and Hsien-Hui Meng, PhD, Central Police University, 56 Shu Jen Road, Taoyuan, Taiwan, ROC*

After attending this presentation, attendees will understand the changes of current forgery Chinese seal types in the digital age in Taiwan, and proposes a valuable method for the examination of current forged Chinese seal impressions.

This presentation will impact the forensic community and/or humanity by demonstrating the changes of current forgery Chinese seal types in the digital age in Taiwan, and proposes a valuable method for the examination of current forged Chinese seal impressions.

Oriental Chinese and Japanese usually use personal seals for the purposes of authentication or as tokens of social status. The ease of fabricating forged seal poses a security problem in Chinese societies. Personal seals are commonly used for authenticating important documents such as bank cheques in lieu of signatures. This paper points out the changes of the different kinds of current forgery Chinese seal types in the digital age.

Generally, the identification of seals authentication was made by comparing the detail line of characteristic differentials between the impressions, which made with different forgery Chinese seals replicate. Forged Chinese seals were mostly produced by photoprinted zinc plate, which was etched chemically to form the surface plate pattern. As impression of this type lacks the three-dimensional attribute, the major character of the knife-carved seal, differentiating it from the genuine seal impression should not be difficult. Another forgery Chinese seal was made by carving machines. Carving machine-made seals were discernible from others in the needle exertion position, framing lines and angles. However, for those forged seals, which made with photo-polymer relief plate and polymer injection molding machine, the employment of genuine impression as the template for platemaking renders them hardly distinguishable. Factors, such as different incident angle of the seal upon imprinting or different degree of inking, constituted the natural range of variation in impressions. The forged seal replicates could be distinguished from the originals in respect of print density and stroke morphology. The possibility of reproducing two identical Chinese seals with photo-polymer relief plate had been confirmed. Document examiners should insist on the submission of the seals. It was the prerequisites for a fruitful examination. In order to ascertain that any observable difference will be an actual natural variation and reach a conclusion, a sufficient quantity of questioned and specimen impressions were necessary. Comparing with various forged methods of Chinese seals, meanwhile, the digital skill edit for print was much popular and easily used for criminals.

Today, the popular personal computer made various Chinese seals and stamp impressions have been easily scanned in to images and used directly to print out on the document. Now and then, the forgery Chinese seal or stamp impressions made by silkscreen were rarely seen because their complicate procedures. Therefore, the ink-jet printer or photocopied machine became the newest implement. This new crime type of forged seal or stamp was proposed to be a new challenge to document examiner.

This paper not only illustrated current crime types of different forgery Chinese seals or stamp but also offered a valuable method for the examination of current forgery Chinese seal impressions from point of view of printing.

Forgery Seal Impressions, Inkjet & Photocopied Printing, Documents Examination

J17 The Effects of Consultation, Writer Origin, and Message Size on Writer Recognition by Forensic Document Examiners

Moshe Kam, PhD, Drexel University, ECE Department, Data Fusion Laboratory, 3141 Chestnut Street, Philadelphia, PA 19104; Chris Gaughan and Andrzej Gorski, Drexel University, ECE Department, Data Fusion Laboratory, c/o Moshe Kam, 3141 Chestnut Street, Philadelphia, PA 19104*

After attending this presentation, attendees will be informed on recent results in proficiency testing of forensic document examiners.

This presentation will impact the forensic community and/or humanity by demonstrating information which will assist forensic document examiners in others in understanding FDE proficiency issues, and may be useful to all sides during *Daubert* hearings.

Since 1993, the Data Fusion Laboratory (DFL) at Drexel University has conducted a series of Questioned/Questioned and Questioned/Known tests, administered to forensic document examiners (FDEs) and laypersons. These tests used handwritten samples (handprinted, non-hand-printed and 'mixed') and signatures, and required different tasks of association and assessment. Some of the tests examined capabilities of FDEs in specific types and styles of handwriting (e.g., paragraphs of words vs. paragraphs of numerals). Other concentrated on procedures and protocols (e.g., scales of opinions, and the effect of peer review and consultation on error rates).

At present DFL studies are being conducted in the following areas:

1. differences (if any) between the capabilities of FDEs in writer identification using hand-printed samples and their capabilities with non-hand-printed, cursive, and 'mixed' samples;
2. FDE reporting scales;
3. proficiency with limited quantities of handwriting;
4. proficiency with texts comprising numerals (primarily or exclusively);
5. proficiency using English texts written by individuals whose mother tongue is not English; and
6. the effect of consultation and peer review on FDE error rates.

This survey talk would highlight our most recent results in these areas.

Proficiency Tests, Forensic Document Examination, *Daubert* vs. Merrell Dow Pharmaceuticals, Inc.

K1 Use of a Novel Large Volume Splitless Injection Technique and Sequential Full Scan/SIM for Simultaneous Screening and Confirmation of Toxicological Specimens

Eric Phillips, BS, Thermo Electron, 2215 Grand Avenue Parkway, Austin, TX 78728*

After attending this presentation, attendees will have the ability to use GC/MS instrumentation to better characterize samples and quantitate unknown compounds.

A novel injection technique coupled with a sequential full scan/SIM acquisition can expand that role and consequently increase the value of GC/MS as an analytical tool. By combining an injection technique that allows injection of up to 35 uL of sample with a sequential full scan/SIM acquisition, the forensic scientist can achieve several objectives with a single injection. SIM analysis enables confirmation of pre-screened presumptive positives, while the presence of full scan data allows investigation into other compounds of interest that may be present in a sample.

The resulting data provided confirmatory, quantitative data about target compounds as well as library searchable results for unknown full-scan peaks. Emphasis was placed on cocaine and metabolites in urine and oral fluid. The custom library contained standards ranging across a broad spectrum of acidic, basic, and neutral drugs. Extraction methods were appropriate for the target compounds. The limit of detection using a standard splitless injection technique was 30 ng/mL for benzoylecgonine (BE) in urine, and this LOD was decreased to 300 pg/mL using an injection volume of 35 uL. The correlation coefficient for BE in urine using the SIM data was 0.991, calibrated from 300 pg/mL to 1200 ng/mL. Run times using the large volume technique were longer than those using the standard technique, due to use of a longer column and a required period of isothermal oven temperature. These longer run times were offset by the decreased detection limits achievable with the large volume injection.

Large Volume Splitless Injection, GC/MS, Sequential Full Scan/SIM

K2 Urinary Fentanyl and Norfentanyl During Application of Duragesic® Transdermal Patches

Alphonse Poklis, PhD, Department of Pathology, Virginia Commonwealth University, Richmond, VA 23298-0165; Ronald C. Backer, PhD, Ameritox, 9930 West Highway 80, Midland, TX 79706*

After attending this presentation, attendees will have data concerning the urinary concentration of fentanyl and its major metabolite norfentanyl in patients treated with "Duragesic®" transdermal patches.

Toxicologist will be aware that urine concentrations of fentanyl and norfentanyl in patients on Duragesic® transdermal patches for control of chronic pain will far exceed previously reported values from overdose cases or patients receiving fentanyl for control of acute pain.

This poster presents the urinary concentration of fentanyl (F) and it's major metabolite norfentanyl (NF) in chronic pain patients treated with "Duragesic" transdermal patches. The Duragesic® continuous release transdermal patch is designed to release 25 µg/h per 10 cm^2 of surface area. The patches are available in 10, 20, 30 and 40 cm^2 sizes releasing 25, 50, 75 and 100 µg/hr F, respectively. Desired therapeutic blood concentrations are obtained 8 to 12 hours after patch application. F is rapidly and extensively metabolized, with NF as the major metabolite. Little data is available on expected urine F concentrations in therapeutic situations, while urine concentrations in overdose cases have been reported to range from 5-93 ng/ml (Baselt, 1995).

Random urine specimens were collected from 200 chronic pain patients wearing 25, 50, 75 or 100 ug F transdermal patches. Urine specimens were collected from hours after application to several days later after continuous F release. Each specimen was analyzed for F, NF, creatinine and pH. Additionally, each was screened by enzyme immunoassay for the following: amphetamines, barbiturates, benzodiazepines, cocaine metabolite, methadone, phencyclidine, d-propoxyphene, opiates and marijuana metabolites. All positive screening results were confirmed by GC/MS. F and NF were isolated from urine by solid phase extraction (Biochemical Diagnostics GV-65), then identified and quantified by GC/MS in SIM mode. Mass to charge ions monitored were: F, 245,146, 246; d_5-F, 250, 251; NF-acetyl derivative, 231,158,132; and d_5-NF-acetyl derivative 236. Quantification of F and NF was by comparing ions 250/245 and 236/231, respectively. The LODs and LOQs for both F and NF were 3 ng/mL. The ULL for F and NF were 250 and 400 ng/mL, respectively. The results of F and NF analysis are presented below:

Dose, ug/hr		Fentanyl ng/mL		Norfentanyl ng/mL	
Patch	No.	mean	range	mean	range
25	46	48	0 - 474	161	0 -800
50	71	78	0 - 569	222	0 - 931
75	29	75	0 - 444	245	0 - 820
100	51	159	0 - 631	220	0 - 722

The incidence of other drugs detected as a percentage the 200 specimens were: opiates, 48% (incidence: Codeine 1, Hydrocodone 41, Hydromorphone 7, morphine 12, oxycodone 36); benzodiazepines, 43%; barbiturates, 3%; methadone, 4%; marijuana metabolite, 3%; amphetamines, 2% and cocaine metabolite, 1%. Other than F and/or NF no drugs were detected in only 25% of the specimens.

Conclusion: These data demonstrate the wide variation in concentrations of F and NF in random urine specimens following application of Duragesic® patches. However, these values obtained during therapeutic use far exceeded concentrations previously reported in fatal poisoning. In general, one may expect to find urine NF concentrations 3 to 4 times higher than those of F. Also, in addition to fentanyl therapy, chronic pain patients routinely are prescribed other opiates and benzodiazepines.

Fentanyl, Norfentanyl, Urine Drug Testing

K3 Use of the QED® Saliva Enzymatic Alcohol Test Device for the Identification and Quantitation of Alcohol in Urine

John Vasiliades, PhD, Kathy Lewis, and Kristin Colonna, BS, Toxicology Labs, Inc., 4472 South 84th Street, Omaha, NE 68127*

After attending this presentation, attendees will learn the use of the QED® Saliva Enzymatic Alcohol Test Device for the identification of ethanol in urine and to determine the concentration of ethanol in urine.

Method: The QED® Saliva Alcohol Test (STC Technologies, Inc., Bethlehem, PA 18018) is a rapid enzymatic alcohol dehydrogenase assay

which quantitatively measures alcohol concentrations from 0 to 150 mg/dL. We evaluated the QED® A-150 Saliva Alcohol Test Device for the determination of alcohol in urine. We followed the manufacturer's procedure, except that the cotton tip of the swab was dipped into urine so that the cotton swab was saturated with urine. Samples were analyzed on the same day by Gas Chromatography (GC) with flame ionization detector (FID) on a glass column, 1.82 m x 2 mm ID glass column, 60/80 Carbopack B/ 5% Carbowax 20M (Supelco, Bellefonte, PA, 16823). N-propanol (NP) is used as internal standard (IS). Urine samples, which were spiked with ethanol at 20, 40 and 80 mg/dl gave the following average results. Within-run precision by QED® at the 3 concentrations (n=12) was 7.3% with a 128 +/- 31% recovery; between-run precision averaged 11% with 131 +/- 29% recovery. For comparison the average within-run precision by GC at the 3 concentrations (n=12) was 2.9% with a 104 +/- 5% recovery; between-run precision averaged 4% with 103 +/- 3% recovery. Urine samples that were analyzed on the same day by QED® and GC gave the following results. The concentration of samples ranged from 0 to 383 mg/dl of ethanol with a mean of 117.35 and standard deviation (+/-) of 79.01 by GC mean= 117.35 +/- 79.01, n=31) and a mean of 100.09 and standard deviation (+/-) of 65.75 by QED® (mean= 100.09 +/- 65.75, n=31). Least squares analysis of urine alcohols by GC (x) in comparison to QED® (y) gave a slope (m) of 0.929, y-intercept (b) of -1.028 and correlation coefficient (r) of 0.99 (y = 0.929x - 1.028, r= 0.99) with a standard error of estimate Syx of 14.95. Recovery studies indicate that QED® overestimates urine alcohols at low concentrations. No false positive results were reported by QED®. Interference studies indicate that n-propanol will cross react 60% and isopropanol 20% with the QED alcohol method. We conclude that the QED® saliva method can be used for the determination (identification and quantitation) of alcohol in urine. Although QED does not have the sensitivity, selectivity and precision or accuracy of GC, it will provide qualitative and quantitative results more rapidly than GC, less than 3 minutes.

Urine Alcohol, Gas Chromatography, QED®

K4 Analysis of Amphetamines in Nail Clippings Collected From Female Prisoners

Dong-Liang Lin, PhD, Rea-Ming Yin, BS, and Hsiu-Chuan Liu, BS, Institute of Forensic Medicine, No. 16, Lane 175, Tong-Hwa Street, Taipei 106, Taiwan*

This presentation will demonstrate the usefulness of fingernails as an analytical specimen for confirming amphetamine use and the relationship of evidence of amphetamines in hair and nail specimens

With respect to the use of fingernail as an analytical specimen, fewer studies have been directed to amphetamines than other commonly abused drugs, such as opiates or cocaine. In this study, paired fingernail and hair specimens were collected from 43 consenting female prisoners who have admitted the use of amphetamines and/or opiates. These specimens were quantitatively analyzed for amphetamine, methamphetamine, methylenedioxyamphetamine, and methylenedioxymethamphetamine. Methamphetamine and amphetamine concentration ranges, and methamphetamine/amphetamine ratios found in the 21 amphetamines-containing specimens were 0.46-58.17 ng/mg, <0.20-5.42 ng/mg, and 4.06-14.01, respectively. Six paired hair specimens from these 21 sets were selected and cut into 1.5-cm sections. The first 5 sections (from the root) were analyzed. Analytical data are shown in Table 1.

Table 1. Amphetamines in fingernail and hair

Sample No.	Fingernail (ng/mg)				Hair (ng/mg)		
	Methamph.	Amph.	Methamph./ Amph.		Methamph.	Amph.	Methamph./ Amph.
3 (A-008)	13.96	2.73	5.11	S-1[a]	16.78	4.32	3.88
				S-5[a]	58.78	12.83	4.58
5 (A-013)	12.43	1.70	7.31	S-1	18.95	2.27	8.35
				S-5	38.29	3.59	10.67
8 (A-024)	58.17	5.42	10.73	S-1	134.1	24.37	5.50
				S-5	80.55	10.42	7.73
11 (A-027)	3.94	0.97	4.06	S-1	7.03	1.76	3.99
				S-5	30.23	5.89	5.13
13 (A-030)	43.63	3.38	12.91	S-1	71.81	11.59	6.20
				S-5	9.24	1.73	5.34
19 (A-041)	11.70	1.42	8.24	S-1	20.95	3.84	5.46
				S-5	45.25	6.44	7.03

[a] S-1, S-5: The first and the 5th sections of the 5 sections analyzed.

It is interesting to note that results obtained from hair sectional analysis follow definite trends. Specifically, the concentrations of methamphetamine and amphetamine in samples 3, 5, 11, and 19 increase continuously, while the same analytes' concentrations in samples 8 and 13 decrease continuously. Nail clippings will be continuously colleted on biweekly intervals. Whether the analytes' concentrations in nail specimens will follow the same trends observed for hair will be investigated.

Nail, Amphetamines, Hair

K5 Validation of Volatile Analysis Using Dual Column Capillary GC

Gerasimos Razatos, BS and Curtis Caylor, BS, New Mexico Department Health, Toxicology Bureau, PO Box 4700, Albuquerque, NM 87196-4700*

The authors will present data obtained during the validation of a dual column capillary gas chromatography (GC) procedure. The assay, which is routinely used by the New Mexico Department of Health for evidential ethanol testing and postmortem investigation, was validated in terms of precision, accuracy, matrix effects, carryover, linearity, limit of detection and limit of quantitation. A comparison of quantitative ethanol concentrations using postmortem and antemortem casework using both capillary columns (Restek BAC1 and BAC2), together with a comparison of capillary and packed GC columns is also described.

A targeted analysis is performed for methanol, ethanol, acetone and isopropanol using an Agilent HP 6890 GC equipped with a flame ionization detector (FID). Methanol, ethanol, acetone and isopropanol are identified based upon characteristic retention times relative to the two internal standards, n-propanol and t-butanol.

The limit of detection (LOD) in blood was 0.001 g/dL for all analytes tested. The limit of quantitation (LOQ) for ethanol, isopropanol and acetone was 0.005 g/dL and 0.010 g/dL for methanol. Precision using whole blood was evaluated by replicate analysis of in-house controls (n=8). Intraassay CVs for ethanol, methanol, acetone and isopropanol were 1.1, 1.1, 1.0 and 1.1% at 0.474 g/dL, 1.2, 0.9, 1.5 and 0.8% at 0.158 g/dL, 1.7, 1.6, 2.4 and 1.2% at 0.079 g/dL and 4.4, 3.5, 1.9 and 3.4% at 0.019 g/dL respectively. Intraassay CVs using a commercial whole blood control (BioRad) were in the range 2.2 - 3.1% (n=8). Accuracy was determined using internal and external controls. Accuracy using in-house blood controls was 99-103% in the concentration range tested (0.039 – 0.379 g/dL). Accuracy using aqueous external controls (Cerilliant) was 96-102% and commercial whole blood controls (Utak Laboratories, BioRad) were within the acceptable limits defined by the

manufacturer. Analysis of samples fortified with compounds at concentrations that were unknown to the analyst revealed concentrations of ethanol, methanol, acetone and isopropanol within 95 - 105% of the target concentration. No matrix effects were observed and the calibration was linear at 0.7 g/dL, the highest concentration tested. No carryover for any of the analytes was detected at this level. Quantitative ethanol concentrations in 128 postmortem and antemortem case samples were compared using both capillary columns. Linear regression analysis revealed an R2 value of 1.000 (y = 1.0138x – 0.0003), where BAC1 and BAC2 were plotted on the y and x-axis respectively. The mean interassay CV was 1.48% for casework samples that contained ethanol concentrations in the range 0.010 – 0.367 g/dL. Quantitative results using the new capillary GC procedure were compared with a previously used packed GC-FID procedure. Analysis of 108 postmortem casework samples revealed an R2 value of 1.000 (y = 1.0188x – 0.00009), where blood ethanol concentrations using capillary and packed GC columns were plotted on the y and x-axis respectively. The mean interassay CV was 1.41% for casework samples that contained ethanol concentrations in the range 0.010 – 0.277 g/dL.

Headspace Analysis, Ethanol, Capillary GC

K6 An LC-Electrospray Tandem Mass Spectrometric Method for Identification and Quantitation of Cocaine and Key Metabolites in Biological Matrices

Jason E. Schaff, PhD and Marc A. Lebeau, MS, FBI Laboratory, Chemistry Unit, Room 4220, 2501 Investigation Parkway, Quantico, VA 22135*

After attending this presentation, attendees will understand a highly sensitive and specific method for analysis of cocaine and its primary metabolites in blood and urine

Since cocaine is one of the most widely abused illegal drugs, providing a robust and reliable new method for the analysis of this compound and its metabolites will likely prove valuable to many practitioners in the fields of criminal forensic toxicology, workplace and sports drug testing, and postmortem toxicology. Many features of the reported method help to ensure that accurate testing results are obtained rapidly with a high degree of analytical confidence.

This poster will present a recently developed method for the simultaneous analysis of cocaine, benzoylecgonine, methylecgonine, and cocaethylene in biological matrices. Both validation data and data from several cases illustrative of the analytical power of the method will be presented.

The presented LC-ESI-MS/MS analytical method was developed to replace an existing GC-MS (CI) method that relied upon derivatization of the extracted analytes to achieve sufficient component volatility. Prior experience had revealed several limitations to this method, including poor long-term stability of the derivatives, poor derivatization efficiency in some putrefied samples, and compromised chromatography in many putrid or highly concentrated specimens. Additionally, the derivatizing reagents for the GC-MS method were costly, toxic, and had a relatively short shelf life, making their elimination highly desirable.

The solid phase extraction of specimens from the prior method was retained essentially intact, with only a change in one of the internal standard compounds. The new internal standard for benzoylecgonine was the phenyl-d5 isotopomer, which, in combination with the use of d3-cocaine, provides a built-in check for any in-assay hydrolysis. In the new method, dried extracts were reconstituted in unbuffered mobile phase and analyzed directly by LC-ESI-MS/MS, using a column and isocratic mobile phase from a specialty method already in use for trace-level quantitation of benzoylecgonine in solid tissues.

The new analytical system was validated on a series of blood calibration curves over a two order of magnitude concentration range for each component. Curves were extracted on three separate days and analyzed in duplicate, with one curve also rerun a day later to check for compound stability. Analytical run time was 15 min, comparable to the 11.5 min run time from the prior GC method. Validation results were generally very good, with excellent lower limits of detection and quantitation, good between day reproducibility, wide linear ranges, and negligible carryover. Best quantitative results were obtained by measurement of RIC traces for the pseudomolecular ions for the analytes and internal standards in full scan MS mode, while tandem mass spectrometry provided unambiguous identification of all analytes. Analysis was performed to a data-dependant scanning mode to allow collection of both types of data in a single analytical run. One interesting cautionary observation emerges from these data. With the chosen chromatographic system, methylecgonine is separated from its N-methyl-d3 isotopomer by almost one minute.While not unheard of, this is a very rare observation, and one that many forensic scientists may not typically have encountered in practice.This peak separation does somewhat compromise the quantitative analysis of methylecgonine, which shows the smallest linear range of the four targeted compounds.

Several of the case specimens analyzed since the development and adoption of this new method illustrate its great power and stability. To date, no sample has been able to “break” the method from the standpoints of putrefaction, interferences, carryover, or failed recovery of internal standards. The only cases requiring reanalysis have resulted from analyte concentrations higher than the chosen calibration range.

The authors feel that this reliable and robust analytical method will be of value to many forensic toxicology laboratories, and points towards a scheme for potential improvements in many other targeted toxicological analyses.

Cocaine, Liquid Chromatography, Mass Spectrometry

K7 Use of the Covino Algorithm in Evaluating the Additive Toxicity of Lidocaine® and Bupivacaine

David M. Benjamin, PhD, Tufts Medical School, 77 Florence Street, Suite 107, Chestnut Hill, MA*

This research project are discuss how to convert bupivacaine blood levels to lidocaine equivalents so that the blood levels of both drugs can be used to assess toxicity in combined lidocaine/bupivacaine toxicity.

The local anesthetics (LAs) lidocaine® and bupivacaine are commonly used together in many surgical and cosmetic procedures. Routes of administration run the full gamut and include: intravenous (IV) lidocaine® as an antiarrhythmic, local infiltration for surgical repair of lacerations and during “face lifts”, extensive infiltration for liposuction, and epidural and subarachnoid administration for abdominal and lower extremity surgery. LA administration may be either the sole analgesic employed, or may be combined as an adjunct with general anesthesia. However, local anesthetics are not innocuous and serious central nervous system (CNS) and cardiovascular toxicity can result in seizures, cardiovascular collapse and death. Antiarrhythmic levels of lidocaine® range from 2-5 mcg/ml and toxic effects are well-established in the 6-10 mcg/ml range; however, the same relationship is less well understood for bupivacaine, and evaluation of blood levels for mixed lidocaine®/bupivacaine toxicity is poorly understood as evidenced by the following case report.

Facts of the case: RB was a 60-year-old female in good general health who underwent facial cosmetic surgery and subsequently died from cardiorespiratory collapse. She had been diagnosed with depression and was taking Fluoxetine (Prozac®) and no other medications. The medical examiner's report stated the following: The intubation went smoothly and she was initially stable from a cardiovascular point of view. About five minutes into the anesthesia a local anesthetic consisting of lidocaine, bupivacaine and epinephrine was injected beneath the skin of the face and scalp. She began to demonstrate cardiovascular instability …. Heart rate decreased to the 30s and CPR was begun with return of pulse and blood pressure. She again deteriorated and was transferred by paramedics to the ER…. Her condition gradually deteriorated to anoxic encephalopathy and she was pronounced dead approximately seven hours after the initial cardiovascular collapse. Toxicology ante- and postmortem lidocaine® and bupivacaine blood levels were:

Time	Ante-Mortem Blood Concentrations (mcg/ml)		Post-Mortem Blood Concentrations (mcg/ml)	
	Lidocaine®	Bupivacaine	Lidocaine®	Bupivacaine
9:50 a.m.	3.1	0.9		
10:34 a.m.	4.5	2.0		
4:27 p.m.		DEATH		
At autopsy: (46 hours after death)			5.3	3.3

Injection sites were identified as follows: "On the midline upper forehead just below the hairline is a punctuate mark representing a needle puncture. A second punctuate mark is present on the left lower forehead just above the lateral end of the left eyebrow. A third punctuate mark is noted on the left upper lateral cheek just lateral to the lateral angle of the left eye. Fourth and fifth punctures are noted on the lateral aspect of the right eye…. A ½ inch area of subcutaneous hemorrhage is present about the lower of the two puncture marks near the lateral angle of the right eye." The Medical Examiner also offered the following interpretation in his report, "Lidocaine® and bupivacaine levels are within the range previously documented following clinical administration. The actual mechanism of her cardiorespiratory collapse is unknown."

Benjamin G. Covino, MD, PhD, was Professor of Anesthesiology at Harvard Medical School and Vice-President of Astra Pharmaceuticals, (a company that marketed lidocaine® and bupivacaine) from the mid-1960s through the 1980s and was an internationally-respected expert in local anesthesia pharmacology and toxicology. Dr. Covino recognized that bupivacaine was four times as potent as lidocaine® and that toxic blood levels of lidocaine® ranged from 6-10 mcg/ml while those of bupivacaine ranged from 1.5-2.5 mcg/ml. Dr. Covino was also the first investigator to convert blood levels of bupivacaine to "lidocaine® equivalents" by multiplying the bupivacaine blood level by four and adding that number to the blood level of lidocaine® to obtain the combined blood level of both local anesthetic agents in "lidocaine® equivalents". Applying the "Covino Algorithm" to the above data, at 9:50 am, a lidocaine® equivalent level of 6.7 and at 10:34 am, a lidocaine® equivalent level of 12.5, well into the toxic cardiodepressant level, and rising. The rapid appearance of bradycardia most likely indicated an initial unintended intravascular administration followed by continuous absorption from the infiltrated region resulting in an additive toxic cardiovascular effect that was further compromised by poor management and hypoxemia, and resulted in the death of a patient.

Lidocaine®, Bupivacaine, Additive Toxicity

K8 Distribution and Optical Purity of Methamphetamine Found in Toxic Concentration in a Civil Aviation Accident Pilot Fatality

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The authors will present toxicological findings of a pilot fatality involved in a unique methamphetamine-related civil aviation accident to aid investigations of such accidents.

This presentation will provide information on the distribution of methamphetamine present in toxic concentration and the stereoselective analysis of this amine in biological samples.

The Federal Aviation Administration's Civil Aerospace Medical Institute conducts toxicological evaluation of postmortem biological samples collected from pilots involved in fatal civil aircraft accidents. The submitted samples are primarily analyzed for the presence of primary combustion gases, alcohol/volatiles, and drugs. Related to such an evaluation, findings of a unique aircraft accident are described in this report. Upon colliding with terrain in weather conditions of poor visibility, a 1-occupant airplane was substantially damaged with no evidence of fire. Remains of the pilot were found outside the crashed aircraft. Pathological examination of the pilot's body revealed multiple blunt force injuries and vascular congestion, including subdural hemorrhage of the cerebral cortex. Autopsied samples—blood, brain, gastric contents, heart, liver, muscle, spleen, urine, and vitreous fluid—were submitted for toxicological analysis. The fluorescence polarization immunoassay disclosed the presence of 8.0 µg/mL amphetamines in urine. Subsequent gas chromatographic/mass spectrometric confirmatory analysis determined the presence of methamphetamine (1.134 µg/mL in blood and 59.171 µg/mL in urine) and amphetamine (0.022 µg/mL in blood and 1.495 µg/mL in urine). Both amines were present in all the submitted sample types, except for amphetamine, which was detected neither in vitreous fluid nor in muscle. The amount of methamphetamine found in gastric contents was 575-fold higher than that of amphetamine. Stereochemical analyses of gastric contents, blood, and urine using a chiral probe, (S)-(–)-N-(trifluoroacetyl)prolyl chloride, indicated that methamphetamine detected in the sample types was not optically pure. In gastric contents and urine, this secondary amine's optical isomers were present in equal proportions. The enantiomeric excess of (+)-methamphetamine over its (–)-form was about 32% in blood. Both optical forms of amphetamine were present in the ratio of 1.2–1.5:1.0 in the 3 sample types. The blood methamphetamine concentration found was in the range sufficient to produce toxic effects, including performance impairment. The observed variation in the ratios of amine isomer concentrations in the sample types would have been attributed to stereoselective metabolic and other pharmacokinetic processes. Findings of this study supported the conclusion of the National Transportation Safety Board that, in addition to the visibility-associated adverse meteorological conditions, the use of the controlled substance played a contributory role in the causation of the aircraft accident.

Forensic Toxicology, Methamphetamine, Stereochemical Analyses

K9 An Analytical Protocol for the Identification of Sildenafil (Viagra®) in Specimens Commonly Submitted to the Toxicology or Analytical Laboratory

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Attendance at this presentation will enable the participant to learn a new analytical protocol for the determination of sildenafil (Viagra®) in specimens commonly submitted to the toxicology or analytical laboratory such as clinical biological specimens or tablets suspected to contain this substance.

As licit and illicit sildenafil use is on the increase due the ease with which this substance may be purchased via the internet, it is important for laboratories to have methods for its detection in unknown tablets or in biological specimens of those suspected or known to be using it for recreational or therapeutic purposes. This paper's contribution to the forensic community is that it offers a variety of analytical protocols for the identification of sildenafil.

Our Forensic Service offers a screening and quantification toxicology service to most of Her Majesty's Coroners and Forensic Pathologists in London as well as various Police Forces and one branch of the Armed Forces. As a result, we are required to screen for a large number of prescribed and illicit drugs in ante- and post-mortem specimens followed by quantification of those detected. All analyses must be completed and our final report must be submitted to the Courts within 15 business days of the arrival of the case at the Service. In addition, we provide a tablet and capsule identification service to national and international clients using the commercially available product, TICTAC (www.tictac.org).

The methodology developed involves the detection of sildenafil in unknown tablets confiscated by the Police, purchased on the Internet or voluntarily surrendered by the public. Methods used included thin layer chromatography (TLC), UV-Visible spectrophotometry, gas chromatography – mass spectrometry (GC-MS) and high performance liquid chromatography – tandem mass spectrometry (HPLC-MS-MS). Each unknown tablet was weighed and approximately 10mg were removed from its core, dissolved in 10mL of methanol or 10mL of deionized water and sonicated for 45 minutes in an appropriately-labeled glass tube. The methanolic tablet mixture was centrifuged and approximately 10µL of the supernatant were spotted onto a silica bonded TLC plate alongside a standard mixture containing five standards (amitryptiline, dextropropoxyphene, methaqualone, morphine and nicotine) and a known positive sildenafil control prepared using the pure analyte of interest generously provided by the drug manufacturer, Pfizer Ltd. The TLC mobile phase consisted of methanol and ammonia (v/v 100:0.5). The developed plates were visualized under UV illumination and spots including those of the known and suspected sildenafil fluoresced. After spraying the developed plate with neutral and acidic iodoplatinate reagent, sildenafil produced a visible strong purple and brown colored spot, respectively. The response factor, Rf, for sildenafil was 0.66 whereas those for methaqualone, dextropropoxyphene, nicotine, amitriptyline and morphine were 0.85, 0.69, 0.58, 0.48 and 0.36, respectively. Each aqueous tablet mixture was adjusted to acidic or alkaline pH and subjected to UV-Visible spectrophotometry from 400 to 190nm. Very characteristic spectra were produced with strong absorbances noted at 290nm and 210nm. 1mL of each methanolic tablet mixture was added to 1mL of methyl tert-butyl ether (MTBE) and 100µL of internal standard (quinoline, pyribenzamine, flurazepam, 1mg/mL, respectively), mixed, centrifuged and an aliquot of the resulting supernatant (1µL) was injected onto a GC-MS comprising of the HP 5890 GC coupled to an HP 5971 MS. The analytical column used was Solgel (30m x 0.25mm i.d., 0.25µm film thickness). The injector was maintained at 250°C, the detector was maintained at 280°C and the column temperature program started at 70°C for 4 min, ramped 40°C/min and held at 280°C for 50.75 minutes giving a total run time of 60 minutes. Each unknown tablet together with positive and negative controls was screened in full scan mode and sildenafil was identified by its retention time (R_t), which measured 48.5 minutes. Each methanolic tablet mixture was further diluted in 80% aqueous methanol to an approximate final concentration of 0.1mg/L and 20µL were injected onto an HPLC-MS-MS. The ions monitored were 472.9 and 281.9. The total run time per sample was 3.5 minutes with sildenafil eluting at 2.4 minutes. The analytical column used was a 15cm x 4.6mm i.d., Supercosil LC-18-DB (5µm particle size) ODS column maintained at 50ºC using a Perkin Elmer series 200 column oven. Isocratic solvent delivery was achieved using a Perkin Elmer series 200 pump set at 1mL/min. Sample injection, 20µL, was performed by a Perkin Elmer series 200 auto-injector. The mobile phase consisted of methanol/water (v/v 85:15) supplemented with ammonium acetate solution to achieve a final concentration of 2mmol/L. Detection was by tandem mass spectrometry (HPLC-MS-MS), using a Sciex API 2000 triple quadrupole mass spectrometer (Applied Biosystems). A turbo ion spray (heated electrospray) source heated to 300°C was used to introduce the sample into the mass spectrometer. A post-column splitter (10:1) was installed just before the ion spray interface. The mass spectrometer was operated in positive ionization, multiple reaction mode (MRM, MS-MS), with the resolution set to unit resolution (± 0.5m/z). High purity air was used as the nebulizer gas and high purity nitrogen as the collision gas. The Applied Biosystems Sciex Analyst software was used to control the HPLC-MS-MS, record the output from the detector, integrate and calculate peak areas. In assays requiring quantification, the Analyst software was used to calculate the peak area ratios, produce the calibration line using $1/x^2$ weighed through zero regression and to calculate the concentration of sildenafil.

Finally, the HPLC-MS-MS analytical protocol was successfully used to screen post-mortem human blood from cases in which sildenafil was suspected to be involved. To compensate for the lack of a suitable internal standard, analytical standards were prepared and analyzed in duplicate in deionized water and added to 100µL of sildenafil-free human blood. 100µL of the case blood specimen were added to 100µL of deionized water. 250µL of phosphate buffer (pH 7.0) and 1mL of MTBE were added to the case specimen and standards. The solutions were then mixed for 5 minutes and centrifuged at 3500rpm for 5 minutes. The supernatant for each tube was collected and evaporated to dryness using a Savant SpeedVac SC200 coupled to a Savant RT4104 refrigerated condensation trap. The residue was then reconstituted in 250µL of 80% aqueous methanol, vortex mixed for 30 seconds and injected onto the HPLC-MS-MS using the analytical protocol described above.

As licit and illicit sildenafil use is on the increase due the ease with which this substance may be purchased via the Internet, it is important for laboratories to have methods for its detection in unknown tablets or in biological specimens of those suspected or known to be using it for recreational or therapeutic purposes.

Sildenafil, Viagra®, Identification

K10 Determination of Opiates (Morphine) in Postmortem Bone Marrow and Comparison With Blood Morphine Concentrations

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After attending this presentation, attendees will know how long after a body postmortem buried could be analyzed for opiates.

The aim of this presentation is to predict how long after a body postmortem buried could be analyzed for opiates. In sudden, unexpected deaths, traumatic or pathologic mechanism must be excluded as possible causes of death and selection and preservation of appropriate specimens for toxicologic analyzes is very important. For toxicologic analyses generally used specimens are blood and urine. Frequently forensic toxicologist is faced with situations in which contamination and decomposition make the collection of blood samples impossible for suitable analytical purposes.

Material and Method: In such cases, to prove the viability of bone marrow analyzes, to 9 albino rabbits were injected morphine into the marginal ear vein in 0.1 mg/kg increased doses from 0,3 gram/kg for each rabbit. One hour after dosing, the rabbits were sacrificed and blood, urine and bone marrow samples were collected for analyzes. The whole body with other extremities bones were buried. At the seventh and fourteenth day, the bones were excavated and bone marrow specimens were collected. CEDIA® technology was used for the analysis.

Results and conclusion: It was demonstrated that an increase in the given total morphine dose and morphine dose per kilogram of cases, an increase blood morphine concentration also occurred. In urine samples, high morphine doses were detected. There were no quantitative linear relationship between the concentration of morphine in urine and blood. In comparison of blood morphine concentration to postmortem [immediately collected] bone marrow morphine concentration, there were statistically meaningful increase in bone marrow morphine concentrations with increasing of blood morphine concentration. Also the increasing of blood morphine concentration was correlated with postmortem seventh and fourteenth day bone marrow morphine concentrations. Morphine concentration seventh and fourteenth day bone marrow decreased relative to the postmortem [immediately collected] bone marrow morphine concentrations.

In drug related sudden deaths. Drugs cannot be determined in resistant tissues like hair and in cases of contamination and decomposition exclude the collection of blood or in skeletal remains, bone marrow may be the most available evidence. It's concluded that further experimental research in this area should be useful and indispensable for forensic toxicology.

Postmortem, Bone Marrow, Opiates

K11 Improving Data Collection Procedures for the Fatal Analysis Reporting System (FARS)

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Participants will learn about 1) the data contained in the FARS (Fatal Analysis Reporting System) database and how to access the data online, 2) how the data is collected and analyzed, and 3) what measures can be implemented to improve the data collection process.

The National Highway Traffic Safety Administration (NHTSA) has collected extensive data associated with fatal traffic accidents in the FARS database since 1975. Over 100 data elements are coded from sources including the police accident reports, death certificates, EMS reports, and coroner/medical examiner reports. Data is collected from the 50 states, the District of Columbia, and Puerto Rico by FARS analysts who code and transmit the data, in a standard format, to the National Center for Statistics and Analysis. The FARS database can be accessed at www-fars.nhtsa.org.

Toxicological data in the database consists of quantitative alcohol results and qualitative results for drugs other than alcohol. Based on the data submitted, estimates are made of the number of alcohol involved fatal traffic accidents for the nation, and on a state-by-state basis. Data submission rates vary significantly from state to state. In 2001, 16,653 fatally injured drivers nationwide had blood alcohol concentration (BAC) results reported to FARS out of a total of 25,840, or 64%. However, only 33 percent of the fatally injured drivers in Texas had BAC results reported compared to 81 percent reported in California.

An informal poll of medical examiner toxicologists indicates the problem is not a lack of testing for alcohol in deceased drivers. Most medical examiner offices test all drivers involved in a fatal traffic accident for alcohol. The poll did indicate most offices are not aware of the FARS database and the need to provide toxicological test results. An electronic data transfer system for submitting data directly from the forensic toxicology laboratory to the Texas Department of Public Safety and the FARS data collection analysts will be presented.

FARS, Traffic, Toxicology

K12 Rapid Blood Alcohol Analysis With a New Automated Headspace-Gas Chromatographic System

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After attending this presentation, attendees will have knowledge of state-of-the-art hardware and methods for performing high throughput blood alcohol analyses.

The determination of blood alcohol levels is one of the most frequent analyses performed in forensic toxicology laboratories. In particular, results by gas chromatography are widely respected by the courts.

A new automated 70-sample headspace sampler has been developed utilizing an inert flow path for improved sample repeatability, accuracy, and reduced carryover. These and other improvements in the headspace hardware reduce the frequency of calibration and performance check samples. High sample throughput is possible with the combination of optimized sample heating overlap and new capillary columns developed for rapid separation. Complete GC blood alcohol analysis in under 4 minutes with cycle times of less than 7 minutes are achieved while maintaining baseline separation of methanol, ethanol, isopropanol, n-propanol, and n-butanol. Additionally, the system will resolve many other common interferents like acetaldehyde and acetone.

Headspace control software will be described that integrates headspace parameters and sequencing into the chromatographic data system. Detailed information on sample vial number and result logging essential for proper tracking of samples is included.

Blood Alcohol, Headspace, Gas Chromatography

K13 Laboratory Analysis of Remotely Collected Oral Fluid Specimens for Ethanol by Enzymatic Assay

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Currently, the drugs of abuse that are available from Orasure Technologies, Inc. for testing with the microplate ELISA assays do not include ethanol, which is one of the most abused drugs. This poster describes an enzymatic assay for ethanol that can be performed in a 96 well microplate which can be analyzed using the same equipment used for the analysis of the other drugs of abuse by ELISA.

This should enable laboratories to analyze ethanol in a 96 well plate format along with the other Intercept microplate assays to improve throughput and decrease sample handling, thereby decreasing chances of error.

The performance characteristics of this method for detecting ethanol in oral fluid specimens using a qualitative, enzymatic assay were examined. The assay uses oral fluid which is obtained using the Intercept® DOA Oral Specimen Collection device. The Intercept® DOA Oral Specimen Collection device utilizes a collection pad which collects approximately 0.4mL of oral fluid. The collection pad is then placed in a vial containing 0.8mL of a buffered preservative solution, which is then shipped to the laboratory for analysis. The laboratory then centrifuges the device to collect the diluted oral fluid mixture. Sample from the device is added to a blank 96 well plate and the plate is read at 340nm for a background reading. This background is performed before the addition of the ethanol reagent since other prescription medications absorb at the same wavelength, which could interfere with the assay. Ethanol reagent, which consists of NAD and ADH, is then added to the plate and the plate is read again at 340nm. The resultant reaction causes a change in absorbance, which is directly proportional to the amount of alcohol present.

Both positive and negative specimens were collected from 560 patients in a Methadone treatment clinic and tested in the ethanol microplate assay using a cutoff of 2.5mg/dL. Ethanol analysis was then performed by Headspace GC/FID (Gas Chromatography/Flame Ionization Detection) using a cutoff of 2.5mg/dL.

The enzymatic assay was tested for precision, stability of the sample, stability of the ethanol reagent and the effects of potential cross-reactants. The total precision for 5 consecutive days of testing yielded CV's less than 10%. The assay was tested and compared against the following possible cross-reacting alcohols: n-butanol, isopropanol, methanol, ethylene glycol, and acetone. The following adulterants were also tested for interference with the assay: sugar water, toothpaste, antacid, antiseptic, cola, and cranberry juice.

Of the 560 patients tested, 19 were positive by both the enzymatic assay and GC/FID. The range of positive results was 2.9 to 150mg/dL of diluted oral fluid sample. The results would need to be multiplied by three to correct for the dilution of the oral fluid in the collection device. The results yielded 99.3% agreement between the enzymatic assay and GC/FID using a cutoff of 2.5mg/dL of diluted oral fluid for both methods.

Oral Fluids, Ethanol, Intercept

K14 Postmortem Redistribution: Practical Considerations in Death Investigation

Bradford R. Hepler, PhD, Daniel S. Isenschmid, PhD, and Carl J. Schmidt, MD, Wayne County Medical Examiner's Office, 1300 East Warren Avenue, Detroit, MI 48207-1051*

After attending this presentation, the attendee will be able to appreciate issues of postmortem redistribution and how practical accounting for this phenomena is of value in death investigation. Use of heart and peripheral (femoral) blood findings along with background investigation and prompt case disposition facilitates interpretation of cause and manner of death. These postmortem case finding considerations allow practical insights into understanding the impact of drug redistribution in interpretation of cause and manner of death.

Postmortem redistribution (PMR) of drugs in heart blood samples has been an ongoing subject of debate in interpretation of cause and manner of death (COD, MOD). The phenomenon's origins through drug redistribution along significant concentration gradients, release from protein bound sights, movement of drug due to decomposition bacterial activity and traumatic contamination is the subject of a large number of research papers. Drug redistribution occurs to the greatest extent in the initial 24 hours following death, and refrigeration with facilitated case disposition will retard the process. Arguably, the importance of the size and extent that redistribution plays in interpreting postmortem findings in routine medical examiner cases remains a topic of debate.

The Wayne County Medical Examiner's office (WCMEO) has an annual caseload of 2,900-3,300 cases. The large majority of cases arrives at the office within 24 hours of being reported and is placed into refrigerated storage. Toxicology studies on this population have demonstrated an incidence of up to 15% of death either directly or indirectly due the presence of drugs in the general population and up to 54% in the pended case population (Table 1).

Table 1: WCMEO Drug Related Fatalities 1998-2002

YEAR	# DRUG DEATH CASES	# PENDING CASES (%) DRUG DEATH	#TOTAL CASES (%) DRUG DEATH
1998	370	692 (53.4)	2924 (12.6)
1999	404	831 (48.6)	3288 (12.2)
2000	495	916 (54.0)	3306 (14.9)
2001	470	990 (47.4)	3263 (14.4)
2002	466	1089 (42.8)	3178 (14.7)

Practical considerations of case history, time of death, time of arrival at the Medical Examiner's office, comparison to reference data, and a consistent system of collection, storage and analysis protocols, can lead to a reasoned and meaningful assessment of postmortem drug findings. Tabulation of over 5 years of analysis data of comparative heart blood and femoral blood data for 50 drug analytes are presented on Table 2. These data are presented as a function of drug Vd heart blood (B1)/ peripheral blood (B2) average ratio, median ratio, SD, and ratio range for cases of an "n" of 4 or greater. Heart bloods were collected primarily from the left side of the intact heart by needle puncture. Peripheral blood samples, 6.93 mL (+/- 4.24 mL SD) were collected from non-ligated femoral veins 96.2% of the time with the remaining samples collected from a subclavian or a non-specified "peripheral" site.

Table 2: Tabulation of Postmortem Redistribution Ratios for Heart and Femoral Blood Concentrations

DRUG	Vda L/kg	n	B1/B2b Ratio Average	B1/B2b Ratio Median	SD[c]	B1/B2[b] Ratio Range Low	B1/B2[b] Ratio Range High
Acetaminophen	0.8-1.0	16	1.083	1.037	0.345	0.693	1.987
Alprazolam	0.9-1.3	9	0.898	0.930	0.230	0.519	1.273
Amitriptyline	6-10	52	1.982	1.408	1.880	0.273	9.885
Benztropine	NAd	11	2.490	1.231	2.484	0.600	7.667
Bupropion	40	7	1.033	0.652	0.956	0.375	3.099
Carbamazepine	0.8-1.8	4	0.969	1.003	0.144	0.782	1.088
Chlorpheniramine	5.9	6	1.171	1.159	0.518	0.560	1.880
Chlorpromazine	10-35	6	1.968	0.946	2.564	0.762	7.193
Citalopram	12-16	10	2.492	1.536	2.908	0.727	10.400
Clozapine	2-7	10	1.684	0.991	2.227	0.753	8.000
Codeine	3.5	21	1.385	1.243	0.852	0.064	3.750
Cyclobenzaprine	NA	8	1.220	1.192	0.523	0.500	2.056
Desipramine	22-59	5	2.795	1.410	2.871	0.929	7.727
Desmethyldiazepam	NA	45	1.268	1.250	0.449	0.288	2.308
Dextromethorphan	255-316	11	1.721	1.694	0.856	0.105	3.158
Diazepam	0.7-2.6	38	1.299	1.235	0.533	0.331	3.053
Diltiazem	3-13	9	3.271	1.515	5.302	0.879	17.333
Diphenhydramine	3-4	48	1.956	1.536	1.487	0.356	8.200
Doxepin	9-33	22	1.604	1.258	0.939	0.612	3.300
Doxylamine	2.7	6	3.808	1.877	4.764	0.625	13.333
EDDP (Meth. Mtb.)	NA	4	0.686	0.540	0.433	0.351	1.313
Fluoxetine	20-42	21	2.395	1.379	1.917	0.586	5.909
Hydrocodone	3.3-4.7	20	1.580	1.275	0.824	0.576	3.646
Hydroxyzine	13-31	4	1.018	1.066	0.416	0.481	1.459
Meperidine	3.7-4.2	4	2.537	1.739	1.877	1.360	5.313
Mesoridazine	3-6	6	1.508	1.581	0.622	0.704	2.222
Methadone	4-5	53	1.684	1.290	1.113	0.327	5.185
Mirtazepine	10-14	4	1.064	1.125	0.612	0.269	1.737
Morphine	2-5	24	1.231	1.155	0.580	0.045	2.846
Nicotine	1.0	41	1.363	1.200	0.749	0.157	3.846
Norclozapine	NA	5	1.116	1.123	0.239	0.847	1.429
Nordoxepin	NA	20	2.720	1.967	2.204	0.280	7.400
Norfluoxetine	NA	7	2.751	1.500	2.034	1.000	5.550
Norsertraline	NA	16	2.092	1.673	1.505	0.241	5.263
Nortriptyline	20-57	43	2.152	1.235	1.896	0.196	9.600
Olanzapine	10-20	22	1.902	1.540	1.120	0.360	5.357
Orphenadrine	4.3-7.8	5	2.308	1.688	1.654	1.143	5.158
Oxycodone	1.8-3.7	4	2.196	2.203	1.031	1.200	3.167
Paroxetine	3-28	24	2.993	1.829	2.889	0.292	10.278
Phentermine	3-4	7	1.887	1.857	1.103	0.720	3.898
Promethazine	9-19	4	1.215	0.747	1.168	0.430	2.938
Propoxyphene	12-36	62	1.622	1.211	1.095	0.365	4.571
Salicylate	0.15-0.20	4	1.058	0.882	0.395	0.821	1.646
Sertraline	76	16	2.452	1.407	2.433	0.415	9.167
Thioridazine	18	5	1.277	1.111	0.713	0.600	2.130
Tramadol	2.6-2.9	9	1.358	1.431	0.465	0.556	2.107
Trazodone	0.9-1.5	14	1.535	1.182	1.095	0.583	4.800
Venlaflaxine	4-12	6	1.506	1.495	0.403	0.864	2.071
Verapamil	2.5-6.5	4	1.595	1.440	0.707	1.000	2.500
Zolpidem	0.5-0.7	8	1.474	1.452	0.337	1.056	2.000

a Vd = Volume of distribution values taken from Randall C. Baselt, "Disposition of Toxic Drugs and Chemical in Man", 6th Edition Biomedical Publications 2002. b B1 = Heart Blood Sample; B2 = Peripheral (Femoral) Blood Sample. c SD = Standard Deviation. d NA = Not Available.

These data indicate that despite size of Vd, under the conditions of case disposition for WCMEO, some drug analytes tend towards redistribution (e.g. amitriptyline, citalopram, doxylamine, paroxetine) while others do not (e.g., acetaminophen, alprazolam, hydroxyzine, mirtazepine,). When individual case tabulations are considered, in all categories PMR may or may not be a factor in cause and manner of death. Full tabulations of all cases for each analyte with COD and MOD will be presented.

Conclusions drawn from this survey indicated that in all cases where borderline drug toxicity is an issue in COD and MOD of death, it is essential to account for PMR. These data also suggest that when actual concentrations are excessively high or low, regardless of PMR, the interpretation of drug involvement or lack thereof in COD and MOD does not change.

Postmortem Redistribution, Postmortem Release, Multi-site Testing

K15 Postmortem Production of Ethanol in Different Tissues Under Controlled Experimental Conditions

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After attending this presentation, attendees would be able to establish the level of postmortem ethanol (produced after death) under controlled experimental conditions within different time intervals and under different temperature.

The authors would like to see the results from this survey considered as a basis for further investigations with crucial aim that is very important in forensic practice - to distinguish postmortem (endogenous) production of ethanol versus ethanol ingestion before death (exogenous one).

There is the assumption that postmortem production of ethanol is in accordance with temperature increase, duration of time interval, and amount of carbohydrates in the tissue.

All the activities of this survey were performed at the Department of Forensic Medicine, Clinical Center Novi Sad, on the corpses of persons of both sexes, aged between 20 and 50 years, whose death occurred 6-12 hours before autopsy, i.e., taking the specimen. The death of the persons whose corpses were used for the analyses was of natural or violent origin and it excluded medical interventions (treatment and death in the hospital, or other medical institution), and the violent deaths caused by toxic substances. The specimen of blood, liver, skeletal muscle and kidney were taken from 30 corpses and were divided into 2 control and 3 experimental groups. The first control group of specimen was analyzed immediately after taking, and the second control group of specimen was stored at the temperature of – 20 ºC. The first experimental group of specimen was stored at the temperature of + 4 ºC, the second at +20 ºC, and the third one at +30 ºC. All experimental groups were divided into four subgroups, according to the duration of incubation at given temperature: the first subgroup was stored at appropriate temperature for 24 hours, the second for 48 hours, the third for 96 hours and fourth one, for 192 hours. Chemical ethanol analysis of the taken specimen was performed by standard gas-chromatography method.

The results show that all of the control specimen stored at -20 ºC do not show any change in ethanol quantity, in all time intervals. There is no statistical significance of ethanol quantity change remarked in any tissue stored at +4 ºC at any time interval. At the temperature of +20 ºC, all tissues, except blood, show statistically significant ethanol quantity change referring to time intervals, comparing with controls. The postmortem production of ethanol at +30 ºC is increased due to the course of time, in all tissues. Statistically significant ethanol quantity change appears on the 1st day (kidney, muscle and liver tissue) and 2nd day (blood) at +30 ºC, while at +20 ºC it appears predominantly on the 2nd day (kidney, liver and muscle tissue). Significant increase of produced ethanol in liver, kidney and muscle tissue at +30 ºC is noted up to particular time interval (liver – 4th, kidney and blood – 2nd, muscle 1st day), after which these levels are mildly decreased without statistical significance, except in blood tissue, where the significant decrease was found. The absolute range of produced ethanol reaches the highest level in liver tissue.

On the basis of the results gained during this survey, we can confirm the assumptions as follows: 1. the postmortem production of ethanol occurs and it varies in different tissues; 2. postmortem production of ethanol is increased by rise in temperature; 3. postmortem production of ethanol depends on the tissue amount of carbohydrates (liver – glycogen); 4. postmortem production of ethanol is increased, in general, in accordance with the course of time. It is observed, too, that postmortem production of ethanol is increased up to particular time interval at +30 ºC, after which the values of measured ethanol are mildly decreased.

Postmortem Production, Ethanol, Experimental Conditions

K16 The Measurement of Uncertainty for Toluene Analysis in Biological Fluids by HS-GC

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After attending this presentation, attendees will understand the uncertainty estimation process and to validate the method in forensic field.

Toluene has been widely used as an industrial solvent. Sniffing of thinners or adhesives containing toluene, which is illegal in Korea, is known to occur. The determination of toluene level in biological fluids such as blood and urine is a powerful tool for monitoring toluene exposure and for evaluation of toluene inhalation. The aim of this work was to validate the method of toluene determination and obtain the uncertainty estimate around cut-off level. The chromatographic conditions of the method employ an HP INNOwax capillary column (30m x 0.25mm, film thickness 0.25um), programmed condition (60 ºC(6min), 10 ºC/min, 140 ºC(3min)) with He at a column flow of 1.0ml/min, injector and detector temperature at 240 ºC, a split ratio of 30:1. Sealed sample vials containing biological sample 1ml, buffer 2ml and isobutanol 50ul as an internal standard were heated at 60 ºC for 20 minutes in headspace autosampler and injected into GC with FID. The linearity of the toluene peak area responses was demonstrated from 0.05ppm to 100ppm. Repeatability and reproducibility of the toluene peak area responses showed R.S.D. of 3.6% and 4.6 %, respectively. The limits of detection and quantitation were determined to be 0.01ug/mL and 0.02ug/mL in water and 0.02ug/mL and 0.05ug/mL in urine, respectively. The other parameters such as selectivity, sensitivity, accuracy and recovery were also examined. The measurement uncertainty for toluene analysis was estimated from experimental results. We determined 0.068ug/mL as the uncertainty for cut-off level, 0.1ug/mL.

Toluene, Uncertainty, Validation

K17 Comparison of Calibration Approaches for the Quantitative GC/MS Analysis on Secobarbital

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After attending this presentation, attendees will be familiar with the characteristics of the calibration curves resulting from the use of isotopic analogs of the analyte as the internal standards (ISs). Specific parameters studied include (a) ion cross-contribution and (b) column temperature programming conditions that may affect the use of calibration approaches.

This study was placed on practically evaluating the calibration approach by using ^{2}H- and ^{13}C-analogs as ISs for the quantitative determination by GC/MS in urine. An automatic well-established solid-phase extraction and methylation procedures were used prior to the GC/MS measurement. The cross-contribution of ions designated for the analyte and its IS were evaluated by the "direct normalized measurement" method through selected ion monitoring (SIM) mode. The spiked IS magnitude and reconstitute volume were also evaluated for the appro-

priate GC/MS determination at low concentration level. To decrease the cross-contribution, 50 ng/mL $^{2}H_5$-analog and 25 ng/mL $^{13}C_4$-analog ISs were respectively added into each standard solution. One-point, linear, hyperbolic and polynomial calibration approaches were used to investigate the quantitative effectiveness based on the comparison of theoretical and observed concentrations of standard solutions containing 10 to 800 ng/mL secobarbital. Two GC column temperature programming conditions, 20 ºC high ramp rate and 2 ºC low ramp rate, were adopted to generate different degrees of peak-overlap and ion cross-contribution for the purpose of evaluating the most appropriate application for each calibration approach.

Ion cross-contribution and the "over-all non-proportional change in ionization efficiency" phenomenon have been regarded as the underlying causes to change the theoretical analyte/IS ratios. Data shown in Table 1 indicate that cross-contribution deriving from IS to the analyte leads to the positive observed concentration at low concentration levels by one-point calibration. This phenomenon obviously shows that 13 % m/z 195 ion contributed from IS generates higher observed concentration values at low concentration levels than that of 1.9 % m/z 196 ion. Thus, the ion-pair with the less amount of ion cross-contribution should be the most appropriate candidate for the quantitation by using the one-point calibration approach. This trend also reveals that the more intensity of ion-pair ratios resulting from ion cross-contribution increases, the more peak-overlapping under 20 ºC high ramp rate does as well. The ratios at low concentration levels become farther to the "expected" values based on the ion cross-contribution resulting from the IS. Temperature programming is the other interference factor in the quantitative determination by one-point calibration. To determine the lower concentration levels, the lower ramp rate is a better temperature programming. The deviation obtained in comparison the theoretical with the observed concentration in standard solutions at low concentration levels by linear calibration was obviously lower than that by one-point approach. Some figures even reduce to negatives. This trend presents that ion cross-contribution generating higher ion-pair ratios at low concentration levels can be adjusted based on the lower ion-pair ratios deriving from the "non-proportional over-all change in ionization efficiency" phenomenon at high concentration levels. Thus, the linearity of the calibration curve increases, especially at low concentration range. Due to the slight increase of ion cross-contribution along with the increasing peak-overlap, the temperature programming with high ramp rate will also bring about the higher observed concentration by linear calibration at low concentration levels Quantitation results using hyperbolic calibration show the different phenomenon. The ion-pair with the higher ion cross-contribution leads to the lower observed concentration and deviation. This trend indicates that the characteristic of the hyperbolic curve is suitable for standard solutions with the higher ion cross-contribution. Thus, the quantitative effectiveness for low concentration levels using high ramp rate are better than those using low ramp rate on GC temperature program. Resulting data using polynomial calibration demonstrate that all of ion-pairs generate ideal quantitation without interference caused by ion cross-contribution and GC temperature programming. Polynomial curves can appropriately fit in ion-pair ratio of each standard solution. The only defect is the complicated procedure used to solve the equations obtaining from polynomial regression.

Ion cross-contribution is the underlying cause to interfere with the quantitative determination by one-point and linear approaches at low concentration range. This situation can be improved by GC temperature programming. On the contrary, hyperbolic calibration can be used for the ion-pair containing high ion cross- contribution. Polynomial calibration is an ideal approach because there is no need to select an ion-pair via the time-consuming evaluation.

Table 1. Comparison of quantitation results using different ion pairs and calibration approaches—
Analyte/IS: Secobarbital/$^{2}H_5$-analog.

Ion-pair§ m/z	Temp. Program	Theor. Conc. ng/mL	Ion Ratio	Obs'ed conc. Dev.% by One Point	Obs'ed conc. Dev.% by Linear	Obs'ed conc. Dev.% by Hyperbolic	Obs'ed conc. Dev.% by Polynomial
196/201	2 ºC ramp rate	10	0.1909	9.843(-1.6)	9.610(-3.9)	7.654(-23.5)	9.859(-1.4)
		20	0.4016	20.71(3.5)	20.36(1.8)	18.74(-6.3)	20.12(0.6)
		50	0.9697	Calibrator	49.35(-1.3)	48.59(-2.8)	48.09(-3.8)
		100	2.070	106.8(6.8)	105.5(5.5)	106.2(6.2)	103.4(3.4)
		200	3.895	200.8(0.4)	198.6(-0.7)	201.2(0.6)	197.9(-1.1)
		400	7.702	397.1(-0.7)	392.8(-1.8)	397.1(-0.7)	400.6(0.1)
		800	15.73	810.9(1.4)	802.3(0.3)	800.5(0.1)	797.8(-0.3)
	20 ºC ramp rate	10	0.2206	11.16(11.6)	10.57(5.7)	9.232(-7.7)	10.44(4.4)
		20	0.4036	20.42(2.1)	20.06(0.3)	18.92(-5.4)	19.72(-1.4)
		50	0.9884	Calibrator	50.36(0.7)	49.83(-0.3)	49.56(-0.9)
		100	1.974	99.84(-0.2)	101.4(1.4)	101.8(1.8)	100.4(0.4)
		200	3.877	196.1(-1.9)	200.0(0.0)	201.8(0.9)	199.9(-0.0)
		400	7.645	386.7(-3.3)	395.2(-1.2)	398.1(-0.5)	399.9(-0.0)
		800	15.49	783.7(-2.0)	801.8(0.2)	800.3(0.0)	801.0(0.1)
195/200	2 ºC ramp rate	10	0.4298	13.18(31.8)	8.568(-14.3)	7.971(-20.3)	9.968(-0.3)
		20	0.7075	21.70(8.5)	18.01(-9.9)	17.50(-12.5)	18.86(-5.7)
		50	1.631	Calibrator	49.41(-1.2)	49.17(-1.7)	48.72(-2.6)
		100	3.347	102.6(2.6)	107.8(7.8)	108.0(8.0)	105.4(5.4)
		200	6.010	184.3(-7.8)	198.4(-0.8)	199.1(-0.4)	196.2(-1.9)
		400	11.84	362.9(-9.3)	396.5(-0.9)	397.7(-0.6)	401.8(0.5)
		800	23.73	727.8(-9.0)	801.2(0.1)	800.5(0.1)	802.4(0.3)
	20 ºCramp rate	10	0.7008	19.68(96.8)	12.28(22.8)	10.72(7.2)	11.40(14.0)
		20	0.9275	26.05(30.2)	20.18(0.9)	18.84(-5.8)	19.04(-4.8)
		50	1.780	Calibrator	49.90(-0.2)	49.32(-1.4)	47.98(-4.0)
		100	3.346	93.98(-6.0)	104.5(4.5)	105.1(5.1)	102.0(2.0)
		200	6.084	170.9(-14.6)	199.8(-0.1)	202.2(1.1)	198.8(-0.6)
		400	11.62	326.4(-18.4)	392.8(-1.8)	396.8(-0.8)	399.0(-0.3)
		800	23.35	655.7(-18.0)	801.3(0.2)	800.6(0.1)	798.9(-0.1)

§Ion cross-contribution–m/z: 196/201 (1.9 % contributed by IS; 0.33 % contributed by analyte); m/z 195/200 (13 % contributed by IS; 0.59 % contributed by analyte).

*Regression equations—For m/z 196/201: y=0.0196 x + 0.0025(r^2=0.9998) under 2 ºC ramp rate, y = 0.0193 x + 0.0165 (r^2=0.9999) under 20 ºC ramp rate; for m/z 195/200: y = 0.0294 x + 0.1779(r^2=0.9998) under 2 ºC ramp rate, y = 0.0286 x + 0.3719(r^2=0.9999) under 20 ºC ramp rate.

†Regression equations—For m/z 196/201: y = (2.3995 + x)/(-0.0020 x + 52.68) (r^2=0.9999) under 2 ºC ramp rate, y = (2.4480 + x)/(-0.0014 x + 52.97) (r^2=1.0000) under 20 ºC ramp rate; for m/z 195/ 200: y = (6.7870 + x)/(-0.0004 x + 34.34) (r^2=0.9998) under 2 ºC ramp rate, y = (14.383 + x)/(-0.0012 x + 35.84) (r^2=1.0000) under 20 ºC ramp rate.

‡Regression equations—For m/z 196/201: $y = 6x10^{-9}X^3-6x10^{-6}X^2+0.0207X-0.0126$ (r^2=1.0000) under 2 ºC ramp rate, $y = 3x10^{-9}X^3-3x10^{-6}X^2+0.0198X-0.0142$ (r^2=1.0000) under 20 ºC ramp rate; for m/z 195/200: $y = 8x10^{-9}X^3-9x10^{-6}X^2+0.0315X-0.1167$ (r^2=0.9999) under 2 ºC ramp rate, $y = 7x10^{-9}X^3-7x10^{-6}X^2+0.0299X-0.3608$ (r^2=1.0000) under 20 ºC ramp rate.

Calibration, GC/MS Analysis, Isotopic Analogs

K18 The Effects of pH on the Oxidation of Ephedrine and Phenylpropanolamine Using Sodium Periodate

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The attendees will better understand the impact that pH may have on the oxidation of ephedrine and phenylpropanolamine using sodium periodate.

The use of sodium periodate to chemically oxidize common over the counter amphetamine like substances such as ephedrine, and phenylpropanolamine has become an accepted practice in forensic urine drug testing environments. However, very little information is available as to the effect that pH has on the efficiency of this oxidative procedure. The purpose of this study was to evaluate the potential of the production of amphetamine and methamphetamine in the presence of high concentrations (3,000,000 ng/ml) of ephedrine and phenylpropanolamine. A saturated sodium periodate solution and sodium hydroxide solution are added to the urine sample containing the drug and deuterated internal standards. The pH of this oxidation step is between 11 and 13. In this study, the sodium periodate was also adjusted to pH 4.4, 5.2, 9.1 and 9.3. Samples were extracted using solid phase technology, and derivatized with MBTFA to form the TFA derivative. GC/MS analysis was conducted using electron impact ionization using three ions for the native compound and two ions for the deuterated internal standard. A single point calibrator at 500 ng/ml was used to establish both qualitative and quantitative results. No amphetamine or methamphetamine was detected at any of the pH levels evaluated. This data suggests that the oxidation of ephedrine and phenylpropanolamine at levels as high as 3,000,000 ng/ml by sodium periodate is effective when the pH is between 4.4 and 13.

pH, Ephedrine, Phenylpropanolamine

K19 The Validity of Surrogate Reporting of Substance Use

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After attending this presentation, attendees will have an understanding of evaluating the validity of surrogate reporting of substance use for the deceased.This study contribute to the understanding of factors involved in achieving high sensitivity and specificity of certain substances when contesting the validity of next-of-kin reporting versus toxicology reports.

Introduction: Collection of substance use information for those who died unexpectedly often rely on proxy respondents or toxicology reports. Past research have examined surrogate reporting about the deceased characteristics. However, the direct assessment of proxy reporting of substance use versus toxicology report were rarely investigated. The purpose of this study were: 1) to use toxicology report as a gold standard to evaluate the validity of proxy reporting of substance use, and 2) to identify which drug groups that are more likely to be accurately reported by the surrogate.

Methods: The data for this study were obtained from the 1993 National Mortality Followback Survey (NMFS) conducted by the National Center for Health Statistics, Centers for Disease Control and Prevention. With the permission from next-of-kin of the deceased, questionnaire data were linked to 3483 toxicology report collected from 1265 medical examiner/coroner offices. Ten items that asking the deceased substance use behavior were selected from questionnaire and compared with toxicology report. In the interview questionnaire, substances were grouped into nine drug categories : alcohol, pain killer, sedative, tranquilizer, antidepressant, stimulant, cocaine, marijuana, and methadone. Sensitivity and specificity test were used to evaluate the validity of next-of-kin reporting. We defined sensitivity is the toxicology report GC/MS confirm positive of a substance used and next-of-kin also reported yes to that substance for the deceased. Specificity is the toxicology report GC/MS confirm negative of a substance used and next-of-kin also reported no to that substance for the deceased.

Results and Discussion: The study results in the table below demonstrated that methadone and painkillers such as morphine, codeine and propoxyphene had 100% sensitivity. High sensitivity reflects that immunoassay procedures and confirmation techniques for these two categories of substance that were well developed and routinely executed for their identification in the laboratory. However, the sensitivity for other categories of substance use was low. The possible explanation for low sensitivity could be: 1) inability of the laboratory to detect substances that were not routinely screened and confirmed; 2) each substance has an unique halflife.

Consumption of substances such as methamphetamine, cocaine, or alcohol few days prior to death often provides a negative lab result; 3) small quantity of substance use frequently causes a lab result below the detection limit; 4) detection time also varies depending upon analytical method used, drug metabolism, individual's physical condition, fluid intake, and method and frequency of substance ingestion prior to death. Furthermore, cutoff values for positive substance vary from one laboratory to another. Regarding specificity, the survey revealed an average 76% specificity indicating that proxy reporting of substance use has some degree of scientific certainty in general. However none of the individual categories of substance reached 100% specificity, meaning proxy respondents did not know whether the decedents had used substance prior to their death. Alcohol, on the other hand, has the lowest specificity. It is probably associated with proxy's social, financial, psychological and legal implications. In conclusion, our study showed that both the toxicology report and proxy reporting provided important information in identifying forensic relevance for those who died unexpectedly. Nevertheless, shortfalls of each reporting system should be cautiously taken into consideration in result interpretation.

	Sensitivity	Specificity
Alcohol	0.93	0.26
Pain Killer	1.00	0.73
Sedative	0.36	0.88
Tranquilizer	0.47	0.85
Antidepressant	0.60	0.75
Stimulant	0.41	0.93
Cocaine	0.59	0.85
Marijuana	0.58	0.80
Methadone	1.00	0.90

Validity, Toxicology Report, Surrogate Reporting

K20 Death Attributed to Quetiapine Overdose

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This is a case report where the cause of death was attributed to quetiapine overdose. There is little literature regarding minimum lethal concentrations of this drug, and presentation of this case may help with compiling such data.

Quetiapine (Seroquel) is an antipsychotic drug belonging to a new chemical class, the benzothiazepine derivatives. We present the first case of quetiapine overdose causing death reported in the Province of British Columbia.

A 56-year-old Caucasian female was found unresponsive on the bedroom floor. The deceased's medical history included bipolar disorder and severe obsessive-compulsive disorder. A full autopsy was performed approximately 32 hours after death. Significant findings included evidence of localizing interstitial pneumonitis. There was no evidence of underlying chronic lung disease or of an aspiration event. Specimens were collected for toxicological analysis.

The blood specimen was initially subjected to a thorough qualitative analysis. Basic drugs were screened for by liquid-liquid extraction followed by GC-NPD and GC-MS electron impact detection. Acidic and neutral drugs were screened for by liquid-liquid extraction followed by HPLC-DAD. Volatiles were assayed by GC-FID. Qualitative analysis identified acetaminophen, carbamazepine, lorazepam, clonazepam, diphenhydramine and quetiapine. The concentration of acetaminophen was less than 10 mg/L, carbamazepine was 8.5 mg/L (36 umol/L), lorazepam was 0.05 mg/L (0.16 umol/L), and clonazepam was 0.027 mg/L (0.086 umol/L). With the exception of acetaminophen, which is less than therapeutic, these concentrations are consistent with levels achieved therapeutically. The concentration of diphenhydramine was 3.7 mg/L (14 umol/L); although this is greater than the therapeutic range (0.010 – 0.10 mg/L) it is less than the commonly accepted minimum lethal level of 8 mg/L.

Quetiapine was assayed in biological specimens as follows: briefly, to each tube add 1 mL of appropriate fluid, 50 uL of Internal Standard (Hydroxytriazolam 0.01 mg/mL), 1 mL of saturated sodium carbonate solution was added, and extracted into 6 mL n-butyl chloride. The extract was concentrated under nitrogen, reconstituted and derivatized with 50 uL of MTBSTFA, heated at 60^{o}C for 30min, and 1 uL was injected into an Agilent model 5890 gas chromatograph coupled to a NP Detector using a 12 m Ultra-1 (0.33um film thickness) capillary column (Agilent). The initial temperature was 260 ^{o}C and increased 10 ^{o}C/min for one min then 50 ^{o}C/min until 300 ^{o}C, then held for 2 min. The concentration was measured by comparison of peak height ratios of quetiapine to that of hydroxytriazolam against a standard curve. Linearity was observed up to 2.0 mg/L. Samples with concentrations exceeding the linearity were diluted.

Elevated concentrations of quetiapine were found in blood 7.20 mg/L (19 umol/L) and in vitreous fluid 0.93 mg/L (2.4 umol/L). Quetiapine is well absorbed from the gastrointestinal tract and reaches peak plasma levels 1.5 hours after oral administration. The drug's half-life ranges from 2.7-9.3 hours. The volume of distribution of quetiapine is 10 L/kg and it is 83% bound to plasma proteins. The specimen in this case were approximately 7 fold greater than the reported therapeutic range (0.1 – 1.0 mg/L), assuming the red cell serum distribution ratio is 1:1, and is comparable to that reported in the literature to be associated with serious/potentially fatal toxicity. The cause of death was ascribed to solely quetiapine overdose.

Quetiapine, Overdose, Fatal

K21 Determination of Clonidine in Postmortem Specimens by LC/MS/MS

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The attendee of this presentation will be introduced to the procedural details of a LC/MS/MS methodology for measurement of clonidine in postmortem specimens. In addition, postmortem clonidine concentration data from a series of cases will be presented and the significance of these findings will be discussed.

The impact of this presentation includes an improved analytical approach for the detection of clonidine in postmortem specimens and documentation of additional postmortem clonidine concentration data to the forensic toxicology community to better facilitate interpretation.

Clonidine Hydrochloride (Catapres, Clorpres, Combipres, Duraclon), an imidazoline derivative synthesized in the early 1960s, is primarily prescribed as an antihypertensive agent available in both oral form and as a transdermal patch. Clonidine acts as an alpha2-adrenergic receptor agonist resulting in reduced sympathetic outflow from the central nervous system, thus leading to a reduction in blood pressure. Recently clonidine has been indicated as continuous epidural infusion for treatment of severe pain in cancer patients that is not relieved by opiate analgesics alone. Other uses for clonidine include treatment of anxiety and attention-deficit hyperactivity disorder (ADHD), as a preoperative sedative, and treatment of withdrawal from narcotics and nicotine. Oral dosages of clonidine hydrochloride are available in 0.1 mg, 0.2 mg, and 0.3 mg tablets with typical daily doses from 0.2 to 0.6 mg/day. Therapeutic plasma concentrations vary between 0.7 and 3.8 ng/mL.

The primary adverse effects of clonidine are dry mouth and sedation. Due to its hypnotic effect, clonidine has been used to incapacitate and subsequently rob victims, and suggested as an effective agent in drug facilitated sexual assault. Blood clonidine concentrations in the reported cases of chemical submission ranged from 13 – 68 ng/mL. Clonidine may also impair driving especially when taken with alcohol and other sedative drugs. Symptoms of overdose include early hypertension followed by hypotension, bradycardia, respiratory depression, and hypothermia. Children are reported to be especially susceptible to the sedative effects of clonidine. A serum concentration of 3.5 ng/mL produced unconsciousness in one child. After intensive treatment, a 28-year-old male survived a 100 mg overdose of clonidine and exhibited a peak plasma concentration of 370 ng/mL.

Clonidine is not detected in routine toxicological screening methods used in most laboratories conducting postmortem analysis. The low therapeutic and toxic concentrations encountered in blood coupled to the need for derivatization prior to GC/MS analysis contribute to this fact. The aim of this work is to develop a simple and sensitive LC/MS/MS analytical procedure for detection of underivatized clonidine and document the occurrence of clonidine in postmortem specimens from casework conducted in our laboratory. Cases for this study were selected based upon clonidine appearing in the list of medications collected at the scene.

Clonidine and 7-aminoflunitrazepam, as the internal standard, were isolated from alkaline postmortem fluid and tissue homogenate by extraction with n-butyl chloride. The n-butyl chloride fraction was evaporated to dryness. The residue was reconstituted in mobile phase, washed with hexane (saturated with mobile phase) and submitted for analysis by LC/MS/MS. Liquid chromatography was performed using an Agilent 1100 with Agilent Zorbax Eclipse XDB-C8 column. The column was 150mm by 4.6mm with 5 micron film. The mobile phase was an isocratic mixture of methanol (55%) and water (25 mmol ammonium formate pH 3.0) (45%). The LC flow (0.25 ml/min) was

directed into an electrospray ionization source and mass spectral analysis was performed with an API 2000 triple quadrupole mass spectrometer (Applied Biosystems).

Qualitative identification of clonidine was established by monitoring two transition ion pairs, m/z 229.9/212.8, m/z 229.9/171.8. Quantitative analysis monitored the peak areas of the m/z 229.9/212.8 transition for clonidine and the 284.1/135.0 transition for 7-aminoflunitrazepam. A five point curve from extracted blood calibrators, ranging from 0.4 to 4.0 ng/mL, was generated, r2 =0.9988. The established limit of detection was 0.1 ng/mL. Of nine cases screened thus far, postmortem blood clonidine concentrations ranged from 0.64 – 6.9 ng/mL.

Clonidine, LC/MS, Postmortem

K22 Death Due to Ingestion of Tramadol in London, UK

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Attendance at this presentation will enable the participant to study an unusual toxicological case in London involving tramadol. The presentation will also enable the participant to learn how such cases are processed by the Forensic Toxicology Service in London, UK.

This presentation is important to the toxicological and analytical community as it is the first such case in London, UK involving the highest reported level of tramadol in addition to a concentration of enalapril consistent with therapy. Considering the lack of any other significant autopsy findings, the results of our toxicological analyses are consistent with the assumption of a fatal overdose of tramadol producing a high concentration of the drug, exceeding any noted in the UK before.

The Forensic Toxicology Service offers a screening and quantification toxicology service to most of Her Majesty's Coroners and Forensic Pathologists in London as well as various Police Forces and one branch of the Armed Forces. As a result, we are required to screen for a large number of prescribed and illicit drugs in post-mortem specimens followed by quantification of those detected. All analyses must be completed and our final report must be submitted to the Courts within 15 business days of the arrival of the case at the Service. This case was presented to the Service in May 2003 and involved a 79-year-old Caucasian female with a history of pain related health problems, which required prescription of various analgesics, including tramadol. At the home of the deceased officers discovered empty boxes of tramadol and zopiclone as well as boxes of co-codamol (preparation of codeine and paracetamol), Duragesic® patches (fentanyl) and paracetamol. We were requested to subject the unpreserved post-mortem blood and urine specimens of the deceased to our standard alcohol and general drug screen in order to facilitate HM Coroner in his Inquest into this death.

The case blood and urine specimens were screened for alcohol and determined negative. Similarly, paracetamol (i.e., acetaminophen) and salicylates were not detected. Our benzodiazepine screen by HPLC-MS-MS on the blood specimen did not detect any benzodiazepines or metabolites. Enalapril was detected by HPLC-MS-MS and, when quantified in blood, it measured 0.02 mg/L, which fell well within low levels observed in therapy. Using our standard liquid-liquid drug extraction scheme for basic (i.e. alkaline) drugs followed by gas chromatography – mass spectrometry (GC-MS), we were able to identify tramadol in both the blood and urine case specimens. The urine specimen also showed a spot under UV illumination following thin layer chromatography. When the TLC plate was sprayed with FPN reagent (ferric chloride; perchloric acid; nitric acid), the spot showed a strong purple color. When quantified by GC-MS using appropriate calibrators and controls, tramadol measured 10.3 mg/L in blood. Urine tramadol was not quantified.

Tramadol is prescribed in the United Kingdom as an opioid analgesic to treat moderate to severe pain as non-proprietary 50-mg capsules or 50mg/mL injection, or under various trade names including Zamadol® and Zydol® capsules and Dromadol® and Zydol® XL modified release tablets. Enalapril is prescribed in the UK to treat hypertension and also to alleviate symptomatic heart failure. It is available as non-proprietary tablets (2.5, 5, 10 or 20 mg) as well as under the trade names of Innovace® and Innozide®.

After reviewing the scientific literature on tramadol related fatalities, it was noted that published post-mortem blood levels in such cases ranged from 3.7mg/L (Loughrey et. al., 2003) to 9.6mg/L (Musshoff and Madea, 2001). Tramadol-related deaths and non-fatal intoxications have previously been studied and tramadol levels ranged from 0.03 to 22.59 mg/L (Goeringer et. al., 1997; Levine et. al., 1997). Our case is important to the toxicological and analytical community as it is the first such case in London, UK involving the highest reported level of tramadol in addition to a concentration of enalapril consistent with therapy. Considering the lack of any other significant autopsy findings, the results of our toxicological analyses are consistent with the assumption of a fatal overdose of tramadol producing a high concentration of the drug, exceeding any noted in the UK before.

Tramadol, GC?MS, Fatality

K23 Investigation of the Analytical Degradation of Clozapine-n-Oxide to Clozapine in a Postmortem Case

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Attendees should be able to use this information to assist with the interpretation of cases involving clozapine.

The goal of this presentation is to provide forensic toxicologists with data from a recent postmortem case in which clozapine was determined to be the cause of death. While clozapine-n-oxide does convert to clozapine with analysis by gas chromatography, our results indicate that this may be an insignificant phenomenon.

Clozapine is a tricyclic dibenzodiazepine used for the treatment of severe schizophrenia patients that have failed to respond to more standard therapy. Clozapine undergoes extensive metabolism including N-demethylation, N-oxidation, chlorine ring oxidation, chlorine and thiomethly conjugation. Clozapine-n-oxide is a major metabolite found in plasma with little pharmacological activity.

A 40-year-old male suffering from schizophrenia became agitated and self destructive in the assisted living facility where he was a resident. He was taken to the emergency room where he expired after extensive resuscitative efforts. Autopsy results were negative. Blood, vitreous, liver and brain specimens were submitted to the toxicology laboratory for analysis. Routine drug and alcohol screens using gas chromatography and gas chromatography/mass spectrometry were positive for clozapine, bupropion, chlorpheniramine, atropine, and desmethylsertraline. Clozapine was quantitated with gas chromatography with nitrogen phosphorous detection (GC/NPD), gas chromatography with flame ionization detection (GC/FID) and high performance liquid chromatography (HPLC).

For the GC analyses, 1.0 mL blood or 1.0 g of a 1:4 liver homogenate spiked with 2.0 mcg olanzapine (internal standard) were extracted with 7.5 mL 1-chlorobutane following alkalinization with 0.5 mL concentrated ammonium hydroxide. The organic layer was transferred and back extracted into 2.5-mL sulfuric acid. The solvent layer was removed. The aqueous acid layer was made alkaline with 0.5 mL concentrated ammonium hydroxide and extracted with 3.0-mL chloroform. Following centrifugation, the aqueous was removed and the chloroform layer was dried to residue under nitrogen at 40°C. The

samples were reconstituted with 50-mcL methanol and 2.0 mcL was injected on an HP 5890 gas chromatograph with nitrogen-phosphorous detection or an HP 6890 gas chromatograph with flame ionization detection. The assay is linear from 0.5 mcg/mL to 8.0 mcg/mL with a limit of detection of 0.5 mcg/mL clozapine.

For HPLC analyses, 1.0 mL blood or 1.0 gram of a 1:4 liver homogenate spiked with 2.0 mcg promazine (internal standard) was extracted with 7.5 mL 3% isopropanol in pentane following alkalinization with carbonate buffer (pH 9.5). The extracts were dried to residue under nitrogen at 40°C. The samples were reconstituted with 200 mcL acetonitrile, filtered with a 0.2 um syringe filter and 20 mcL were injected on the Varian 5500 HPLC equipped with a cyanopropyl column and ultraviolet detection. The samples were analyzed using ultraviolet detection at 257 nm and a flow rate of 1.5 mL/min for the 60:35:5 acetonitrile: ammonium acetate: methanol mobile phase.

Clozapine-n-oxide has been shown to convert to clozapine by thermal degradation by GC analysis, in vivo processes in animals, and base reduction during extraction. We investigated the influence of clozapine-n-oxide on the results obtained by gas chromatography for the present case. Injection of unextracted clozapine-n-oxide on GC/NPD resulted in the detection of clozapine plus other unknown products. Three clozapine and 3 clozapine-n-oxide blood controls (2.0 mcg/mL, each) were spiked and extracted using the alkaline liquid-liquid method above. They were compared to extracted standard curves for each compound ranging from 0.5 to 8.0 mcg/mL. The mean concentration of clozapine (± SD) from the clozapine controls was found to be 2.2 (± 0.1) mcg/mL. The mean concentration of clozapine found when the extracted clozapine-n-oxide samples were compared to the clozapine curve was 1.1 (± 0.07) mcg/mL. When the clozapine-n-oxide extracts were compared to the clozapine-n-oxide standard curve, a mean of 1.8 (± 0.1) mcg/mL was obtained.

Two experiments were performed using HPLC. First, standards were prepared and subjected to the extraction protocol outlined above (blank, negative control, 0.5 mcg clozapine, 0.5 mcg clozapine-n-oxide, 0.5 clozapine + 0.5 mcg clozapine-n-oxide). We found no conversion of clozapine-n-oxide to clozapine. Secondly, a clozapine standard curve (0.5 to 8.0 mcg/mL blood) was extracted and used for comparison to 2 blood controls, 1 containing 1.0 mcg/mL clozapine-n-oxide, the other 1.0 clozapine-n-oxide + 2.0 mcg/mL clozapine. The control containing only clozapine-n-oxide demonstrated no clozapine conversion. The control containing both compounds showed the expected 2.0 mcg/mL clozapine.

These results indicate that clozapine-n-oxide does convert to clozapine during GC analysis and/or under strong alkaline conditions. Our HPLC analysis showed no conversion of clozapine-n-oxide to clozapine. Interestingly, when the blood from the postmortem case was extracted and analyzed by both the GC and HPLC protocols, the same result was obtained: GC, 2.1 mcg/mL; HPLC, 2.0 mcg/mL. These results indicate that the likely presence of clozapine-n-oxide did not cause significant overestimation of clozapine in a long-term user of this drug.

Clozapine, Clozapine-N-Oxide, Chromatography

K24 Demographic and Toxicological Profiles of 127 Decedents Testing Positive for Ephedrine Alkaloids

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Attendants will learn the basic profile of ephedrine-related deaths, as well as the relationship between blood ephedrine, blood norephedrine concentrations, and possible episodes of ephedrine toxicity.

This presentation will impact the forensic community by providing the substantial toxicological and pathological data needed to make informed diagnostic decisions about cause of death when ephedrine is detected by postmortem toxicological screening.

The relative safety of ephedra-containing dietary supplements is disputed, and the toxicology of ephedra-supplements remains poorly understood. Two theories have been advanced to account for purported episodes of ephedrine toxicity; (1) It has been suggested that humans may metabolize ephedrine to form norephedrine (phenylpropanolamine) which, in turn, may cause dangerous elevations of pulse and blood pressure; (2) It has been suggested that, when ephedrine-related toxicity occurs, it "results from accidental overdose often prompted by exaggerated off-label claims and a belief that 'natural' medicinal agents are inherently safe. " According to this theory ephedrine toxicity results from inadvertent overdosage, occurring when consumers ingested poorly produced supplements containing unpredictable amounts of ephedrine. Both theories are plausible, but evidence is lacking. Accordingly, a review of all autopsies performed in our Medical Examiner's jurisdiction was undertaken, from 1994 through 2000, where ephedrine or ephedrine-related compounds (E+) were detected in blood or urine drug screening. Methods: When available, urine samples were initially screened with the polyclonal EMIT test. When no urine was available, blood was screened using GC/MS. Following alkaline extraction, ephedrine, pseudoephedrine, and norephedrine were identified by gas chromatography with nitrogen-phosphorus detection. Samples were subsequently confirmed using full scan electron impact mass spectrometry. Other drugs were identified following a similar protocol. Drug concentration values in E+ cases, where trauma was the cause of death, were compared with values in E+ cases dying of all other causes. Results: A total of 127 cases were identified. The mean postmortem interval was 17.4 hours in the trauma group, and 18.4 hours in the non-trauma groups (not significantly different). The mean age for the 127 cases was 44.9 ± 1.2 years. Fifty-nine percent were Caucasian, 22.8% black, 10.2% Asian, and 3.9% Hispanic. Decedents were mostly male (80.3%). Thirty-three (25.9%) died of trauma. Mean blood ephedrine concentrations in trauma vs. non-trauma were not significantly different (1.27 mg/L, SD = 2.49 for trauma cases vs. 1.61 mg/L, SD = 2.47 for non-trauma cases, $p = 0.603$). Blood ephedrine concentrations were < 0.49 mg/L in 50% of the cases, and ranged from 0.07 to 11.73 mg/L in trauma victims and from 0.02 to 12.35 mg/L in non-trauma cases. Norephedrine (NE) was present in the blood of 22.8% (29/127) of all cases (mean of 1.81 mg/L, SD = 3.14 and in the urine of 36.2.% (mean of 15.6 mg/L, SD = 41.12). Pseudoephedrine (PE) was present in the blood of 6.3% (8/127). More than 88% (113/127) of all cases tested positive for drugs in addition to ephedrine alkaloids, the most common being cocaine or its metabolites, and morphine, each detected in the blood of 21.3% (27/127). Blood concentrations in E+ cases, where only ephedrine alkaloids were present, and E+ cases where cocaine and/or methamphetamine were present were not significantly different ($p = 0.231$). In only eight of the 127 cases (6%) was ephedrine the only drug detected in the blood. Conclusions: (1) Blood concentrations of E+ in trauma deaths completely overlap concentrations in non-trauma deaths and cannot, in isolation be used to identify the occurrence of ephedrine toxicity. This is exactly the same situation previously observed with cocaine and methamphetamine-related deaths. (2) Based on the high blood concentrations observed in this group of decedents, especially in those dying of trauma, it seems unlikely that variations in production and quality control could have much of an impact on toxicity, since the average doses contained in supplements are too low to account for the blood levels seen in this group of decedents. (3) Norephedrine was detected in the blood in only a quarter of all E+ cases, suggesting that demethylation of ephedrine does not occur to any great degree in humans, (4) blood concentrations in cases where ephedrine and illicit stimulants were both present were not significantly different, suggesting that actions of ephedrine and other stimulants are not synergistic.

Ephedrine, Norephedrine, Polydrug Abuse

K25 The Detection of Oxycodone in Meconium Samples

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After attending this presentation, attendees will learning a procedure for the extraction of oxycodone from meconium and its detection using gas chromatography-mass spectrometry (GC/MS) is described for the first time. The abuse of oxycodone (OxyContin™) has been widely discussed in the mainstream media and it is often described as a cheap form of heroin. Following the presentation, attendees will understand the abuse potential of oxycodone and be able to analyze the drug in meconium.

The described procedure can be used by researchers to determine the exposure of newborns to oxycodone, a drug with high abuse potential. The detection of exposed neonates will aid in their treatment, and allow mothers to be counseled and assisted with their drug use problems. Identification of drug exposed newborns may assist in the prevention of further drug-addicted children being born to the same mother, since services and assistance can then be provided.

Introduction: Oxycodone is a semi-synthetic opioid derived from the opium alkaloid thebaine.Oxycodone (14-hydroxy-7,8-dihydrocodeinone) marketed as OxyContin™ and Roxicodone™ is a strong opioid agonist that is available alone or in combination with mild analgesics. It is suitable for oral and nasal administration due to high bioavailability (50-65%), which makes it a good candidate for nasal abuse. In analgesic potency, oxycodone is comparable to morphine and with the exception of hallucinations, which may occur more rarely after oxycodone than after morphine, the side effects of these drugs are closely related. The abuse potential of oxycodone is equivalent to that of morphine

Oxycodone has been reported as having a high degree of abuse and potential complications in neonates from maternal drug use. Using a standard enzyme multiplied immunoassay (EMIT) screening technology, the cross-reactivity of oxycodone to the morphine antibody is only 5-6%. A positive screening value would require a high concentration of drug to be present, so an assay for the detection of oxycodone in meconium using gas chromatography-mass spectrometry was developed. Hospitals employ routine testing of neonatal and/or maternal specimens for the determination of drug and alcohol use during pregnancy. While neonatal urine is widely tested, it gives only a short history of maternal drug use. Meconium, the first fecal material passed by a newborn, extends the window of drug detection up to 20 weeks and has become widely accepted as an alternative to urinalysis. In addition to morphine and codeine, there have been reports of heroin metabolites in meconium, hydrocodone and hydromorphone, but to date there are no reports of the metabolism, deposition or detection of oxycodone or its metabolites, in either meconium or neonatal urine. Since oxycodone has been increasingly identified as a potent narcotic resulting in drug dependence, overdose and death, its use during pregnancy may result in withdrawal symptoms in the newborn.

Sample Preparation: Deuterated internal standard (50 µL) was added to an aliquot (0.5 g) of each calibrator, control or meconium specimen. The internal standard concentration of deuterated oxycodone was 200 ng/g. Methanol (3 mL) was added and the specimens were homogenized, centrifuged, and the supernatant was decanted into a small glass tube. The supernatant was evaporated to dryness at 40ºC, and refrigerated overnight. The next day, 0.1M hydrochloric acid (3 mL) was added with 250µL of 10% methoxyamine hydrochloride (aqueous). The mix was incubated at room temperature for 1 hour and mixed. 0.1M phosphate buffer (pH 6.0; 3mL) was added.

Extraction Procedure: Solid-phase mixed mode extraction columns were placed into a vacuum extraction manifold. Each column was conditioned with methanol (3 mL), deionized water (3 mL) and 0.1 M phosphate buffer (pH 6.0; 3 mL). The sample was allowed to flow through the column using no vacuum. The sorbent bed was dried for one minute at full vacuum. The column was washed with deionized water (3 mL), 0.1M hydrochloric acid (3 mL) and methanol (3 mL). The column was allowed to dry after each wash stage. Glass collection tubes were placed in the manifold and the opiates were finally eluted fresh methylene chloride: isopropanol: ammonium hydroxide (80:20:5; 3mL). The extracts were evaporated to dryness under nitrogen at 17psi at 60°C. Ethanol (100µL) was added, the specimens were mixed and transferred to autosampler vial inserts and re-evaporated to dryness.

Derivatization: The vials were capped and the residue was reconstituted with 50 µL iso-octane and 10 µL of BSTFA + 1% TMCS. The extracts were heated for 30 minutes at 80°C in dry heating block prior to analysis by GC/MS.

Analytical Procedure: An Agilent 6890 gas chromatograph coupled to a 5973 mass selective detector (MSD) operating in electron impact mode was used for analysis. The gas chromatographic column was 5% phenyl -95% methyl silicone DB-5 MS, 0.20 mm ID, 0.33 µm film thickness, 25 m length and the injection temperature was 280°C. The injection mode was splitless and the injection volume was 3 µL. The oven was programmed from 150°C for 1 minute; ramped at 20°C/min to 245°C and held for 8 minutes. Then, it was ramped at 50°C/min to 290°C. The source was held at 230°C and the quadropole at 150°C. The ions monitored were 419.4, 420.4 for d_3 Oxycodone and 416.4, 417.4 for Oxycodon.

Results and Discussion: Since inception of this procedure, three meconium specimens received into our laboratory have been determined as being positive for oxycodone. The concentrations detected were 117 ng/g, 150 ng/g and 2279 ng/g. There are no published reports of oxycodone concentrations in meconium samples, so correlation with maternal use or abuse is not possible.

While no specific reports of oxycodone on neonatal outcome have been reported, there are many papers studying the effects of heroin, buprenorphine, methadone or other opiates. It is estimated that 55-94% of infants born to opioid-dependent mothers in the USA show signs of withdrawal. Newborns exhibiting neonatal abstinence syndrome (NAS) generally have longer hospital stays and symptoms include tremors, irritability, sleep abnormalities, feeding problems, low birth weight and seizures. It has further been shown that methadone maintenance treatment during pregnancy is associated with more consistent prenatal care, more normal fetal growth and reduced fetal mortality. However, neonatal withdrawal from methadone appears to be more severe than from heroin, as judged by amount of medication required to control symptoms and duration of treatment. The analytical procedure described details the determination of oxycodone in meconium specimens and may provide useful information to neonatologists and researchers studying the effects of opiates on newborns.

Oxycodone, Meconium, Neonatal Abstinence Syndrome

K26 Distribution and Comparison of Oxycodone and Other Drugs in a Case with Pre- and Post-Embalmed Autopsy Specimens

Robert A. Middleberg, PhD and Laura Labay, PhD, National Medical Services, Inc., 3701 Welsh Road, Willow Grove, PA 19090*

This poster will provide the reviewer a potential means of correlating oxycodone, acetaminophen, paroxetine and alprazolam concentrations in pre- and post-embalmed autopsy specimens.

The data presented can provide potentially useful interpretive information for several drugs in pre- and post-embalmed blood and tissues.

Embalming fluid is a formaldehyde-based fluid that is infused into the body through the vasculature in preparation for burial to help disinfect and preserve the remains. It is well-recognized that embalming fluids can alter many agents of toxicological significance. For example, pseudoephedrine in the presence of formaldehyde partially or completely converts to an oxazolidine structure. At its worst, the effects of embalming fluids on cyanide may result in an inability to detect the compound at all in postmortem specimens. Unfortunately, there is a general paucity of information regarding the effects of embalming on the majority of compounds of toxicological interest. Most studies on the subject involve in vitro experiments. The work here afforded us a rare opportunity to study the effects of embalming on a few different drugs before and after embalming in the same individual.

The case history was that of a 20-year-old male who had undergone a dental procedure. For pain, he was prescribed an oxycodone/acetaminophen compound. He was subsequently found dead at home within 24-hr post-procedure.Within a period of three days, he was autopsied, embalmed and then re-autopsied. Typical tissue specimens were collected during both autopsies. In addition, while whole blood was not available during the second autopsy, a blood-like substance was recovered from the left popliteal vein and submitted for toxicological analysis.

Two different laboratories performed the toxicological analyses; with one laboratory analyzing pre-embalmed specimens while the other analyzed post-embalmed specimens.Analyses were carried out using standard extraction and analytical toxicological testing procedures and followed the individual laboratories standard operating procedures. In addition, post-embalmed specimen analyte concentrations were determined by the method of standard addition and dilution. Analytical techniques included liquid chromatography, gas chromatography and gas chromatography/mass spectrometry.

Oxycodone Concentrations in Pre- and Post Embalmed Fluid and Tissues

Specimen	Pre-Embalmed Levels	Post-Embalmed Levels
Blood	500 ng/mL	120 ng/mL*
Liver	400 ng/g	720 ng/g**
Kidney	NP	1800 ng/g**

*blood-like material from popliteal vein
**total concentration

Other pre- and post-embalmed drug findings.

Pre-Embalmed Concentrations

Specimen	Acetaminophen	Alprazolam	OH-Alprazolam	Paroxetine
Blood	< 10 mcg/mL	60.9 ng/mL	< 10 ng/mL	200 ng/mL
Liver	Not Detected	245 ng/g	24 ng/g	9.2 mcg/g

Post-Embalmed Concentrations

Specimen	Acetaminophen	Alprazolam	OH-Alprazolam	Paroxetine
Blood	0.57 mcg/mL	46 ng/mL	----	~ 140 ng/mL
Liver	4.3 mcg/g	410 ng/g	~ 25 ng/g	~7.6 mcg/g

This case allowed for a comparison of oxycodone, acetaminophen, paroxetine, alprazolam and hydroxyalprazolam concentrations in blood and liver as determined prior to embalming and following the embalming process. One potentially influencing factor in comparing the concentrations in this case was that two different laboratories performed the analyses. Even so, findings revealed that oxycodone in the blood decreased by 76% whereas in the liver levels increased by 80% following embalming. The latter finding can be explained through comparison of free versus total concentrations, especially in light that between 7-30% of oxycodone is excreted as a glucuronide conjugate. The former finding is most likely due to the post-embalming "blood" specimen and the effect of embalming fluids (i.e., degradation of oxycodone, redistribution of drug, dilution effects). Regardless, it appears that liver oxycodone findings may be a good monitor of pre-embalmed concentrations in post-embalmed tissue. Other drug findings in the case were comparable pre- and post-embalming and would not appear to have significant affect on the interpretation of the findings.

When comparing pre- and post-embalmed drug findings, numerous factors must be considered, including: completeness of initial tissue perfusion and pooling effects that may occur between and within specimen types; incomplete or non-uniform perfusion of any given tissue with embalming fluid; potential redistribution of drugs caused by the embalming fluids; and, analyte stability in embalming fluids. In addition, it is sometimes inferred that penetration of the embalming fluid is uniform throughout the body. However, this may not necessarily be true in all instances. For example, more vascularized tissues have greater infiltration of embalming fluid. In addition, structures closest to the site of administration are subject to higher pressures of infiltration.

The consequence of these variations in pre- and post-embalmed fluids and tissues is dependent upon factors surrounding the nature of the death investigation. One should be acutely aware that the process of embalming might affect the concentrations of certain drugs within body fluids and tissues. This study provides potentially useful interpretive information for the compounds detected in this case.

Acknowledgment: Forensic Toxicology Laboratory, Office of Chief Medical Examiner, New York, NY

Embalmed, Oxycodone, Distribution

K27 The Use of Hair Analysis in Postmortem Toxicology to Aid in the Determination of Cause of Death

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After attending this presentation, attendees will understand the potential use of hair analysis to aid in cause of death determinations.

The victim was found unresponsive and was transported to the emergency room via ambulance. Upon presentation to the emergency room on 4/14/XX at 0452 hours, the victim was in cardiac arrest with hypoxic ischemic encephalopathy, secondary to a possible drug overdose. The victim was transferred to the ICU and on 4/15/XX the parents signed a withdrawal of care form. On 4/18/XX at 0430 hours the victim was pronounced dead.

The MCCO was not notified of the death until 4/25/XX at 1435 hours. After review of the medical records and police reports MCCO requested an exhumation of the body and an autopsy was performed. Based on police reports, the decedent was a known heroin abuser. Autopsy results were remarkable for mild cerebral edema and histologic confirmation of hypoxic brain injury and diffuse ischemic injury within the liver.

The toxicology laboratory at MCCO received the following specimens; peripheral blood (1 mL), abdominal inferior vena cava and portal venous blood (35 mL), brain, cerebrospinal fluid (CSF), gastric, liver, muscle, urine (trace), vitreous fluid, bile and head hair. The specimens were from an embalmed body and there was no hospital admission blood available. Analysis of the bile and blood revealed the presence of lorazepam and midazolam. Analysis of the blood and the vitreous for opiates revealed the presence of free morphine. During the decedent's hospital course lorazepam, midazolam and morphine was administered.

Analysis of the hair was performed in an attempt to document the presence of 6-monoacetylmorphine (6-MAM), a marker of heroin use. Hair analysis was accomplished using a combination of two published methods, Welch et al., (1993) and United Chemical Technologies (UCT) Inc., in conjunction with in house development. The hair was prepared for analysis using the Welch method and was extracted by solid phase extraction (SPE) using UCT method. A blank hair matrix was also analyzed.

Hair analysis revealed the presence of 6-MAM, codeine, morphine and oxycodone. Allegations later arose which indicated that the manner of death in this case may be homicide. These allegations are still under investigation at this time. In light of the decedents' history in combination with an autopsy revealing no evidence of traumatic injury, the cause of death was determined to be acute heroin intoxication. Hair analysis played a key role in confirming previous heroin exposure thus enabling cause of death determination.

Opiates, Hair Analysis, Postmortem Toxicology

K28 Analysis of Nitrite in Adulterated Urine Specimens by Capillary Electrophoresis

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The purpose of this study was to develop and validate a simple, inexpensive, and robust method for the detection and quantitation of nitrite in urine for the confirmation of screening results. A method was developed that was specific, accurate, and precise with a wide dynamic range.

This research presents methods that improve the detection of nitrites in urine, which have been used to adulterate samples submitted for forensic urine drug testing. Thus, this presentation provides a method to make this testing more reliable.

Continual issues arise in urine drug testing with adulteration of samples. Nitrite (NO2-) compounds are sometimes used as adulterants to destroy traces of drugs in urine samples. Many laboratories use either specific or general oxidant colorimetric tests to screen for the presence of nitrite or other oxidants. However, for forensic acceptability, it is necessary to have a second test of the samples, preferably using a distinctly different chemical basis to confirm the initial findings.

A Beckman Coulter P/ACE MDQ Capillary Electrophoresis System was used for these experiments. The capillary was uncoated fused silica with an inner diameter of 0.75 mm and an effective length of 40 cm (total length of 50 cm). A window was burned in the polyimide coating with a lighter for direct UV detection at 214 nm. The method employed a hydrodynamic injection, and the analytes were separated using -25 kV. The column temperature was maintained at 35ºC by a liquid cooling system. Each buffer reservoir consisted of a 2-mL vial containing 1.3 mL of run buffer. Each reservoir was used for no more than three injections. The run buffer consisted of 25 mM phosphate with 3.5 mM TBAS as a modifier to slow the electro-osmotic flow. The pH was adjusted to 7.5 with NaOH.

At the start of each batch of samples, the column went through an initial regeneration/equilibration cycle that included washes with NaOH and buffer. Before each sample was injected, the column was flushed for 1min with run buffer. After every three samples, the column was regenerated with NaOH and buffer.

The lower limit of linearity for this method was determined to be 80 mg/mL NO2- in urine (4mg / mL on-column concentration.) Although the quantitative values were acceptable up to 6000 mg/mL, the relative migration time restricted the upper limit of linearity to 1500 mg/mL. The LOD for this method was determined to be 20 mg/mL NO2- in urine with a S:N of approximately 11.

The precision and accuracy of the method were determined by analyzing Axiom Test True™ Truetrol™ Adulteration Controls. Controls were analyzed as received, and were also diluted to span more of the linear range. The precision of the data was good with the relative standard deviations of the calculated concentrations consistently below 2%. The accuracy of these analyses was acceptable, as the concentrations obtained for all of the samples within the linear range were within + 20% of the actual values.

Several anions were studied to determine if they would interfere with the analysis of the NO2-. The anions were fortified in urine at concentrations of 100 or 1000 mg/mL, except chloride, which was fortified at concentrations of 1000, or 10,000 mg/mL. Interference with the NO2- quantitation was checked at the lower limit of linearity (80 mg/mL) and at the threshold cutoff concentration (500 mg/mL). These data indicated that, among these anions, there were no serious interferences noted at the threshold level of 500 mg/mL. However, CrO4-2, S2O8-2, and Cl- caused erroneously high results at the lower limit of linearity (80 mg/mL NO2-). None of the other anions that were tested interfered with the quantitative analysis of the nitrite.

There were two main issues noted with this method. The first was that it was difficult to attain reproducible migration times. The migration times became progressively longer with each injection, and no amount of buffer rinsing helped. It was decided to use a 1-minute buffer rinse between each injection to flush the column and replenish the electrolyte, then perform a 13-minute regeneration cycle after each third injection. This method resulted in the 2.2% RSD for the relative migration time of nitrite that was reported earlier in this paper. (The absolute migration times had approximately 7% RSD.) Regenerating after each injection could readily reduce the error in the migration time. However, it was decided that the increased precision in the migration time was not worth the large amount of time that would be required to regenerate after each injection.

The second main issue was the peak shape of both the nitrite and the internal standard. Due to differences in the mobilities of the analytes relative to the phosphate run buffer, both peaks fronted. The only means to correct this problem would be to change the buffer system. Various buffer systems were tested, but none performed well. Given the simplicity of the phosphate buffer system, the ease of making it, and the low cost of the chemicals, it was decided that the phosphate buffer provided adequate results.

The method had an acceptable range of linearity, with good quantitative precision and accuracy. The precision in the relative migration times was not as impressive, as it is recommended that a 4% window be allowed rather than the standard 2% window applied to most chromatographic methods. The method had few interferences, and the buffers and samples were simple and inexpensive to prepare. The method passed a rigorous validation protocol, and was successfully used to test more than 100 real urine samples.

Adulteration Testing, Nitrite in Urine, Capillary Ion Electrophoresis

K29 Evaluation of Data From Non-Physiological Workplace Drug Testing Urine Samples

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After attending this presentation, attendees will understand complexity related to the evaluation of pilot urine samples for specimen validity.

This presentation will provide authorities with information for carefully assessing the possibility of non-physiological sample submission and related alteration confirmation when evaluating all workplace urine drug test results.

Safety sensitive workers in the transportation industry are required by federal law to provide valid urine samples for workplace drug testing. A number of readily available adulterants may effectively disrupt such urine testing, allowing workers to circumvent this mandate. In addition,

water loading may dilute a drug below its analytical detection limit in urine. Several lawsuits involving airline personnel in such cases have already been litigated. This study documents types of altered urine samples received from aviation pilots and mechanics. During 1999-2001, laboratory litigation packages from 50 cases of suspected alterations were submitted through the FAA's Drug Abatement program to the Civil Aerospace Medical Institute for expert review. Methods from laboratories performing these drug and alteration analyses were examined for forensic defensibility. Data were evaluated for the types of urine-modifiers present in these cases. Six different types of alterations were found. There were 17 cases of adulteration with chromate, 15 with nitrite, 5 with acid, 2 with glutaraldehyde, and 1 with soap—7 of these 40 cases involved multiple adulterant additions and/or dilutions. The remaining 10 cases, out of 50 total, were only diluted or substituted, wherein creatinine concentrations were less than 20 or 5 mg/dl, respectively. In approximately 30 of the 50 cases, the initial drug assays were negative, suggesting possible masking of drug use. However, detection of non-physiological conditions flagged these particular urine samples for further testing. Drug confirmations were successful in 2 cases, even though adulterated. Alterations of urine were confirmed in all 50 cases. Donors may alter their urine in many ways. Laboratories use a wide variety of screening and confirmation assays in verifying these alterations. Therefore, aeromedical authorities must carefully assess the possibility of non-physiological sample submission and related alteration confirmation when evaluating all workplace urine drug test results.

Forensic Urine Drug Testing, Specimen Validity Testing, Specimen Alterations

K30 Compliance of Individuals Prescribed Dexedrine® Through Determination of Amphetamine Isomer Ratios in Oral Fluid

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After attending this presentation, attendees will understand the usefulness of determining amphetamine isomers in oral fluid as a means of assessing a patient's compliance with prescribed Dexedrine®.

An application of oral fluid as means of assessing an individual's compliance with prescribed Dexedrine®.

Oral fluid samples (N=20) were collected from individuals in drug treatment programmes who were prescribed Dexedrine® (N=10) or had a history of amphetamine use (N=10). Samples were collected on-site using the Cozart® RapiScan oral fluid collection system and sent to the laboratory for immunoassay screening. Amphetamine positive screens were confirmed initially by GC-MS-EI following solid-phase extraction with Bond Elut Certify columns and derivatisation with PFPA diluted 1:1 with ethyl acetate.

Oral fluid samples confirmed positive for amphetamine by GC-MS-EI were then analysed for both, the S-(+) and R-(-) isomers of amphetamine. After a simple dilution step (carbonate buffer, pH 9), oral fluid samples (0.05 mL) were derivatized with S-(-)-heptafluorobutyryl-prolyl chloride. Resulting diastereomers were extracted into 0.1 mL of cyclohexane, separated by GC (HP-5MS column) and detected by MS in the negative-ion chemical ionisation mode, with a calibration range of 75-3750 µg/L for each enantiomer of amphetamine.

Amphetamine was confirmed in all twenty oral fluid samples collected, S-(+)-amphetamine concentrations ranged from below LOQ to 3513 ng/mL and from below LOD to 1872 ng/mL for R-(-)-amphetamine. The R/S-amphetamine ratios ranged from 0.02 to 0.08 with a median of 0.05 for individuals compliant with the prescribed Dexedrine® and from 1.02 to 1.99 with a median of 1.30 for subjects using illicit amphetamine. This study has shown that determining amphetamine isomer ratios in oral fluid provides a simple and effective means of assessing an individuals compliance with prescribed Dexedrine®.

Dexedrine, Isomer Ratios, Oral Fluid

K31 An Assessment Oral Fluids Point-of-Collection Drug-Testing Devices

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After attending this presentation, attendees will understand the advantages and limitations of currently marketed oral fluids point of collection devices for use in forensic cases.

This presentation will impact the forensic community by demonstrating Toxicology testing has reached cross roads where testing of non-traditional specimens such as hair, sweat and oral fluids may replace testing of traditional specimens such as blood and urine. The data presented here will assist the audience in evaluating the potential use of oral fluids and point of collection oral fluid testing devices in forensic applications.

New technology is currently being marketed to rapidly test oral fluids for drugs of abuse at the point of collection. There are no nationally accepted standards or cutoff concentrations for detecting drugs in oral fluids [either workplace or criminal justice] and, for most analytes there are significant differences in cutoff concentrations across devices [i.e., sensitivity to detect drug]. In this study, we evaluated six devices [Oral Screen-Ansys Technologies, Inc. USA; Oratect - Brannan Medical USA, Rapiscan -Cozart Bioscience Ltd., UK; Uplink - Orasure Technologies USA/Germany, Drugwipe - Securetec, Germany and SalivaScreen -Ulti-Med, Germany] for their ability to meet manufacturers claims, and proposed federal standards for criminal justice and workplace programs.

Human oral fluids fortified with known quantities of drug/metabolite were used to test the products. Oral fluids were fortified with known quantities of drug(s) or metabolite(s) at 0, one-half, two and ten times the cutoffs proposed by SAMHSA and used to challenge the devices. GC or LC/MS verified concentrations of the fortified drugs/metabolites. Overall, the performance of the rapid point-of-collection oral fluid drug-testing devices was quite variable. Some devices performed well in the analysis of some drugs, but poorly for others. No single device consistently performed better than the others. In general, most of the devices detected methamphetamine and opiates well, but none of the devices could reliably detect marijuana [delta-9-THC] at less that 50 ng/mL. The ability to accurately and reliably detect cocaine and amphetamine was dependent on the individual device.

Results indicate that the devices evaluated in this study are not suitable for testing programs where marijuana is the primary drug of interest. Because the devices did perform well in detecting opiates and methamphetamine they may be suitable for programs where one or both of these classes of drugs are of primary interest. For programs where cocaine or amphetamines are of interest, some devices may be suitable while others are not.

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Oral Fluids, Point of Collection Testing, Toxicology

K32 Detection of Ketamine in Urine of Nonhuman Primates After a Single Dose Using Microplate Enzyme-Linked ImmunoSorbent Assay (ELISA)

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After attending this presentation, attendees will understand the analysis of urine using newly developed ELISA screening technique for ketamine and its metabolites.

The general anesthetic ketamine (Ketalar®, Ketaject, Vetalar) (KET) is used in human and veterinary medicine for induction of anesthesia for short surgical procedures and routine veterinary examination. Its illicit use by teenagers in rave parties has been reported. It has recently been identified as a substance associated with sexual assault, so-called "date-rape" drug. Sexual predators use it for the purpose of "drugging" unsuspected victims and raping them while under the influence of the drug. The objective of this study was to apply and evaluate a newly developed ELISA screening methodology for detection of KET and its metabolites in urine samples collected from five non-human primates which received a single dose of KET, and to study how long after drug administration, KET and its metabolites can be detected. The test kits and a microplate reader were kindly provided by the Neogen Corporation, Lexington, KY. The data are of great importance to law enforcement agencies and the forensic toxicology community in order to determine how long after sexual assault the urine samples can be collected from the victim to successfully prosecute the perpetrator. This study was reviewed and approved by the University of Illinois at Chicago Animal Care Committee. The aim of this study was: 1) to apply ELISA screening for detection of KET and its major metabolites directly in 20 µl of urine, 2) to increase a detectibility by extracting urine samples prior to ELISA screening, 3) to compare results from ELISA screening with previously obtained results of NCI-GC-MS analysis of urine samples for KET and its major metabolite norketamine (NKET).

Method: Urine was collected from five stumptail macaques (*Macaca arctoides*), four females (8-19 kg) and one male (17 kg) caged individually. All animals received a wash-out period of six months prior to the experiment. One urine sample was collected from each animal before KET administration. All monkeys received a single dose (5 mg/kg, I.M.) of KET. This dose represents an average I.M. dose in humans (3-8 mg/kg). Urine samples were collected from each animal for 18 hours every day (excluding weekends) up to 24 days then once every four days up to 35 days.

Urine screening procedure: The kit was first tested using urine spiked with KET or NKET at the following concentrations: 0, 5, 10, 25, 50, 75, 100, 500, 1000, 1500, and 2000 ng/ml. They were tested using the following procedure: 20µl of sample or control (positive or negative) was added to the appropriate well. 180 µl of a 1 to 180 dilution of enzyme conjugate in Neogen's EIA buffer was then added to each well. The plate was then covered with parafilm and incubated at room temperature for 45 minutes. Each well was then washed three times with 300 ?l of Neogen's wash buffer. 150 µl of Neogen's K-Blue Substrate was then added to each well and then incubated at room temperature for 30 minutes. The plate was gently shaken periodically throughout the incubation. To insure uniform color development. 50 µl of Neogen's Red Stop Solution was added to each well in order to stop the reaction. The plate was read at 650 nm. After the limitations of the kit and cross-reactivity with NKET were established, urine collected from monkeys dosed with ketamine was tested for the presence of KET.

Extraction: All urine samples (2 ml) were extracted from urine using HCX solid phase extraction (SPE) columns. To all control and study samples, 0.1 M acetate buffer (pH 4.5, 1 ml) and crude β-glucuronidase solution (50 µl) were added, and samples were incubated for 1.5 hours at 37^0C. After incubation 1.93 M acetic acid (1 ml) and deionized water (10 ml) were added. Each SPE column was conditioned with methanol (3 ml) deionized water (3 ml) and 1.93 M acetic acid (1 ml), the sample was added and the column was washed with deionized water (3 ml), 0.1 N HCl (1 ml) and methanol (3 ml). The final elution from the extraction column was achieved using methylene chloride:isopropanol:ammonia (78:20:2:, v/v/v, 3 ml). All extracts were evaporated to dryness in the stream of nitrogen, dissolved in 20 µl of the Neogen's buffer and transferred to microplates. They were treated as described above.

Results: KET and NKET were determined to be easily detectable at 25 ng/ ml. In one monkeys KET and its metabolites were detected in urine up to four days after drug administration, in two up to seven days, in one up to eleven days, and in one animal sixteen days after KET injection. Urine extraction followed by screening using ELISA methodology allowed for significant extension of the detection period in all animals from the study.

Date-Rape Drugs, Ketamine, ELISA

K33 2,5-Dimethoxy-4-n-propylthiophenethylamine (2C-T-7) Dose Response Relationship in the Rat

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Attendees will be exposed to a model for studying the pharmacological properties of 2C-T-7 in the rat.

This report will provide novel analytical and behavioral protocols for studying the pharmacological properties of 2C-T-7, a drug that has been recently detected in postmortem cases in the United States.

Sprague-Dawley rats, 200-250 gms, were given 2C-T-7 by intraperitoneal (ip) injection to establish both a lethal and a high pharmacological dose. The doses included 5, 25, 37.5, 50, 70, and 100 mg/kg with a group size of 5. The measurements consisted of behavior, body temperature, and 2C-T-7 tissue concentrations in blood, brain, lungs, liver and heart. 2C-T-7 was quantified using a liquid-liquid extraction with trimethoxyamphetamine as internal standard. Tissues were first treated with dilute perchloric acid (8% v/v) then centrifuged. The supernatant was transferred and the pH of the specimens and standards was adjusted to > 10 by addition of ammonium hydroxide. 1-Chlorobutane was added to the standards and specimens and they were placed on a rotary extractor for ten minutes and then centrifuged. The upper solvent layer was transferred to 5.0 mL conical test tubes and the solvent evaporated to dryness using a nitrogen evaporator with a water bath set at 40°C. The dried extracts were reconstituted in 50 uL of chloroform and placed in glass autosampler vials. The samples were then analyzed by gas chromatography-EI mass spectrometry utilizing selected ion monitoring. The instruments and conditions were as follows: Agilent 6890 gas chromatograph, with a 15 meter HP-1MS (100 % methyl polysiloxane), 1.0 mL per minute helium carrier gas flow, 250°C injector port, 300°C detector interface, oven 120°C ramped to 300°C at 20°C per minute. The ions monitored were 226, 255, 183 m/z for 2 C-T-7 with the 226 m/z used as the quantitation ion and 182 m/z for the internal standard.

TABLE 1. Tremors and Convulsions After 2C-T-7 Administration

Dose (mg/kg,ip)	5	25	37.5	50	100
Rats (#)	5	5	5	19	5
Tremor	0	0	2 (40%)	2 (11%)	4 (80%)
Automatisms (Jaw)	0	0	2 (40%)	5 (26%)	2 (40%)
Myoclonic Jerks	0	0	1 (20%)	4 (21%)	3 (60%)
Intermittent Myoclonus	0	0	0	3 (16%)	3 (60%)
Jacksonian-like	0	0	0	1 (5%)	1 (20%)
Tonic-Clonic	0	0	2 (20%)	5 (26%)	5 (100%)

Physiological events resulting from the 2C-T-7 are listed in Table 1. At the 100 mg/kg dose, the animals died in 19.6 ± 10.7 minutes (range 9-35) from suffocation and/or convulsions. A straub tail followed by a tonic-clonic convulsion occurred at 9.6 ± 1.5 minutes (range 7-13). The 50-mg/kg ip dose was selected as the high pharmacological dose with one hour being past the absorption phase. Only three out of 90 rats died within that time interval (30, 42,and 55 minutes). Behavioral effects occurred within 2 minutes post 50mg/kg ip dose with peak effects between 30 and 60 minutes; at 17 hours post dosing 30% of the rats still had intermittent tremor and body jerks. No obvious behavior effects occurred post 24 hours. After the 50-mg/kg ip dose there was no significant body temperature change in the 2.5 hour measurement period. A temperature elevation did not occur at any dose. A small (2ºC maximum) but significant decrease occurred after the 5, 25 and 37.5 mg/kg ip dose. 25mg/kg ip dose had greater temperature effects. Lethal 2C-T-7 tissue concentrations after the 100mg/kg dose were 23.9 ± 9.3 µg/ml for blood, 21.3 ± 9.0 µg/gm for brain, for 285.9 ± 156.0 mg/gm lungs 51.4 ± 9.2 µg/gm for heart and 126.3 ± 94.6 µg/gm for liver. Lethality in the rat is an LD_{50} of 69 ± 8 mg/kg with a minimum observed lethal dose at 37.5 mg/kg.

In conclusion, a 2C-T-7 rat model has been established to study the dose-response relationship for 2C-T-7. Future research is needed to elucidate the complete pharmacological profile of this drug.

2C-T-7, Phenethylamine, Behavior

K34 Use of MDA (the "Love Drug") and Methamphetamine in Toronto by Unsuspecting Users of Ecstasy (MDMA)

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Attendees will learn that a variety of amphetamine derivatives are now being marketed to ecstasy users in Canada who request only ecstasy (MDMA) from the drug supplier. More importantly, discussion at the presentation will offer explanations for the reasons why illicit drug manufacturers are including MDA and methamphetamine in ecstasy tablets despite the absence of any specific demand for these drugs.

This presentation will alert the forensic community and the general public to an emerging trend of illicit drug use in Canada and stimulate discussion, which will attempt to provide the basis for this change in recreational drug marketing.

Background and specific aim. MDA (3,4-methylenedioxyamphetamine), previously known as the "love drug", is a synthetic amphetamine derivative, which has been used illicitly in part for its reported ability to induce a state of heightened empathy and introspection. Although MDA was a commonly used drug thirty years ago, the present drug of choice in the "entactogen" class of drugs is the related compound "ecstasy" (3,4-methylenedioxymethamphetamine, MDMA), which can be metabolized to MDA in the human. Most users of the drug "ecstasy" expect that they are obtaining MDMA.

As death has occurred following ingestion of MDA and MDMA, it is important to establish the extent of use of either drug by the public as well as emerging trends of drug use. Typically, marketing of an illicit drug is determined to a large extent by true demand. However, demand can also be influenced by the surreptitious inclusion by the clandestine laboratory of additional substances in the drug formulation, which enhance the desired effects of the drug "cocktail."

The purpose of our pilot investigation was to establish the identity of the drug(s), which are marketed and used in the Toronto area as ecstasy. For this purpose, we conducted forensic drug hair analysis of subjects who requested from their drug supplier tablets, which contain only ecstasy (MDMA). Our hair data, together with local drug seizure findings, indicate that despite an absence of any specific demand, the drugs MDA and methamphetamine are now being marketed to unsuspecting ecstasy users.

Methods: Levels of psychostimulants (ecstasy, MDA, MDEA, PMA, PMMA, methamphetamine, amphetamine, cocaine, and metabolites), ketamine, PCP, and opiates (heroin, morphine and metabolites, codeine) were measured by GC-MS in consecutive one half-inch segments of scalp hair taken from the back of the head of 21 drug users who reported that ecstasy (MDMA) was the only drug requested over the period of time corresponding approximately to the extent of growth of scalp hair (one month/one half-inch of hair) with the exception, for some of the subjects, of use of cannabis and "mushrooms."

Major Findings; MDMA was detected in one or more one-half inch hair segments of 19 of the 21 drug users, providing good agreement between the results of a structured interview and the forensic drug analysis.

MDA could be detected in most of the hair samples, which tested positive for MDMA. In urine, autopsied brain, and hair of ecstasy users, the ratio of MDA to MDMA is approximately 0.20 or lower. Although no precise cut-off ratio has yet been established, high ratios MDA:MDMA (e.g., >1.00) are highly suggestive of use of both MDA and MDMA. Thus, of the 19 subjects testing positive for MDMA, 12 subjects had MDMA levels in hair much greater than those of MDA; or MDMA in the absence of any MDA, suggesting selective use of MDMA; whereas 7 subjects had levels of MDA equal to or much greater than those of MDMA, indicating use of both MDMA and MDA. One female subject, in particular, tested positive for MDA in a total of 23 of 26 examined one half-inch hair segments (representing about two years of hair growth), with relatively low levels of MDMA in only two segments, indicating primary or exclusive use of MDA for this extensive period of time.

Hair analysis also revealed that amphetamine/methamphetamine was detected in a total of 8 of the 21 subjects.

Analysis of contents of seized suspected ecstasy tablets in the southern Ontario area confirmed presence of MDA and methamphetamine alone or in combination with MDMA. Estimates are that about half the tablets submitted for analysis in Ontario as ecstasy contain only MDMA. The remainder contain one, a few, or several of the following components: MDMA, MDA, MDEA, methamphetamine, ketamine, caffeine, ephedrine, pseudoephedrine, and/or phencyclidine. Eleven clandestine laboratories producing either MDMA or MDA were seized in southern Ontario during the time period January 2000 to June 2003. Of those eleven, three produced only MDMA; three only MDA; three MDMA, MDA, and methamphetamine; and two MDMA and methamphetamine.

Conclusions: Ecstasy users need to be advised that MDA and methamphetamine are being marketed as ecstasy despite the absence of any specific demand for these amphetamine derivatives. Possible reasons for the clandestine laboratory operators to include MDA and/or methamphetamine in their "ecstasy" preparations are related to either the syntheses involved or the effect that the added (substituted) drugs will have on the user.

Conversations with two MDMA / MDA clandestine lab operators indicated that they perceived that the preparation of MDA is simpler than that of MDMA. In addition, they believed that the chemicals needed to synthesize MDA were easier to obtain and were not monitored (by the authorities) as closely as those for the synthesis of MDMA. While neither of these statements is necessarily true, it is the underground chemist's perception that is important. It is also possible that MDA is included in some ecstasy preparations because of its reputed higher potency and longer half-life. Methamphetamine might be included in ecstasy tablets to provide enhanced stimulant effects and to maintain and increase market size because of the addiction potential of the drug.

Finally, our observations confirm that studies designed to determine whether ecstasy alone might cause brain damage need to confirm by forensic drug testing whether ecstasy was the only illicit drug used by the subject.

The opinions and assertions contained herein are the private views of the authors and are not to be construed as official or as reflecting views of the United States Departments of Army or Defense, or of Health Canada.

Ecstasy, MDA, Methamphetamine

K35 Postmortem Morphine Concentrations – Are They Meaningful?

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The goals of this presentation are to review factors influencing postmortem morphine concentrations and to compare concentrations in terminally ill patients to a varied population. The presentation will provide recommendations for interpretation of postmortem morphine concentrations, as well as, describe how these factors can influence the cause and manner of death.

Introduction: Morphine is a strong opioid agonist that has become the drug of choice for the treatment of moderate to severe pain associated with cancer and in palliative and terminal care. One of the most daunting tasks for forensic pathologists is interpretation of the toxicological findings. This is especially difficult in decedents with multiple medical problems who receive morphine and other opioids for comfort care in the terminal stages of disease, in which high concentrations may be suspicious for euthanasia. Many factors will alter postmortem morphine concentrations. Intrinsic factors include general health, disease processes, renal failure and hepatic function. Postmortem factors include the postmortem interval, site of specimen collection, and postmortem redistribution. Medication factors include dosing, frequency, duration of exposure to opioids and tolerance to opioids. Published therapeutic and toxic values of morphine are typically based on measures in living, non-chronic users, and postmortem data obtained from terminal patients receiving morphine for comfort measures is lacking.

Methods: We conducted a retrospective review of medical examiner cases with morphine identified in the toxicological evaluation. More than 50 cases from the District 5 Medical Examiners Office in Leesburg, Florida from the years 2001, 2002 and 2003 were identified. Included were deaths that occurred at home, with and without hospice care; in nursing homes and assisted living facilities, with and without hospice care; and deaths that occurred in a hospital, inpatient setting. Cases involving heroin use, those with incomplete medical records, or decedents who were embalmed were excluded from the study. Antemortem medical records were reviewed for age, general health status, and disease processes with special attention to evidence of renal and hepatic failure. In addition, medication schedules and dosing were reviewed, as well as, length of time receiving morphine and previous exposure to opioids. The autopsy files were reviewed for cause and manner of death, confirmation of disease processes, site of specimen collection and the time interval from death to acquisition of specimens (postmortem interval).Toxicological analyses were performed according to standard laboratory protocol using gas chromatography-mass spectrometry for identification and quantitation of morphine. Morphine concentrations in blood were measured as free and total morphine.

Results: Evaluation of the data revealed an age range from mid 40s to early 90s. Disease processes were highly varied including cancer, dementia, acute injury and chronic pain due to injury and other causes. The data showed a wide range of morphine concentrations from less than the defined therapeutic values to more than 20 times the therapeutic value (as compared to non-chronic users). The reported cause and manner of death varied from natural death resulting from end-stage disease processes to accidental deaths from injury and morphine toxicity. The results of our study mirror previous studies with elevated postmortem morphine concentrations in decedents with renal failure, chronic use of opioids and collection of specimens from central sites. Morphine concentrations were highly variable in decedents who were terminally ill and receiving morphine for comfort measures.

Conclusion: It is important for forensic pathologists to be aware of all factors that influence postmortem morphine concentrations before deciding how these values influence the determination of cause and manner of death. Postmortem morphine concentrations were elevated in decedents with renal failure because of a decreased ability to excrete the drug. Decedents with chronic illness, cancer, and liver failure had a decreased ability to metabolize the drug. Decedents with tolerance to opioids had higher postmortem concentrations beyond the defined therapeutic range. Specimen site must also be considered, as concentrations are higher when collected from a central site versus a peripheral site. Special attention to these variables is required when the decedent was terminally ill and receiving morphine for comfort measures, as the concentrations are highly variable. The significance of a prolonged postmortem interval in these cases is unknown.

In summary, when an elevated postmortem concentration of morphine is reported, an exhaustive search of the medical records must be conducted. Information obtained should include underlying disease processes, medication schedules and dosing and evidence of length of time on morphine, previous exposure to opioids and development of tolerance. Postmortem interval should be noted and communicated to the forensic toxicologist. This information, when considered, will be important when declaring the cause and manner of death.

Morphine, Postmortem, Interpretation

K36 A Review of Succinylmonocholine Concentrations in Body Fluids and Tissues Analyzed by LC-MS/MS

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The objective of this data compilation was to summarize analytical findings for succinylmonocholine from a wide variety of forensic and clinical specimen types obtained over a period spanning four years, along with a statistical analysis of the data set; also, the identification of basal levels of succinylmonocholine in normal postmortem mammalian tissues.

Demonstration of presence of succinylmonocholine in postmortem tissue samples known not to have been exposed to succinylcholine, and presentation of levels of this compound in a variety of postmortem samples.

Succinylmonocholine is the initial breakdown product of succinylcholine (succinyldicholine), a quaternary ammonium neuromuscular blocking agent often used during surgical procedures. Succinylmonocholine is rapidly generated as a metabolite from succinylcholine by cholinesterase enzymes and, more slowly, by chemical degradative processes. Very seldom is succinylcholine itself detected, due to its very short half-life in biological systems; rather, its more stable initial metabolite, succinylmonocholine, is detected. Succinylmonocholine further breaks down to succinic acid and choline, both of which are found as normal constituents in biological matrices.

Succinylmonocholine is of forensic toxicological interest because, as the initial metabolite of succinylcholine, it is potentially useful for the identification of exposure to succinylcholine, particularly in suspected poisoning cases. In conjunction with such forensic cases (as well as numerous clinical cases), this laboratory has analyzed a wide variety of specimen types for succinylmonocholine (and other quaternary ammonium neuromuscular blocking drugs including succinylcholine itself). The analyses were performed using an initial liquid-liquid extraction procedure, followed by a reverse phase ion-pairing solid phase extraction procedure. The final extracts were analyzed for neuromuscular blocking agents by high performance liquid chromatography-tandem mass spectrometry (LC-MS/MS), using either a tandem quadrupole instrument or a hybrid tandem quadrupole-time of flight (Q TOF) instrument.

Analytical samples varied widely in age and condition, ranging from relatively fresh clinical specimens to embalmed, exhumed specimens up to ten years old. Specimen types included: kidney, liver, brain, diaphragm, lung, urinary bladder, spleen, psoas muscle, urine, blood from various sources, skin, buttock, thigh muscle, mixed tissue, right biceps, clots from various locations, fat, kidney fluid, liver fluid, serum, renal medulla, renal cortex, formalin, plasma, bile, and bone marrow. More than 250 individual specimens were analyzed over a four-year period. Analytical findings ranged from none detected (with a typical detection limit of 1 ng/g) in most specimens to an extreme value of 7400 ng/ml in a clinical urine sample. Data from all of these analyses will be presented along with statistical analysis of the data set. Of significant interest is the identification of basal levels of succinylmonocholine in fresh autopsy specimens from individuals known not to have been exposed to succinylcholine prior to death. Typical values for these specimens were in the 10-30 ng/g range for postmortem human liver and kidney, with similar values also observed for bovine and porcine tissues. We are not aware of any prior literature documenting the presence of succinylmonocholine in normal postmortem mammalian tissues.

Succinylmonocholine, Postmortem, Tissue Concentrations

K37 Postmortem Ropivacaine (Naropin) Concentrations

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After attending this presentation, attendees will understand postmortem concentrations of ropivacaine in biological fluids and tissues of an accidental overdose during a routine surgery involving an axillary block.

To report the concentrations of ropivacaine found in post-mortem tissue and fluid samples from a patient who died after being administered ropivacaine in a surgical setting. This is to provide post-mortem concentrations in the literature for ropivacaine, a drug that thus far has not been reported in this context.

Introduction: Ropivacaine is a local anesthetic indicated for surgical and acute pain management. It is manufactured by AstraZeneca under the name Naropin® and received FDA approval in late 1996. Ropivacaine is an amide local anesthetic, belonging to the same group as mepivacaine and bupivacaine, and is supplied as the enantiomerically pure *S*-isomer in isotonic solutions (0.2-1.0 % w/v) of the hydrochloride salt. Ropivacaine has similar potency and duration of action to bupivacaine but has less central nervous system (CNS) and cardiovascular toxicity. Ropivacaine is used as an epidural injection for surgery, obstetric procedures, and postoperative pain. Additionally, it is used in the technique of peripheral nerve block and local infiltration for surgical procedures.

A case study is presented to document the post-mortem concentrations of ropivacaine found in an individual who was to undergo open reduction and external fixation surgery on his left hand. The deceased, a 32-year-old, healthy, male Caucasian, was administered midazolam and fentanyl for sedation prior to entering the Operating Room (OR). Once in the OR, he was given ropivacaine (30 mL of a 0.5% solution; 150 mg) via an axillary block whereupon he began to seize and subsequently die in the recovery room despite 2 hours of resuscitative work, which included bicarbonate, epinephrine, and electrical shocks.

Methods and Results: Ropivacaine was extracted from the samples by liquid-liquid extraction with *n*-butyl chloride: ether (4:1) after basifying the matrix with ammonium hydroxide. Extracts were back-extracted with 1M sulfuric acid, which was further washed with hexane. After re-basifying the aqueous phase, ropivacaine was extracted with *n*-butyl acetate. The extracts were analyzed by electron ionization gas chromatography/mass spectroscopy, operating in the selected ion monitoring mode, utilizing lidocaine as the internal standard. The following groups of ions (*126*, 84, 98) and (*86*, 120, 91) were monitored for ropivacaine and lidocaine, respectively, with a calibration curve ranging from 0.1-2 mg/L.

The results of the toxicological analyses performed for ropivacaine are shown in the table below. The method of standard addition (SA) was utilized for the liver and bile. The central blood was also found to contain therapeutic concentrations of midazolam (0.05 mg/L) but fentanyl was not detected. The empty vial of ropivacaine HCl used in the OR and an unopened bottle (0.5 %) of the same lot number were also submitted for toxicological analysis. The results of the pharmacy samples were positive for ropivacaine and 4400 mg/L ropivacaine, respectively, as expected.

Source of Sample	Aorta	Femoral	Liver (SA)	Vitreous Humor	Bile (SA)
Ropivacaine	2.4 mg/L	2.0 mg/L	4.4 mg/kg	1.4 mg/L	1.9 mg/L

Discussion: Ropivacaine was developed in response to the incidence of death from several accidental intravascular injections of bupivacaine. The rationale for developing ropivacaine (the propyl analog of bupivacaine) was a drug of lower lipid solubility to bupivacaine would be less cardiotoxic. Unintended intravenous injection may, however, still cause severe CNS- and cardiac toxicity. Systemic plasma concentrations of ropivacaine depend on the total dose and concentration of drug administered, the route of administration, and the vascularity of the administration site. The recommended dose of ropivacaine is between 75-300 mg for most surgical anesthesia (epidural and major nerve block).

CNS symptoms of ropivacaine toxicity occur before cardiovascular symptoms and include numbness of the tongue, lightheadedness, visual disturbances, muscular twitching, tinnitus, and more seriously, convulsions and coma. Cardiovascular toxicity is a result of depressed cardiac conduction due to inhibition of inward flow of sodium ions, which may lead to ventricular arrhythmias and cardiac arrest. The greater tolerance to ropivacaine compared to other local anesthetics, however, may hide the early warning signs of toxicity. In two human studies (n=24) of continuous intravenous infusions of ropivacaine at a rate of 10 mg/min up to a maximum dose of 160 mg, symptoms of CNS toxicity occurred at plasma concentrations between 0.5 and 3.2 mg/L. Minimal cardiovascular effects were observed during these studies and included increased heart rate and arterial pressure.

The concentrations of total ropivacaine found in the post-mortem whole blood specimens of the deceased were consistent with those reported (1.0-6.0 mg/L; medium 3.5 mg/L) from the peripheral venous plasma samples (taken at various time intervals, 7-150 minutes, after administration) in six cases where inadvertent intravascular injection of ropivacaine during surgical procedures caused convulsions and cardiovascular toxicity. In addition, ropivacaine is highly protein bound (94%) and the whole blood concentrations reported here will, therefore, be more dilute compared to plasma concentrations. The patients in all the reported cases recovered. During surgical procedures, negative aspirations for blood and CSF fluid alone are not enough to ensure that inadvertent intravascular injection has not occurred; incremental administration and constant communication with the patient is essential to prevent accidental overdose.

In the absence of a history of illness, especially epilepsy and cardiovascular disease, and the timing of the seizure in relation to the administration of ropivacaine, it is probable that the levels reported here are indicative of fatal ropivacaine levels seen in post-mortem fluids and tissues due to inadvertent intravascular injection of the drug. These levels can be used in toxicological interpretations as to possible cause of death in subsequent investigations.

Ropivacaine, Local Anestheisa, Toxicity

K38 A Multi-Drug Fatality Involving the Highest Reported Level of Venlafaxine in London, UK

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Attendance at this presentation will enable the participant to study a British toxicological case involving alcohol and several other drugs including the highest recorded level of venlafaxine in London. The presentation will also enable the participant to learn how such cases are processed by the Forensic Toxicology Service in London, UK.

The case is an interesting one as it is the first multi-drug case involving such high concentrations of venlafaxine, in addition to a significant amount of alcohol, paroxetine, paracetamol and some tricyclic antidepressant drugs too. Considering the lack of any other significant autopsy findings, the results of our toxicological analyses are consistent with the assumption of a fatal overdose of alcohol and several drugs, including the highest measured levels of venlafaxine in the London area.

The Forensic Toxicology Service offers a screening and quantification toxicology service to most of Her Majesty's Coroners and Forensic Pathologists in London as well as various Police Forces and one branch of the Armed Forces. As a result, we are required to screen for a large number of prescribed and illicit drugs in post-mortem specimens followed by quantification of those detected. All analyses must be completed and our final report must be submitted to the Courts within 15 business days of the arrival of the case at the Service. This case was presented to the Service in May 2003, and involved a 50-year-old Caucasian female who had a history of mild depression during the previous 2 years and who had previously made two unsuccessful suicide attempts involving drug overdosing during the preceding two months. The Service was requested to subject the unpreserved post-mortem blood specimen of the deceased to our standard alcohol and general drug screen in order to facilitate HM Coroner in his Inquest into this death.

The blood alcohol was determined at a level of 174mg/dL. Paracetamol (i.e., acetaminophen) was found present at a concentration of 55mg/L but no salicylates were detected in the case specimen. Our benzodiazepine screen by LC-MS-MS on this specimen did not detect any benzodiazepines or metabolites. Using our standard liquid-liquid drug extraction scheme for basic (i.e., alkaline) drugs followed by gas chromatography – mass spectrometry (GC/MS), we were able to identify in the case specimen venlafaxine and its major metabolite, in addition to paroxetine, amitriptyline and nortriptyline. When quantified by GC/MS, venlafaxine measured 139.0mg/L and paroxetine measured 7.0mg/L. HPLC with UV detection was used to quantify amitriptyline and nortriptyline, which measured at 3.2mg/L and 0.9mg/L, respectively.

Venlafaxine is readily prescribed in the United Kingdom to treat depression under the trade name Effexor® tablets (37.5, 50 or 75 mg) and Efexor® XL modified release capsules (75 or 150 mg). Paroxetine is prescribed in the United Kingdom to also treat depression as well as obsessive-compulsive disorder and panic disorder under the trade name Seroxat® in tablets (20 or 30 mg) or liquid (10mg/5mL). Recently, there has been considerable debate regarding its safety. Amitriptyline continues to be a commonly prescribed sedative antidepressant in the UK on its own (non-proprietary as 10, 25 or 50 mg tablets), or in combination with perphenazine (Triptafen®, Triptafen®-M). Nortriptyline is also used to treat depression under the trade name Allegron® as 10 or 25 mg tablets or in combination with fluphenazine (Motipress® and Motival®).

The case is an interesting one as it is the first multi-drug case involving such high concentrations of venlafaxine, in addition to a significant amount of alcohol, paroxetine, paracetamol and some tricyclic antidepressant drugs too. Considering the lack of any other significant autopsy findings, the results of our toxicological analyses are consistent with the assumption of a fatal overdose of alcohol and several drugs, including the highest measured levels of venlafaxine in the London area.

Venlafaxine, Paroxetine, Multi-Drug Fatality

K39 Methadone Concentrations and Concurrent Drug Findings in Three Populations; Methadone Treatment Patients, Impaired Drivers, and Death Investigation Cases

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In this presentations, authors will compare methadone concentrations and concurrent drugs in three populations, to assist in interpretation of data.

Forensic Toxicologists are often asked to interpret levels of drugs in drivers and death investigations. Questions arise as to the significance, when the subject is in a methadone treatment program. In evaluating this data, it is helpful to know levels detected in treatment patients and the typical co-ingested drugs. Tolerance and drug-drug interactions can greatly influence the role of methadone in death or impairment.

Methadone is an important analgesic drug and also has a significant role in replacement therapy for individuals stopping opiate abuse. The significant narcotic analgesic effects of the drug, its frequent combined use with other CNS depressants, and the significant tolerance that can develop in long term users make methadone concentrations difficult to interpret. We evaluated methadone concentrations in three populations; individuals enrolled in a methadone treatment program who received daily controlled doses of methadone, individuals arrested for impaired driving who subsequently tested positive for methadone, and in deceased individuals who tested positive for methadone in postmortem toxicology screening. The treatment population was an urban population of 76

patients (50% male). Methadone doses ranged from 9mg to 250mg/day (mean 94mg, median 100mg) and were invariably administered as syrup. Samples were collected during a periodic medical evaluation, and were collected within 0-3.5 hours of administration of the daily dose. Methadone concentrations in this population ranged from 0.013 to 0.85mg/L (mean 0.29mg/L, median 0.29mg/L). These samples were collected anonymously and there was no information available regarding their medical examination. All patients however were ambulatory and many had driven to their appointments at the clinic. The second group studied were individuals whose driving or behavior had resulted in them being arrested, suspected of drug impaired driving. Over an 18 month period, 67 cases tested positive for methadone. The population was 73% male with a median age of 43. The average concentration of methadone in this group was 0.24mg/L (median 0.19mg/L), with a range of 0.015 to 0.83mg/L. Driver behaviors in this group included CNS depression, confusion, disorientation, incoordination, and physiological parameters consistent with intoxication from narcotic analgesics. We were not able to assess any relationship between drug concentrations and degree of effect. Finally, over the same 18month period, methadone was detected in autopsy samples from 224 deceased individuals (70% male, median age 43). Deaths were attributed to a variety of causes, not all drug related. The average methadone concentration was 0.48mg/L (median 0.26mg/L) within a range 0.05 to 7.4mg/L. We will present several case studies in the impaired driving and death investigation groups. It was concluded that the range of concentrations in ambulatory populations exceeded that previously reported for the normal therapeutic range (0.35 – 0.56mg/L), and that deaths were often attributed to methadone intoxication in the absence of other obvious causes at concentrations within the range frequently encountered in these other ambulatory populations. Consideration of the presence and concentrations of other co administered drugs, the individual's enrollment in a supervised methadone program, and the length of time they had been taking the drug are important factors in being able to assess the significance of methadone in death investigations.

Methadone, Impaired Drivers, Death Investigation

K40 Postmortem Fentanyl Concentrations Following High-Dose Transdermal Administration

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The authors intend to present postmortem fentanyl concentrations from a patient that was receiving high-dose transdermal fentanyl.

This presentation will report postmortem fentanyl concentrations following high dose transdermal administration. The reported case will provide information that will assist with the interpretation of postmortem fentanyl concentrations.

Fentanyl is a synthetic opioid analgesic that is approximately 50-100 times as potent as morphine. It is used as an adjunct to surgical anesthesia and for the management of chronic pain. Transdermal fentanyl patches (Duragesic®) are available for chronic pain management in delivery doses of 25, 50, 75 and 100 mcg/hr. Steady-state serum fentanyl concentrations reported for the 25, 50, 75 and 100 mcg/hr patches are 0.3-1.2 ng/mL, 0.6-1.8 ng/mL, 1.1-2.6 ng/mL and 1.9-3.8 ng/mL, respectively.

A case was received at the State of Delaware Office of the Chief Medical Examiner involving an AIDS patient who was receiving fentanyl for chronic pain. The decedent was a 43-year-old black male who resided alone in an apartment. He was diagnosed as HIV + in 1985 which had since progressed to full blown AIDS. According to his physician, he was dying from End Stage AIDS and had developed a staphylococcal infection of the spine. He suffered from severe pain and was initially receiving morphine for pain management. Approximately 6 to 7 months prior to his death, the decedent was prescribed Duragesic® patches for pain management. The dose was gradually increased and at the time of his death he was wearing eight 100 mcg/hr Duragesic® patches as well as receiving morphine and oxycodone for breakthrough pain. According to his physician, the decedent continued to work and function normally even at this high dose of medication. He often traveled out of town to visit friends and relatives. His physician also described him as a compliant patient.

The decedent was found dead in bed when his niece requested the police check on his welfare because he failed to show up for a doctor's appointment two days earlier. Early decompositional changes were present at the time the decedent was found. The decedent was brought to the OCME for examination because the investigator noted eight 100 mcg/hr Duragesic® patches on his thighs and was concerned he may have overdosed. During the postmortem examination, the specimens collected for toxicological analysis included subclavian blood, antecubital blood, liver and urine.

Fentanyl was analyzed in biological specimens by solid phase extraction followed by electron ionization gas chromatography-mass spectrometry (SIM mode). Quantitation was performed with deuterated fentanyl as an internal standard and a 6-point calibration curve ranging from 1.0-50 ng/mL. The concentrations of fentanyl in the various specimens analyzed are summarized in the table below:

Specimen	Fentanyl (ng/mL or ng/g)	Other findings
Subclavian Blood	35	Oxycodone: 119 ng/mL
Antecubital Blood	33	Oxycodone: 76 ng/mL
Liver	352	None
Urine	175	Oxycodone: 222 ng/mL

The blood and liver fentanyl concentrations in this case are significantly higher than the reported therapeutic concentrations for fentanyl. However, these fentanyl concentrations are consistent with the high dose of fentanyl that the decedent was receiving. Since the decedent was known to tolerate this high dose of fentanyl and function normally, the death was not ruled a fentanyl overdose. The cause of death was attributed to end stage acquired immunodeficiency syndrome and the manner was ruled natural. This case illustrates the importance of obtaining a comprehensive case history along with the autopsy and toxicological findings when determining cause of death.

Fentanyl, Transdermal, Postmortem

K41 Determination of Clozapine and Desmethylclozapine in the Postmortem Blood of a Schizophrenic Patient

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Attendance at this presentation will enable the participant to study a toxicological case involving the determination of clozapine and its metabolite, desmethylclozapine, in the blood of a schizophrenic patient who suddenly collapsed and died after recently switching to this medication. The presentation will also enable the participant to learn how such cases are processed by the Forensic Toxicology Service in London, UK.

This presentation is important to the toxicological and analytical community as it is the first such case in our London Service involving a possible toxicological involvement of clozapine. Our determination of

clozapine and metabolite in the case blood specimen levels appears to be in agreement with previously published data on the significant post-mortem redistribution of clozapine. Our findings, when considered in the light of data from the drug manufacturer's therapeutic drug monitoring scheme, do not support the hypothesis that clozapine was directly involved in this death, despite the apparently high concentrations of the drug and its metabolite, probably due to the significant post-mortem redistribution.

The Forensic Toxicology Service offers a screening and quantification toxicology service to most of Her Majesty's Coroners and Forensic Pathologists in London as well as various Police Forces and one branch of the Armed Forces. As a result, we are required to screen for a large number of prescribed and illicit drugs in post-mortem specimens followed by quantification of those detected. All analyses must be completed and our final report must be submitted to the Courts within 15 business days of the arrival of the case at the Service. This case was presented to the Service in November 2002 and involved a 40-year-old Caucasian female with a history of schizophrenia who was committed under the UK's Mental Health Act. The deceased collapsed and died only 15 days after switching to this medication under medical supervision.

We were requested to analyze an unpreserved post-mortem blood specimen from the deceased using our standard alcohol and illicit drug screens, in order to facilitate HM Coroner in his Inquest into this woman's unexplained death. No other biological specimens were available.

Using appropriate calibrators, the case blood specimen was screened for alcohol and determined to be negative. Similarly, paracetamol (i.e., acetaminophen) and salicylates were not detected. Using our standard liquid-liquid drug extraction scheme for basic (i.e., alkaline) drugs followed by gas chromatography – mass spectrometry (GC-MS), we were able to identify clozapine and its major metabolite, desmethylclozapine, in the blood sample. When quantified by GC-MS using appropriate calibrators and controls, blood clozapine was determined to be 0.8 mg/L and blood desmethylclozapine measured 0.3 mg/L. Using our benzodiazepine screen by HPLC-MS-MS no benzodiazepines or metabolites were detected in the blood specimen. No amphetamines, methadone, opiates or cocaine were detected in the sample.

Clozapine is prescribed in the United Kingdom as an antipsychotic drug to treat schizophrenia in patients unresponsive to, or intolerant of, conventional antipsychotic drugs. It is prescribed in tablet form (25 or 100 mg) under the trade name Clozaril®. Patients on clozapine must be closely supervised and must participate in a therapeutic drug monitoring scheme sponsored by the drug manufacturer. Amongst clozapine's side effects are cardiac disorders such as arrhythmia, pericarditis, myocarditis, delirium and tachycardia.

After reviewing the scientific literature, it became apparent that it is most unusual for a patient to collapse and die within 15 days of switching to clozapine therapy. Although the measured concentrations of clozapine and its metabolite initially appeared relatively high, it is now well established that these substances undergo significant post-mortem redistribution and their concentrations increase several-fold after death (Flanagan et. al., 2003). Our case is important to the toxicological and analytical community as it is the first such case in our London Service involving a possible toxicological involvement of clozapine. Our determination of clozapine and metabolite in the case blood specimen levels appears to be in agreement with previously published data on the significant post-mortem redistribution of clozapine. Our findings, when considered in the light of data from the drug manufacturer's therapeutic drug monitoring scheme, do not support the hypothesis that clozapine was directly involved in this death, despite the apparently high concentrations of the drug and its metabolite, probably due to the significant post-mortem redistribution.

Clozapine, Desmethylclozapine, GC/MS

K42 DUI on Sunday at the Occasion of a Disco Weekend in the City of Bern, Switzerland: DUI Case Reports

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Authors will present recent DUI cases and to learn about the strategy to face this problem. Young adults using recreational drugs during the weekend often drive cars without showing distinct signs of impairment. These drivers, however, are a road safety problem.

A discotheque located near the main rail station in Bern reopens after a break of one hour its doors on Sunday at 5:00 am. The customers are usually socially integrated smart looking people. It is well known that this discotheque is a place where drugs are sold and consumed as well. Between April 24, 2002, and April 13, 2003, the police made six specific traffic controls checking customers driving off this place.

Methods: The drivers were checked by the police at the nearby station. The police used urine tests indicating Amphetamines, Cannabis, Opiates and Cocaine and a breathalyzer. The police filled in the Police report of suspected inability to drive safely. For the positive cases the next step was the medical examination. The MD took two blood samples and filled in the report of medical examination. In the laboratory the urine screening was performed by EMIT or in special cases by GC/MS. Alcohol was determined in the blood sample by head-space GC-FID. The quantitative determination of drugs in the blood samples was performed by GC/MS (opiates, THC, THC - COOH, cocaine, EME, BE), GC-NPD or HPLC-DAD (basic drugs), GC-ECD (benzodiazepines). The results were reported to the legal authorities.

At the occasion of the six specific traffic controls a total of 74 DUID cases were detected. In 15 of these cases Alcohol was present as well. Most of the persons showed Polytoxikomanie. Cannabis, Amphetamines and Cocaine were the most encountered drugs in these cases.

DUI, Amphetamines, Cocaine

K43 Estimate of the Incidence of Drug-Facilitated Sexual Assault in the United States

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After attending this presentation, attendees will 1) develop sensitive and quick method for the detection of 60 drugs and compounds that could be used as a "date-rape" drug, 2) determine which drugs victims of sexual assault have in their system following the crime, and 3) determine the prevalence of "date-rape" drugs in sexual assault victims.

This work will help to further elucidate the prevalence of drug-facilitated sexual assault among presenting sexual assault victims. Currently, the impact of "date-rape" drugs on society is unknown and only anecdotal evidence exists. The authors hope to confirm or deny this evidence by examining a non-biased sample of sexual assault victims.

Sexual abuse of both women and men, while under the influence of so-called "date-rape" drugs, has been the focus of many investigations in the U.S. Throughout the 1990s, an alarming increase in anecdotal reports of this crime as well as in the number of scientific publications on drug-facilitated sexual assault has been observed. In a typical scenario, a sexual predator surreptitiously spikes the drink of an unsuspecting person with a sedative drug for the purpose of "drugging" and subsequently sexually assaulting the victim while under the influence of this substance. Reported substances associated with drug-facilitated sexual assault include flunitrazepam, other benzodiazepines such as diazepam, temazepam, clonazepam, oxazepam, and also GHB, ketamine, scopolamine, and many other sedative-hypnotics, muscle relaxants, and antihistamines.

There are approximately 100,000 reported cases of sexual assault in the U.S. every year. It is estimated (Bureau of Justice Statistics) that there are more than 300,000 sexual assaults every year, three times the number actually reported. At present, there is no reliable data or estimates on the fraction of sexual assaults - actual or reported - that involve "date-rape" drugs. This project was designed to estimate the prevalence of drug-facilitated sexual assaults through a random sample of 135-150 sexual assault complaints from four reasonably representative U.S. jurisdictions. Sites include a location near San Diego, CA, one in Texas, one in the state of Washington, and one in Minnesota.

Prospective volunteers are asked if they would like to participate in the study, following a protocol approved by the UIC IRB. Those who enroll answer a set of questions concerning the general circumstances of the assault and which if any drugs the victim is using or has used. Victim's urine is then collected and refrigerated. The victim is then asked to return in one week to donate another urine sample and a hair sample. All of these samples are then sent to our laboratory where they are properly stored.The samples are analyzed for all drugs of abuse (cocaine, opiates, PCP, etc.) and any drug, over-the-counter or prescription that could be used to incapacitate someone. The classic "date-rape" drugs are analyzed for using highly selective and sensitive methods previously developed by this laboratory.

Thus far, thirty sexual assault victims have been recruited at the Texas location, forty one at the San Diego site, and 19 at the Minnesota site. The total number of sexual assault victims recruited into the study as of 6/30/03 is 90. Urine samples collected from 31 victims have thus far been screened by immunoassay for the "NIDA" drugs of abuse. All positive samples were confirmed by GC-MS following extraction and derivatization if appropriate. Out of the 31 patients, 13 provided only one (initial) urine sample. Twelve out of the 13 samples were positive for at least one drug (cocaine, marijuana, opiates, PCP, barbiturates, amphetamines or oxazepam). Eighteen victims provided initial and follow-up urine sample as well as a hair sample. Seven out of 18 initial samples were positive for drugs. In 5 cases both initial and follow-up sample was positive for drugs. In two cases the initial sample was positive for drugs but the follow-up sample was negative.

All 90 victims have been screened by GC/MS for the additional 30 drugs and substances commonly associated with sexual assault. Sixty-five of the victims were positive for at least one of the thirty drugs with twenty-two being positive for three or more drugs. All positive samples will be confirmed by GC/MS and additionally analyzed for GHB and valproic acid.

Samples are still being received and all new samples will follow the same analysis procedure. Once all samples have been collected (January 2004), the epidemiological analysis will determine how prevalent the drugs are in sexual assault complainants in these populations. We will also be able to learn more about the reliability of self-reporting of drug use among sexual assault victims by comparing our results to what drugs they have admitted to using. Conclusions will also be drawn about drug use and age group, race, and geographical location. This research will help determine if "date-rape" drugs are a serious problem, or if anecdotal reports have exaggerated their use.

Date-Rape Drugs, Prevalence, GC/MS

K44 "Slim 10" - Slim Chance

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This is a fatal case of fulminant hepatic failure, probably induced by N-nitrosofenfluramine, present as an adulterant in a weight-reducing, herbal product, sold as complementary medicine. It illustrates the difficulties and medico-legal issues encountered in the evaluation of the role of a specific nitrosamine in the causation of death, in the absence of published reports on its hepatotoxicity in humans.

It is hoped that knowledge of the avoidably tragic consequences of this case might alert users of sliming agents, including herbal preparations (generally regarded by the lay public as being safe), to exercise vigilance and discernment in their choice of these products. From a forensic perspective, it also indicates the need for more extensive, multidisciplinary research into the human hepatotoxic potential of the nitrosamines, especially in the case of N-nitrosofenfluramine.

Case History**:** A 42-year-old lady developed acute hepatitis, which rapidly progressed to fulminant hepatic failure and eventual multi-organ failure, after having ingested an unknown quantity of a herbal product over a period of some 4 months prior to the onset of her illness. The product contained the following ingredients: *Herba Gynostemmae, Folium Camelliae Sinensis, Succus Aloes Folii Siccatus, Semen Raphani* and *Fructus Crataegi.* It was officially listed as a form of Chinese Proprietary Medicine (CPM) and marketed as weight-reducing capsules, under the trade name "Slim 10." The probable cause of liver failure was clinically assessed to be drug-induced and she eventually underwent total hepatectomy, with porto-caval shunting, in anticipation of an allogenic (living unrelated) liver transplant. Unfortunately, her condition deteriorated and she died <48 hours post-operatively, some 3 weeks post-admission.

Post-mortem Findings**:** The subject was deeply jaundiced and severely obese (BMI: 47.1 kgm^{-2}), with evidence of diffuse hemorrhage, including the presence of nearly 1.5 l of blood in the peritoneal cavity (which was likely to be iatrogenic in nature). The liver had been removed and was later recovered as a formalin-fixed specimen, which was markedly contracted, comprising multiple micronodules interspersed with extensive areas of dense fibrotic tissue. Histologically, there was massive necrosis of the hepatic parenchyma, such that the residual hepatocytes were disposed as nodules displaying variable cellular regeneration and ballooning degeneration, attended by florid ductal proliferation and mixed inflammatory infiltrates (CD3+, CD20-). Infective, autoimmune, metabolic, vascular, neoplastic and most other natural causes of massive hepatocellular necrosis were effectively excluded.

Forensic Toxicology**:** Analysis of the post-mortem blood samples yielded (µg/ml) fluconazole (1.8), frusemide (3.1), lignocaine (0.59) and tramadol (0.11), which would have been therapeutic agents administered to the patient during her last illness. Subsequent analysis of a sample of residual "Slim 10" capsules (purchased by the patient) revealed that it was contaminated by fenfluramine, N-nitrosofenfluramine (1.3-1.6 g per capsule), nicotinamide (13.3 - 15.6 g per capsule) and thyroid extract.

Conclusion**:** None of the herbal ingredients is currently known to be hepatoxic (indeed, *Succus Aloes Folii Siccatus* is apparently liver-protective) and much the same applies to fenfluramine, nicotinamide

(except in exceptionally high doses, exceeding 3 g per day) and thyroid extract. However, as nitrosamines are known to be variably hepatotoxic, it would be reasonable to surmise that, in the absence of a more plausible cause of liver damage, N-nitrosofenfluramine was the likely cause of massive hepatocellular necrosis in this instance. The importer of the herbal product was later convicted of contravening the Medicines Act and was subsequently found by a Coroner's inquiry to be responsible for having caused death through an act of criminal negligence.

N-nitrosofenfluramine, Massive Hepatocellular Necrosis, Sliming Agent

K45 The Presence and Distribution of the Cocaine Like Stimulant Fencamfamine in a Postmortem Case

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Authors will report the detection of fencamfamine in a Medical Examiner's case, to remind the toxicology community of the abuse potential of this substance and to emphasize the internet as a modern source of illicit substances.

This presentation gives information about a banned, cocaine like drug over the internet and emphasizes the accessibility and harm of it to the public.

Fencamfamine (FEN, 2-ethylamino-3-phenylnorcamphane, Figure 1) is a conformationally-rigid, cyclic analog of amphetamine. It is approximately one tenth as active as d-amphetamine as a releaser of dopamine but possibly more potent than cocaine in some behavioral tests. In rodent models, FEN has been shown to produce central nervous system stimulation. In humans, FEN has been claimed to increase drive, mental alertness and feelings of well-being. It has been evaluated for the treatment of fatigue and depression and, at one time, was prescribed for its psycho-analeptic properties. Abuse of FEN has been reported among athletes and it has been sold in the United States as cocaine. Experts have suggested it would be very difficult for an individual to distinguish FEN, in combination with a local anesthetic, from cocaine. FEN is not currently available by prescription and is listed as a banned substance by most athletic unions.

We report a drug-related fatality in which small amounts of FEN were detected. Death in this 51-year-old female was attributed to the combined presence in blood of hydrocodone (0.62 mg/L), alprazolam (0.2 mg/L) and sertraline (0.32 mg/L).

FEN was isolated from post-mortem specimens by extraction into 1-chlorobutane at an alkaline pH. Separations were achieved on a DB-5 capillary column (12 m, 0.23 mm id). The carrier gas (He) flow rate was 1.2 mL/min. The initial oven temperature was 50°C, rising after 1 min to 100°C (50°C /min) and held for 1 min. Oven temperature was increased at 20°C/min to 285°C and was held for 7 minutes. Under these conditions, the retention times of FEN and SKF-525A were 7.2 and 10.5 minutes, respectively.

Total ion spectra were collected over the mass range 40 to 450 amu. Chromatographic peaks corresponding to FEN and the internal standard were identified by positive matches to library spectra and by comparison of retention times to authentic reference standards. Major ions in the mass spectrum of FEN appeared at m/z 215 (m*) 98, 84 and 58.

Standard curves were constructed by analysis of drug-free blood spiked with FEN at concentrations of 0.01, 0.02, 0.05, 0.10, 0.15, 0.40 and 0.50 mg/L. Quantitation was by linear regression analysis of plots of relative peak area ratios (FEN area at m/z 98 / IS area at m/z 86) as the dependent variable and concentration as the independent variable. Triplicate control specimens containing 0.05 or 0.1 mg/L of FEN were assayed in parallel to the specimens.

Amounts of FEN in tissues were: 0.03 mg/L in blood, 0.44 mg/kg in liver, 0.02 mg/L in bile and 0.5 mg/L in urine. FEN in specimens chromatographed as a single well resolved peak, without evidence of erythro/threo isomer separation. The n-dealkylated metabolite of FEN was not observed.

In spite of the notoriety associated with FEN this appears to be the first report of its presence in a forensic case, in the readily available literature. The other unusual feature of this case is that the deceased apparently obtained this restricted substance through an internet source. The implication is that the internet must be realized as a modern venue of drug-diversion and distribution.

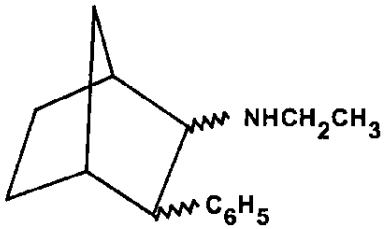

Figure 1: Chemical structure of Fencamfamine

Fencamfamine, Cocaine, Internet

K46 Acute Albuterol Intoxication in Acute Asthma: A Case Report and Review of the Literature

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After attending this presentation, attendees will take into consideration albuterol intoxication as a potential cause of death in cases of lethal asthma with resultant consideration of accident as a manner of death.

Albuterol is one of the more common therapeutic agents encountered in the routine practice of forensic pathology. While generally viewed as a medication with little potential for toxicity and even less potential for lethality, there are circumstances in which the agent itself may reasonably be considered to be the primary cause of death. This paper will present the findings in a case of acute albuterol intoxication that occurred in the setting of an acute asthma attack in a young adult male. Toxicology testing revealed a level of albuterol higher than any previously reported in the literature. This paper will also review the literature of published intoxications, both lethal and non-lethal, with reported levels. The symptoms of albuterol toxicity and its potentially lethal side-effects (hypokalemia, prolonged Q-T interval) will be highlighted.

Methods: The medical records, emergency room chart, laboratory results and autopsy protocol with toxicology results were reviewed and are presented. The medical literature was searched via PubMed using the keywords albuterol, salbutamol, toxicity, poisoning, overdose, and asthma for articles relating to acute albuterol toxicity for the period 1971 to present. Bibliographies in standard toxicology texts and articles from the initial search were also reviewed for relevant citations.

Results: Only a few cases in the literature report levels of albuterol. Of all the cases identified, the vast majority were in children and most were associated with inadvertent over dosage. Only 24 total cases reported albuterol levels and all were in adolescents and adults admitted after suicide attempt. Reported levels ranged from 50 to 449 ng/mL. The only fatality in the 24 cases also involved concomitant theophylline toxicity. None of the 24 cases involved albuterol administered in the setting of an acute asthma attack. The level in this case (490 ng/mL) exceeds any previously reported level.

Conclusions: While albuterol remains one of the safest drugs used in clinical medicine today, its overuse may not always have benign consequences. This case report highlights the potential toxicity of albuterol. Medical examiners need to be aware of the potential for drug toxicity, even in the setting of an underlying lethal disease for which the drug is prescribed. Quantitation of levels may lead to better understanding of the subset of patients that die of self-administered therapeutic overdose in the setting of acute asthma and appropriate consideration of accidental death in some cases.

Asthma, Accidental Death, Albuterol Toxicity

K47 Stability of Methadone in Frozen Postmortem Whole Blood for Five Years After Fatal Methadone Intoxication for Complex Regional Pain Syndrome

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After attending this presentation, attendees will understand that methadone is stable in frozen -20°C whole blood, and sudden death can occur after initiating methadone therapy for chronic pain syndromes.

Recognition that methadone use is increasing in clinical chronic pain syndromes, sudden death can occur from such use, and that medicolegal re-testing of frozen autopsy whole blood is valid if court ordered.

Methadone is a synthetic opioid narcotic commonly used for the treatment of heroin addiction. It was developed in the 1940s in Germany as a substitute for morphine, but its unpredictable and variable biologic behavior and half-life between patients soon rendered it unsuitable for clinical use. Today methadone is increasingly used in the treatment of chronic pain due to its longer action than other opiates, and also possibly due to the recent adverse publicity of long-acting oxycodone preparations. We present a case of fatal methadone intoxication occurring in a 39-year-old white man who suffered a work-related injury to his right ankle with development of Complex Regional Pain Syndrome (CRPS) that required toxicology re-testing for methadone five years later. Six days prior to death, the deceased had a spinal stimulator for pain control removed, and 10 mg twice daily oral methadone was added to his medication regimen. His stable chronic medications were trazodone, gabapentin, fluoxetine, baclofen, and dicloxacillin for which he was compliant. Six days after initiating methadone therapy, his wife noted he was lethargic and somnolent sitting on the couch watching television. Before she went to bed she noticed him apparently sleeping in the same position with unusual snoring respirations. The next morning she found him dead in the same position on the couch with abundant white edema foam on his face. Postmortem examination showed a well-developed and well-nourished 208 pound, 5-foot nine-inch white male with facial edema foam, and a markedly edematous, hyperpigmented and scaled right foot and ankle of CRPS. Internal examination showed cardiomegally without dilatation (534 gm), recannalized atherosclerotic-thrombotic occlusion of the left anterior descending coronary artery, anterior left ventricular wall interstitial myocardial fibrosis with few scattered lymphocytes of a healing infarct, marked pulmonary edema and congestion with airway foam. The stomach contained brown food without pill material.Toxicology testing in whole blood showed methadone in the blood and liver of 0.46 ug/ml and 1.42 ug/gm, fluoxetine 0.70 ug/ml and 10.8 ug/gm, norfluoxetine 0.69 ug/ml and 10.4 ug/gm, trazodone in blood of 0.95 ug/ml, and gabapentin in blood 6.5 ug/ml. Methadone concentration in the blood was within fatal range of 0.4-1.8 ug/ml, although levels in high-dose methadone maintenance therapy in opiate tolerant patients can overlap. Gabapentin was three times normal levels for his dose. Medication bottles were inventoried and pill counts documented with appropriate pill numbers. The cause of death was certified as methadone intoxication due to CRPS due to an industrial accident. Healing myocardial infarct due to coronary atherosclerosis was considered a significant contributing factor in his death. His pain control regimen may have prevented symptoms of his healing infarct. The manner was certified accidental. His wife filed lawsuits after workmen compensation death claims were rejected. Autopsy whole blood was saved frozen at -20° Celsius in our toxicology lab in sodium fluoride for an extended time. Numerous outside physician consultant opinions regarding cause of death were generated for all parties in the lawsuits. After five years of frozen storage the blood was re-tested through court order by an independent laboratory for methadone and metabolite EDDP. Blood methadone concentration was stable at 0.41 ug/ml and metabolite EDDP 0.064ug/ml. Lawsuits were settled after this second testing apparently confirmed that methadone can rise to known fatal levels in low dose therapy for chronic pain in a non-opiate tolerant person. Possible mechanisms for this remarkable elevation are either genetic deficiency of the enzyme that metabolizes methadone in the liver, or a competitive drug interaction, or a combination of both. These factors are important as methadone is increasingly being used as a long-acting alternative to sustained-release opiates for chronic pain treatment. A rediscovery of methadone's unpredictable biologic behavior may be repeating fifty years later. If lawsuits do arise from methadone intoxication, as have occurred in other drugs used to treat chronic pain, it is important to know that methadone is stable in frozen postmortem blood for at least five years if confirmation re-testing is ordered.

Methadone, Complex Regional Pain Syndrome, Frozen Whole Blood

K48 Acute Selenium Poisoning in a Suicide

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The authors intend to present the latest clinical and forensic science information regarding deaths attributed to acute selenium intoxication.

Selenium (Se) is a gray non-metallic chemical of the sulfur group widely used in commercial applications and therefore, a source of common human exposure. Industrial usage includes solar energy, semiconductor processing, and the manufacturing of electronics and ceramics. It is present in steel and copper alloying, metal pigmentation used in glass and paint manufacturing, rubber vulcanization, nutritional supplements, Selsun™ shampoo, and in gun-bluing agents. Selenium is also an essential mineral in the daily human diet, as there are cases of selenium deficiency syndrome.

Cases of acute selenium intoxication, as reported in the medical literature, are rare. The authors present a case of a fatal acute selenious acid intoxication covering clinical presentation prior to death, pertinent autopsy findings, and postmortem tissue concentrations. In this case, death resulted from suicidal ingestion of a gun-bluing agent by a young adult. The patient initially experienced nausea and vomiting, followed

by pulmonary edema and a rapid cardiovascular collapse approximately 3 to 4 hours post-ingestion. Postmortem toxicologic analysis of whole blood yielded toxic levels of selenium. In addition, tissue samples of brain, kidney, and liver contained high levels of selenium.

Selenium, Intoxication, Acute Poisoning

K49 Deaths Due to the Acute Effects of Drugs Investigated in Jefferson Parish Louisiana

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After attending this presentation, attendees will understand quantitative toxicology's role in rendering cause and manner of death in any case; the impact of prosector variation in under- or overestimating deaths due to the acute effects of drugs.

This presentation illuminates the growing problem of drug abuse in suburban and rural areas including the possible change in the pattern of abuse and offers the hope for/opportunity for future collaborative study with other areas, and also stresses the importance of investigative information in rendering the appropriate cause and manner of death.

The Jefferson Parish Forensic Center is a regional Forensic Center in Harvey, Louisiana that serves Jefferson Parish (JP), a suburban area neighboring New Orleans, as well as 20+ other rural and suburban parishes in south/central Louisiana. Of the 798 post mortem examinations performed in 2002, 146 (18%) were due to the acute effects of drugs. In JP alone 24% of cases (101/421) were due to the acute effect of drugs. These drug-related deaths accounted for 37% (101/272) of all violent deaths in Jefferson Parish. Of these 101 drug deaths in JP, 85 were classified as accident, 13 as suicide, and 2 as undetermined. The accidental acute drug-effect related deaths accounted for 53% (85/161) of all accidental deaths in JP. Most of these were due to the effects of multiple drugs ranging from illicit drugs such as cocaine, methamphetamine and heroin to the commonly abused prescription drugs especially hydrocodone, carisoprodol, and alprazolam. Numerous cases also were positive for methadone alone or most often in combination with other drugs. Similar trends were present in other parishes though suicides were more frequent than in JP. Additional data will be presented on the individual drugs detected, the combination of drugs including the significance of levels, the presence of concomitant natural disease, and the interaction of various factors. Rendering of the various causes and manners of deaths in cases in which drugs are present will also be discussed including possible prosector variation in under- or overestimating these types of deaths.

Drugs, Toxicology, Deaths

K50 Death Due to Acetaminophen, Doxylamine, Dextromethorphan Toxicity in an Infant

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The primary purpose of this presentation is to discuss the inherent danger of treating neonates with medication intended for adult. This is a report of an infant death due to poly over the counter drug toxicity. After a thorough review of the medical investigator's report, the autopsy findings and the toxicology results, it was concluded that the cause of death in this case was acute multiple drug toxicity, with the manner of death being homicide.

The impact of this presentation is to point out the lethal concentration of acetaminophen, dextromethorphan and doxylamine in a neonate.

The deceased is a 5-week-old male, reported by the mother to have had a runny nose, a cough and a temperature of 101.3ºF the evening of May 8. At 7:00 am the next morning, the mother gave the infant a fever reducer before she left for work, put him to bed and left him in the care of his father. The father reported the infant was irritable all day but otherwise symptomless. At some point during the day the father gave the infant "a half a dropper" of Nyquil, the exact amount undetermined. Sometime between 4:00 and 5:00 PM the father reported that he wrapped the infant in a thin sheet and put him to bed with a bottle of formula, with the bottle being propped up on a pillow. When the mother arrived home from work at 6:30pm she was told by the father that the infant was sleeping and shouldn't be disturbed. Before leaving to run an errand at 7:00 pm, the father reportedly removed the bottle from the infant's mouth but did not check further. At 7:55 pm, the mother discovered the infant cold, cyanotic and unresponsive, with milk vomitus evident. Toxicological analysis of the blood, urine, liver blood and stomach contents obtained at autopsy were subjected to a full toxicological screening which revealed the presence of ethanol, doxylamine, dextromethorphan and acetaminophen. Volatiles were quantitated by headspace GC/FID, doxylamine and dextromethorphan were extracted using a standard basic extraction and quantitated by GC/NPD and acetaminophen was quantitated by HPLC with UV detection. The results were ethanol (0.01 g/dL), doxylamine (1.2 mg/L), dextromethorphan (0.60 mg/L) and acetaminophen (294 mg/L). The stomach contained less than 125 mg/L acetaminophen and less than 2.5 mg/L each of doxylamine and dextromethorphan. The milk in the bottle was unavailable for testing.

Deaths have occurred in children from acetaminophen at 54 mg/L. The average in 139 *adults* who died of acetaminophen overdose in combination with at least one other drug was 170 mg/L. The range in 3 doxylamine fatalities is 0.7-12 mg/L, in dextromethorphan 1.1-18 mg/L.

Further investigation revealed that the father had given the infant *adult* Nyquil rather than Children's Nyquil. Adult Nyquil contains alcohol, dextromethorphan (15 mg/15 mL dose), doxylamine (6.25 mg/dose), acetaminophen (500 mg/dose) and pseudoephedrine (30 mg/dose). Children's Nyquil contains *no* alcohol, doxylamine or acetaminophen, equivalent amounts of dextromethorphan and pseudoephedrine as the adult preparation, and chlorpheniramine (2 mg/15 mL dose).

The cause of death was reported as acute multiple drug toxicity, the manner of death was homicide.

Over the Counter Drugs, Nyquil, Infant Death

K51 A Study of Drug Detection in a Postmortem Pediatric Population

Amanda J. Jenkins, PhD, Office of the Cuyahoga County Coroner, 11001 Cedar Avenue, Cleveland, OH 44106*

By attending this presentation, the attendee will: (1) acquire data regarding drug prevalence in the young, and (2) understand some of the parameters which may affect the likelihood of detecting drugs and therefore, the utility of conducting drug testing.

With declining operational budgets resulting in decrease staff and resources, Coroner and ME offices need data in order to make informed decisions about the utility of providing comprehensive services for all cases. This presentation will provide information so that attendees may be able to assess the need to conduct toxicology testing in every pediatric case.

Deaths in the pediatric population comprise a small (in absolute numbers) part of the Coroner and Medical Examiner workload. Many young individuals who die are not autopsied and for a large proportion of those that are, little or no drug testing is performed. Therefore, in most

jurisdictions, the prevalence of drug use in the young is unknown. This study was undertaken to provide some preliminary data to answer this question.

ll pediatric deaths accepted by The Office of the Cuyahoga County Coroner (CCCO) in Cleveland, Ohio in 2002 were reviewed. Demographic information including age, gender and race was collected. Cases in which the pathologist provided the laboratory with specimen were subject to toxicological testing. The heart blood or liver was subjected to comprehensive toxicological testing which included volatiles by headspace gas chromatography; acetaminophen, salicylate and ethchlorvynol screening by colorimetry; acidic/neutral and basic drug screening by liquid-liquid extraction followed by GC-FID or GC-NPD with confirmation by GC/MS; benzodiazepine screening by GC-ECD; and modified opiate immunoassay screening. If urine was submitted, immunoassay screening for amphetamines, benzodiazepines, cannabinoids, cocaine metabolites, phencyclidine, and opiates was conducted. One limitation of the study was that unless urine was submitted, or the case history suggested exposure, decedents were not routinely screened for cannabinoids.

In 2002, there were 129 deaths reviewed by CCCO. These were divided as follows:

Age	N
0 - 1 day	33
> 1 day - 2 years	43
> 2 years - 12 years	21
>12 years - 18 years	32

There were 77 males (60%) and 52 females and 55% of the individuals were black. The majority of the deaths were classified as natural (48%), with 31 (24%) accidents, 8 suicides and 13 (10%) homicides. For 9 cases, no sample was received or the sample was of insufficient volume for testing, and 5 cases were tested for volatiles only. Therefore, 115 cases were subject to comprehensive toxicological testing. No drugs were detected in 64% of these cases (N=115). Drugs administered during medical treatment, for pain and resuscitation, accounted for a further 19 cases or 16%. These drugs included lidocaine, morphine, phenytoin, midazolam, and pentobarbital. For the remaining cases, drug prevalence in descending order was as follows- cocaine/metabolites; cannabinoids; ethanol, and carbon monoxide. This preliminary data showed that the majority of cocaine/metabolite positive cases were newborns; and all cannabinoid positive cases occurred in teenagers who had violent deaths (by accident, suicide or homicide).

Pediatrics, Forensic Toxicology, Post Mortem

LW1 The Stray Bullet: Does History Have it Correct? Evidence 140 Years Old

Rod Englert, BS, Englert Forensic Consultants, PO Box 605, West Linn, OR 97068*

After attending this presentation, attendees will understand scene reconstruction which can deliver undisputable facts, despite time, if enough physical evidence is available.

This presentation will impact the forensic community and/or humanity by demonstrating historic events which bear looking into for clarification to support or refute what has previously been documented.

A stray bullet fired from a sharpshooter's rifle found its way through two solid wood doors and into the body of the young lady as she was making bread in her sister's kitchen.

The date was July 3, 1863, and the young lady was Mary Virginia Wade, more popularly known as Jennie Wade. 140 years later questions about the historic event are investigated by an on-scene reconstruction, and additional evidence is found that establishes facts about this long remembered servant who was making biscuits for hungry soldiers.

The location of this incident is where over one million people a year visit to view a battleground still echoing the casualties of over 50,000 Union and Rebel soldiers, 8,000 who died. That battlefield is Gettysburg, Pennsylvania, where President Lincoln would later deliver the Gettysburg Address. Gettysburg is considered the crossroads to Baltimore, Washington, D.C., and Philadelphia, and is mere miles above the Mason-Dixon line.

Jennie Wade became so famous on that July morning that she and Betsy Ross are the only two women in America who have a United States flag flying above their graves 24 hours a day. Jennie Wade was the only civilian killed during the historic Battle of Gettysburg, and the home where the incident occurred still stands with lead bullets embedded in the brick building. Large caliber pock marks dot the structure and one large splintered hole in the entrance door on the north side causes reflection that this is the bullet path that Jennie Wade was standing in line with when shot. Curious lay forensic visitors continue to rub the bullet holes and try to mentally analyze the event. The stray bullet would find its way through another door in the middle of the residence before striking the body of Jennie Wade, killing the only non-combatant in the massive and deadly battle. Other bullets shattered windows and one struck a bedpost where Jennie's sister Georgia and her baby were huddled in an adjoining bedroom. Rebel sharpshooters were firing at Union soldiers on that early July morning to harass them as they were gathered around the small house for biscuits Jennie was kneading and baking for them. The trajectory path of the bullet has been theorized in the 140 years since the tragedy. No formal forensic reconstruction of the event has been known to take place.

With permission of the owners, an analysis and reconstruction of the shooting death was allowed to determine if history has its facts correct. Several visits were made to the now museum home. A model of the same age and weight as Jennie in period costume assumed the role of Ms. Wade. Trajectory rods and strings were utilized to determine the fatal path of the hot lead fired from the sharpshooter's rifle that tore through two doors, establishing points of reference to work with. During the reconstruction, the antique bread trough Jennie was kneading bread in was utilized. During an examination of the small coffin-appearing box, another bullet graze was noted on the side as well as suspicious stains in the bottom of the dough tray that appear to be large blood stains from pooled blood. It was interesting to note the position Jennie Wade was in when that fatal round struck her.

Being able to go back in time (140 years) and reconstruct a shooting was a unique opportunity that certainly needs to be shared with the forensic community. The cooperation of the owners of the Wade Museum were most open to disclosure of the truth that forensics would reveal. Authors and historians familiar with the Wade death were very cooperative in providing valuable information.

Photos of the reconstruction will establish the position of where Jennie Wade had to be in the residence when shot as well as evidence from the event in the dough trough still on public display.

Jennie Wade is a heroine shot while baking bread to feed Yankee soldiers on that fateful morning. Her sister Georgia heard her utter her last words that day, "If there is anyone in this house that is to be killed today, I hope it is me, as 'George' has that little baby."

Jennie Wade, Bullet Trajectory Reconstruction, Battle of Gettysburg

LW2 Inquest at the OK Corral - The Forgotten Trial of The Earps and Doc Holliday

Robert J. Koolkin, DDS, Montague Dental Arts, 300 Avenue A, Turners Falls, MA 01376*

This presentation is intended to familiarize the forensic community with the judicial proceedings that followed the most famous gunfight in American history.

This presentation will impact the forensic community and/or humanity by discussing trials, which like gunfights tend to have two sides. Wyatt Earp would be remembered far differently today if he had been hanged as a murderer. His legacy depends as much on the outcome of this trial as it did on his survival of the gunfight.

It is a common misconception that violent death was such a frequent occurrence in the Wild West that no one even took official notice. Gunplay was common, especially on the streets of Tombstone, which at the time was a silver mining boomtown in the Arizona Territory. There was however an effective judicial system that demanded compliance with statute.

On the fateful afternoon of October 26th 1881, three members of the so-called "Cow-boy" gang were, in the words of the Tombstone Epitaph, "Hurled into Eternity" by a posse consisting of the three Earp brothers and John Henry 'Doc' Holliday. The most famous gunfight in American history, now known as "The Gunfight at the OK Corral," had lasted a mere thirty seconds.

Dr. H.M. Matthews, the County Coroner, impaneled a jury of citizens to hold an inquest into the deaths of Billy Clanton and the McLaury brothers, Frank and Tom. The inquest was a one-day affair with testimony taken from eight witnesses, including two survivors of the shooting and the County Sheriff. A verdict was returned that the three cowboys, ***"came to their deaths from the effects of pistol and gunshot wounds inflicted by Marshall Virgil Earp, Deputies Morgan, Wyatt Earp, and one Holliday, commonly known as "Doc" Holliday."***

Formal charges were filed and brought before Justice of the Peace Wells Spicer. Although the Spicer court had no authority to try a murder case, Judge Spicer could rule on the evidence, much as a Grand Jury does. He could determine whether the defendants should be bound over for a full-scale murder trial in District Court.

Much has been written about the feud between the cowboy gang of cattle rustlers and the law-and-order faction represented by the Earps with the support of Wyatt's friend Doc Holliday. To rural Arizonians cattle theft from nearby Mexico was barely a crime. Nonetheless, much

to the dismay of the mine owners and townsfolk, not to mention the federal authorities, the cattle rustling had led to a virtual border war. The cycle of cross-border violence had repercussions all the way to the White House. There were calls for military intervention and for more aggressive law-enforcement. This of course only heightened tensions between the cowboys and the Earps.

The evening prior to the shootout nearly all the principals were to be found at the Occidental Saloon intent upon an all-night poker game. County Sheriff Johnny Behan was a political adversary and frequent rival of Wyatt Earp. He, along with cowboy gang members Ike Clanton and Tom McLaury sat at the same table for nearly five hours with Morgan, Virgil, and Wyatt Earp and Doc Holliday. History did not record the name of the big winner. Although the game was peaceful enough, Ike Clanton then followed Virgil Earp into the street threatening both Virgil and Doc Holliday. Drunk and rowdy, Ike roamed the streets of Tombstone, openly carrying a gun in violation of the city ordinance and he continued to threaten the Earps and Doc Holliday. Wyatt and Virgil were awakened to deal with the trouble-maker and did so with a pistol-whipping followed by an arrest and summary fining of $25 plus costs. Although his firearms were confiscated, Ike was immediately released and directed to the saloon to which his weapons had been taken. Upon leaving the courthouse Wyatt gave similar treatment to Tom McLaury, leaving him sprawled and bloodied in the street.

By this time, everyone in Tombstone knew that a fight was brewing. People lined the streets to see what was going on. A gunfight commenced in the vacant lot next to Fly's Photography Studio and Boarding House, just down the block from the rear entrance to the OK Corral. Two pistol shots were fired almost simultaneously. After a brief pause, followed by perhaps thirty more shots from both sides and two blasts from Doc Holliday's shotgun, the fight was over. Ike Clanton, the man who started it all, had run for cover and escaped unharmed. Wyatt Earp, also unharmed, refused to be arrested by his nemesis Sheriff Johnny Behan.

While most of Tombstones citizens supported the Earps, the cowboy faction had its defenders as well. The bodies of Tom, Frank, and Billy were displayed outside the local undertakers establishment propped beneath a sign reading "Murdered in the Streets of Tombstone." Their funeral was attended by thousands of mourners as the town band led a cortege to the graveyard on Boot Hill.

The Spicer Hearing came to order only five days after the gunfight. All the prosecution needed to show was "probable cause" and the case would go to trial. Because Virgil and Morgan Earp were bedridden from wounds received, only Doc Holliday and Wyatt Earp were arrested. Thomas Fitch, an old friend of Mark Twain's served as Wyatt's counsel. Doc Holliday sought separate counsel. It appears that Doc may never have been actually deputized when he joined Virgil Earp's posse. In Tombstone, Doc was widely regarded as a renegade, both fast and deadly with a gun. At the very least it might be construed as criminally negligent for Virgil Earp to bring the notoriously erratic Doc into what was already a tense situation. If it could be shown that it was Doc Holliday who opened fire, that would explain the shots from the cowboys that wounded Virgil and Morgan Earp. As such, Doc Holliday and his infamous nickel-plated revolver became the cornerstone of the prosecution's case.

After a month-long hearing in which several unconventional strategies were employed by both sides; the Spicer Decision was released. It began: ***"To constitute the crime of murder there must be proven not only the killing, but also the felonious intent…in looking over this massive testimony…I find that it is anything but clear."*** After outlining the evidence in detail Judge Spicer concluded ***"…the evidence taken before me in this case, would not, in my judgment, warrant a conviction of the defendants by trial jury of any offense whatever."*** In his conclusion, Judge Spicer promptly hedged his bets. Since the Grand Jury was then in session he acknowledged that they were within their rights to disregard his findings and bring an indictment if they thought the evidence sufficient to warrant a conviction. All the defendants were released, the Grand Jury never sought an indictment and two more attempts by Ike Clanton to "hang the Earps by legal means" were never destined to make it to the docket.

OK Corral, Spicer Decision, Wyatt Earp

LW3 The Death of Ted Binion: Drug OD/Suicide or Murder by Poisoning - When the Average Means Too Much

David M. Benjamin, PhD, Tufts Medical School, 77 Florence Street, Suite 107, Chestnut Hill, MA 02467*

After attending this presentation, attendees will understand the proper method to research and interpret post-mortem toxicology drug test results.

This presentation will impact the forensic community and/or humanity by demonstrating that specialized training in pharmacology/toxicology and attention to detail are required to avoid errors in the interpretation of post-mortem blood levels of drugs; Drugs administered by an atypical route are suspicious and can provide clues to the manner of death.

On September 17, 1998, the body of Las Vegas casino owner Lonnie Theodore Binion was discovered by his girlfriend, Ms. Sandra Murphy, lying on the floor of his den. He was not breathing and did not respond to his name. "911" was called but Mr. Binion was beyond resuscitation. Ms. Murphy stated that she had last seen Mr. Binion asleep on the floor around 10 am that morning.

Mr. Binion had a long-time heroin dependency and he used to buy "black tar" heroin and smoke it on a piece of aluminum foil by heating the underside with a lighter, a technique called, "Chasing the Dragon," because in old days in China the trail of smoke that evolved from the heated heroin looked like the "tail of a dragon." Ms. Murphy also reported that Mr. Binion, when he smoked heroin would sometimes put the barrel of a handgun in his mouth. It was also learned that on the day before his death, Mr. Binion received a prescription for 120 tablets of 0.5 mg alprazolam (Xanax), from his physician. Around the mouth and lips was a patchy, slightly red discoloration (which did not resemble the shape or pattern of fingers), and pulmonary edema was present at autopsy, but no other evidence of significant pathology or trauma was apparent. Trauma to the face was described by one pathologist for the State as "due to vigorous cleaning to remove vomitus," with which the pathologist expert for the defense disagreed, and due to "Burking," a form of smothering, by a pathologist expert for the State, with which the pathologist expert for the defense again disagreed. An empty pill bottle which had contained alprazolam was found on the floor near the body, as was a piece of foil. The pathologist expert for the defense criticized the technique of the autopsy because the small intestines were not opened to look for residue of pills and/or heroin that might have been ingested orally.

Samples of peripheral and heart blood, vitreous humor, gastric contents, liver and lung tissue were collected and submitted for toxicology analysis. The State pathologist opined that, "Based upon observations that the body and death scene were tampered with, that the drugs which killed Mr. Binion were ingested in an atypical fashion, and that inconsistent accounts of events preceding and immediately following Mr. Binion's death have been reported by the individual who discovered the body, it is my opinion that another person or persons were involved in the death of Lonnie Binion. The manner of death is therefore determined to be homicide." The Clark County, NV Chief Medical Examiner determined the Cause of Death as follows: "It is my opinion that the decedent, Lonnie Theodore Binion death as a result of ALPRAZOLAM AND OPIATE INTOXICATION." Manner of death: Homicide. Toxicology results were reported as follows:

Results of Toxicology Testing

	Heart Blood*	Peripheral Blood*	Gastric Contents*	Vitreous Fluid*	Liver**
Morphine	75	88	1,755	67	189
6-Monoacetylmorphine			13,317	14	
Alprazolam (Xanax)	◂ 270 ▸ Sample site for Xanax not clear			56	124
Codeine				81	
Diazepam (Valium)	Therapeutic levels of diazepam and metabolites were detected in blood				

Key: *ng/ml; ** ng/g

Opinion of the State's expert pathologist: murder by suffocation; Opinion of the defense's expert pathologist: suicide due to alprazolam/heroin OD; Opinion of the author expressed on Court-TV: Murder due to forced ingestion of alprazolam and heroin, due to the additive effect on respiratory depression and some contribution from diazepam, all probably after smoking heroin. Facial erythema was most likely due to burns from hot smoke.

Interpretation of Postmortem Blood Levels, Route of Administration, Tolerance

LW4 The Inaccurate Conception?

Robert M. Failing, MD, Retired, PO Box 5055, Santa Barbara, CA 93150*

After attending this presentation, attendees will discuss the potential value of DNA analysis in resolving paternity questions of historical interest.

This presentation will impact the forensic community and/or humanity by demonstrating the use of DNA to finalize a controversy of historical significance.

Learning Objective: To challenge the accepted paternity of the sixteenth President of the United States of America.

Many rumors, myths and legends have come and gone regarding the paternity of Abraham Lincoln. There is no doubt that his mother was Nancy Hanks (1782-1818). However, many have questioned his father as being Thomas Lincoln (1778-1851), his place of birth as Kentucky or accepted his official birth date as February 12, 1809. Even Lincoln himself, was evasive in discussing his heritage with his closest confidants.

At least seven men, including John C. Calhoun, of South Carolina, and a foster son of Chief-Justice John Marshall, have been proposed as Lincoln's father. One of these, Abram Enloe (1762-1841), was an educated, prosperous landowner and trader living in the foothills of North Carolina.

This presentation will attempt to show that Abram Enloe was the most likely biological father of Abraham Lincoln. It will discuss how Nancy Hanks arrived in North Carolina and her relationship with Abram Enloe.

In support of this legend, it will endeavor to offer reasonable explanations as to, when and where Lincoln was born, what happened to Nancy Hanks and son immediately following his birth, how they got to Kentucky and Nancy's marriage to Thomas Lincoln.

Robert Todd Lincoln, the President's only adult surviving child, held his father in high esteem and was proud of the many honors and tributes paid him. He was well educated, held influential positions in government and business and was even considered several times as a candidate for President. He exercised a "strong hand" in attempting to censor many of the biographies about his father, especially those parts concerning the President's early life. He himself was known to have burned or destroyed several of his father's personal letters and documents that were left in his charge following the assassination.

James H. Cathey's, *Truth Is Stranger Than Fiction; True Genesis of a Wonderful Man*, published in 1899, seems to have escaped Robert Todd Lincoln's literary suppression. This, and other references to it, are the principal source of material supporting the claim of Abram Enloe fathering Abraham Lincoln.

A photograph of one of Enloe's sons, Wesley Matthews Enloe (1811-1903), is pictured in Cathey's book. If the North Carolina legend be true, Wesley and Abraham would be half-brothers. There is a striking resemblance between certain pictures of Lincoln and the photo of Wesley Enloe.

Those who believe in the legend are quick to note there are numerous assumptions in the writings and documents of those who hold Thomas Lincoln, the father. And, the Thomas Lincoln supporters claim erroneous assumptions are made by the Enloe backers.

There are living today several direct male descendents of Abram Enloe. There are two known repositories of potential Abraham Lincoln DNA material: The Army Medical Museum and The Chicago Historical Museum. The author hopes that time and sophisticated techniques will bring the Lincoln DNA and the Enloe DNA together so as to give Society The Last Word.

Lincoln, Paternity, DNA

LW5 "We Opened Several of Them to Determine the Cause of Their Illness": Samuel de Champlain and the New World's First Adult Autopsy, L'île Sainte-Croix, 1604-1605

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In commemoration of the 400th Anniversary of the first French settlement in the New World, this paper presents the results of our excavations and forensic analyses of 25 men interred at St. Croix Island, Maine. Buried in 1604-1605, these individuals represent the oldest European remains found to date in North America and include the earliest osteological evidence of a European autopsy in the New World. This discovery provides an opportunity to consider the modern practice of human dissection and autopsy within a historical context spanning over half a millennium.

This presentation will impact the forensic community and/or humanity by enlightening the audience regarding the history of autopsy in the New World, as well as place the modern decline of the practice in historical perspective. The paper will also introduce the forensic community to the earliest European skeletal remains found to date in North America and demonstrate the information that can be learned even from remains of significant antiquity.

St. Croix Island is today a nondescript 6.5-acre island at the mouth of the St. Croix River near Calais, Maine, on the Canadian border. But the events that occurred there beginning in June 1604 literally changed the Renaissance world. It was then that Samuel de Champlain chose the island as the site of the first permanent French settlement in the New World, which due to the ravages of scurvy and frostbite failed in just over one year. It was also the unlikely setting for the first recorded autopsy performed by Europeans on an adult in the New World. A unit of Acadia National Park and the only International Historic Site in the United States National Park System, the island is the final resting place for 25 men who died during the unusually harsh winter of 1604-1605. Predating Jamestown by three years, these skeletons represent the oldest European remains found to date in North America.

Born in ca. 1567, Samuel de Champlain served as geographer and cartographer to Huguenot nobleman Pierre Dugua, sieur de Mons, to

whom King Henri IV granted a fur trade monopoly in 1603 in return for transporting 100 colonists a year to New France. Together they led their first expedition to Acadia in 1604, leaving Havre de Grace on April 7 and arriving on the east coast of modern Nova Scotia in May. This was Champlain's third trip to the New World and he described the entire voyage, including its tragic conclusion, in his book *Les Voyages*, published in 1613. The group discovered St. Croix Island on June 25 and chose it as their base, fortifying the small island with two cannons for protection from both the British as well as the local Native Americans. The complement of artisans and gentlemen spent the remainder of the summer building their settlement and planting gardens. On the last day of August their two large ships left for France, leaving behind 79 men.

Because St. Croix Island lies at roughly the same latitude as France, the colonists believed the climates would be similar and were unprepared for the unusually severe winter weather. The first snow fell on October 6 and lasted until the end of April. Champlain wrote that their "beverages all froze except the Spanish wine. . . . of seventy-nine of us, thirty-five died, and more than twenty were very near it." His graphic descriptions of the groups' desperate plight provide first-hand clinical accounts of their symptoms as just less than half of them died from scurvy, malnutrition, and exposure during the bleak winter. The company's ships returned to relieve the survivors on June 15, 1605, more than six weeks late. At the end of that summer de Mons ordered the settlement transferred to the opposite side of the Bay of Fundy, establishing a colony at Port Royal on the western coast of Nova Scotia.

In 1969 excavations by Temple University for the National Park Service revealed the graves of 23 of the expedition's men. Portions of each individual's remains were removed and taken back to Philadelphia for analysis. The remains were re-accessioned by the Park Service in 1994. In preparation for the 400th Anniversary celebration of the settlement the Park Service sponsored our project in June 2003 to return the bones taken from the island in 1969 and allow forensic anthropologists the opportunity to conduct thorough examinations of the skeletal remains of the 23 men. Among our discoveries were two additional burials and the autopsy of Burial 10, a man 18-19 years old whose cranium had been sawn open in a standard autopsy cut. Champlain had written in 1613: "We could find no remedy with which to cure these maladies. We opened several of them [deceased colonists] to determine the cause of their illness. . . .Our surgeons were unable to treat themselves so as not to suffer the same fate as the others." Not observed during the 1969 excavations, our identification of Burial 10's craniotomy confirms Champlain's account for the first time.

Before 1700, most of western European held a negative view of human dissection. Even though Pope Sixtus IV issued an edict in the 1470s permitting the practice in an attempt to find the cause of plague, dissection and autopsy remained rare until the late 1700s. The first recorded autopsy in the New World was conducted on July 19, 1533, in Santo Domingo on the island of Hispaniola. It was performed following the orders of the local priest on the remains of conjoined (Siamese) twins to determine if they had two souls or one. In 1565, London's Royal College of Physicians received permission to perform dissections, but it was not until Giovanni Baptista Morgagni published his text on pathology in 1769 that autopsy findings were first correlated with clinical diseases. The first reported American autopsy conducted on a homicide victim occurred in Maryland in 1635, to determine the cause of death of a servant allegedly killed by his master. The autopsy of Burial 10 therefore represents the first recorded adult postmortem also confirmed by skeletal evidence in the New World.

Although legal today, modern autopsy rates have fallen to their lowest levels since the historical period. Forty-five years ago 50 percent of patients who died at teaching hospitals were autopsied; by 1985 that rate had dropped to 14 percent. In 1994 a survey by the College of American Pathologists found that autopsy rates at 75 percent of hospitals were less than 13.5 percent, and half of those had rates below 8.5 percent. In 1995 the National Center for Health Statistics stopped reporting autopsy rate data. This is a true loss for medicine, forensic science, and the relatives of the deceased, as a major study in 2001 demonstrated that 20 percent of patients in a Cleveland hospital generated different diagnoses before death and after autopsy. The same study found that 44 percent of major pathology identified through autopsy had not been diagnosed while the patients were alive.

It is unlikely that the precipitous downward trend in recent autopsy rates will return modern medicine to the days when diseases were thought caused by humors, such as Champlain opined in 1613 regarding the cause of scurvy: "it comes altogether from eating too much salt meat and vegetables which heat the blood and corrupt the inward parts. . . . And from the earth, when it is opened, there come forth certain vapors enclosed therein and these infect the air." But when viewed through the lens of the history of medicine, the potential loss of medical information for future generations may be just as injurious.

Samuel de Champlain, Autopsy, Physical Anthropology

LW6 Steinbeck Could Have Been Responsible

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The purpose of this presentation is to compare the prose of John Steinbeck to a real northern California homicide case.

John Steinbeck once said, "man is the only kind of varmint who sets his own trap, baits it, then steps in it." While there is no record that Steinbeck ever worked in law enforcement he writes as though he had. He seems to have relished troubled people by detailing their hardships.

In *Of Mice and Men,* Steinbeck writes of two men after they arrived in California during the "Dust Bowl." One of his characters, George Milton, is worldly while the other, Lennie Small, is slow and simple minded. The story ends when George kills Lennie, who is clearly seeking companionship. I was reintroduced to the story in 1986 when the Coroner's Office in Butte County California asked my assistance in analyzing a crime scene and some recovered skeletal remains. The remains had been discovered on a "ranch" south of the community of Oroville. Oroville could easily pass as a community created by John Steinbeck for reasons that will become clear.

For various reasons throughout its past, northern California seems to have attracted a number of rugged characters but more recently it has been due to the manufacture of methamphetamine. Meth, crank, or crystal can rather easily be made from household goods.

At the center of the 1986 crime scene was much trash, a rundown trailer-home, an old Nash Rambler, evidence of "crank" production, and various human and nonhuman skeletal elements. During the investigative phase of the case, the property owner, his wife and adult child, spoke of a series of personnel they had hired as caretakers. One was "Ricky" who, unlike Steinbeck's Lennie Small, was a small man. Slightly built at 5 feet 8 inches, 130 pounds, he was 23 years old when he was hired.

To assist Ricky the property owners hired a second caretaker, Steven Fredrick Zornes. Steve was older than Ricky was, and much more experienced. Just as Steinbeck's character George Milton, Steve was worldlier.

Shortly after Ricky's 24th birthday during spring 1984, a common friend, Diane, joined the two. Not long afterward Diane was killed in an auto accident which Ricky took particularly hard. At first Ricky became a recluse but later left the ranch for weeks. According to Steve, when Ricky returned he accused Steve of having had sex with Diane. In addition, Ricky blamed Steve for various difficulties he and Diane had experienced. Steve said that he put up with Ricky's accusations until he grew tired of them, and finally confronted Ricky. Their relationship

apparently improved over the summer, because they continued to work and live together throughout the remained of the summer, fall, and most of the following winter.

During conversations the investigators had with the property owner it appeared that just as Lennie in *Of Mice and Men*, Ricky had found the friendship he desired in Steve. They had become soul mates. The two continued a carefree life together through early 1985 when for reasons that were never made clear, Steve decided to leave. During his confession to the authorities, Steve said he had told Ricky he was planning a brief tip to Reno but in fact he was planning to permanently leave the ranch, and Ricky. According to Steve, Ricky asked if he could accompany him on the trip, but Steve said no. Ricky is then reported as having threatened to expose Steve to the law for a parole violation. While Ricky may have wanted to continue to be Steve's friend, Steve felt threatened by Ricky. It was the last conversation the two had. According to Steve a heated argument ensued during which Steve picked up the handle of a splitting maul and beat Ricky over the head, killing him.

Steve told his boss that Ricky had left town just as Ricky was known to do. However, in fact, Steve had hidden Ricky's body under a pile of lumber at the ranch. It was soon after Ricky's murder that Steve made arrangements for the property owner to drive him to town; Steve said he needed to go to the laundromat. However, when the owner returned to pick Steve up, Steve was nowhere to be found. He had skipped town.

Because of Steve's disappearance and Ricky's unpredictable wanderings, the property owner was again in need of a caretaker. So, another young couple was hired to work at the ranch. In addition to the ongoing effort of cleaning-up the ranch, the owner asked the new husband and wife team to build a chicken coop from a pile of lumber on the property. The team built the coop, but soon after its construction left the ranch for a better job.

The owner hired yet another caretaker, and it was this last caretaker that discovered Ricky's remains and brought them to the attention of the authorities. The previous caretaker couple had noticed the skeletal remains under the pile of lumber from which they had built the chicken coop. However, they never reported their find. When later asked about this lapse the couple claimed they thought the remains were those of a calf.

It seems the last of the caretakers cleaned the surrounding grounds and did so by raking a medley of the debris into a number of piles, which he then incinerated. The rubbish piles had been burned before he notified the authorities of his odd discovery. Thus, several of the burn piles contained calcined human and nonhuman bone. Interestingly, there was a makeshift hibachi constructed of cinder blocks and a metal grate, over which the most recent caretaker had apparently cooked. Human remains among the coals prompted interesting speculation among all of us at the scene. Simply, there could be little doubt that the caretaker had prepared at least one meal over burned human body parts.

My report described the human remains of this case as those of a white male who died during his mid-twenties to early thirties. The decedent's stature was suggested to have been 5'6" to 5'8". The recovery of a boy's size 25 shirt and a general lack of robustness on the skeleton suggested a slight body build. The combination of dental work evidenced by fillings and crowding of the lower anterior dentition was suggested to offer the most likely opportunity for identification. Indeed, the identification was later achieved using antemortem dental records. After several hours spent reconstructing the decedent's skull I suggested that he had been struck with a heavy club several times, at least three, and that blunt force trauma was the most likely manner of death.

The remains were identified as those of the slightly built 24-year-old white male Richard Eugene Hoskins, Jr. As the facts of the case were coming together, a warrant was issued for the arrest of Steven Fredrick Zornes in connection with the possible homicide of Ricky. Two Butte County Sheriff's Officers did an excellent job of tracking Steve down. During the winter of 1986 the officers were able to locate Steve's mother in Iowa. When the investigators asked her if she knew where Steve could be found, she said no. When further asked if Steve might have contacted his father the mother said the two men had been estranged for a long time and that it was not likely that Steve's father would know where Steve was. However, as the conversation continued the officers learned that Steve had sent a card to his mother with a Salt Lake City postmarked. The Butte County authorities then contacted the Salt Lake City Police to see if they had had any contact with Steve. As luck would have it, Steve had been stopped for a minor driving violation there. The officers made arrangements for Steve to be arrested in Utah on the warrant from Butte County. He was placed under arrest in March 1987.

It was during his interrogation that Steve admitted having struck Ricky over the head with a splitting maul. It became clear that Steve had refused to befriend Ricky and take him to Reno. Additionally, Steve felt threatened by Ricky's comment that he might turn Steve over to authorities for a Kansas parole violation. Because the prosecutor's case was based entirely upon Steve's admission, he was tried and convicted for manslaughter. Steve served an eleven-year sentence in prison for the death of "Ricky."

Ricky's lifestyle choice put him at danger. Moreover, the life of both the major characters in this drama was not unlike that found among Steinbeck's characters. Such a lifestyle has been responsible for many untimely deaths. Indeed, while there are similar stories not unlike those by Steinbeck to be told from recent events in northern California, I would like to end my prose with a quote from Ernest Hemingway. "All things truly wicked start from innocence."

Physical Anthropology, Northern California, John Steinbeck

LW7 The Incorruptibility of St Cuthbert, or What the Lindisfarne Monks Saw in 698

Dale L. Davis, BA, Archaeology Program, McGraw Hall, Cornell University, Ithaca, NY 14853; Cynthia T. Camp, MA, Medieval Studies Department, Cornell University, Ithaca, NY 14853*

The goal of this presentation is to present the forensic community with a fresh look at a very old case and to provide a scientific and factual explanation for the claim of incorruptibility.

This presentation will impact the forensic community and/or humanity by demonstrating stories of incorruptible saints which are prevalent throughout Church history. Though it is likely that many of these "miracles" lack historic evidence, it is possible that some, such as St Cuthbert, were preserved by methods based in fact. Further research into the long-term stability of adipocere and its interaction with other preservative agents will provide a new way to evaluate these age-old cases as well as current studies.

St Cuthbert's incorruptibility, at least from his death until 698 AD, was most likely due to adipocere formation.The explanation of adipocere as the main preservative agent has been given before. However, the explanation is always given without accompanying scientific proof. This presentation will report the ongoing research into the circumstances following the death of St Cuthbert, a seventh century Catholic monk and hermit who died in 687 AD on the island of Farne in northeast England. Eleven years later, upon disinterment in order for the translation of his bone from a stone coffin into an elaborate reliquary, Cuthbert was found "…intact, and whole as if [he] were still alive." Believed to be a miracle, Cuthbert's incorruptibility served as propaganda for the Catholic Church and one of England's largest saint's cults grew up around his relics. Cuthbert is one of the few incorrupt saints mentioned in Bede's *Ecclesiastical History of the English People*, and one of the first incorrupt saints to be documented. It is due to this inimitability that a scientific, rather than sacral, reason for his incorruptibility is probable.

If a body is interred under relatively wet conditions, in an area protected from animal and insect scavenging, adipocere is known to form. Adipocere, also referred to as "grave wax," is created by the hydrogenation and hydrolysis of the body's subcutaneous fats into fatty acids. A relatively slow-forming compound, adipocere formation causes a drop in pH of the body's tissues and acts to cease bacterial and enzymatic function and therefore decay. Whereas there are current journal articles in which adipocere formation is detailed, studies of the long-term stability of adipocere deserve additional research.

When Cuthbert died in 687, he was wrapped in cere-cloths and buried in a stone coffin. Studies on adipocere following World War II and at the turn of the twentieth century indicate a significant effect on soft tissue preservation, especially when the corpse was clothed, even after twelve years. Readily associated with adipocere formation, the combination of the wrappings and the cool, wet, anaerobic environment within the coffin may have been enough to ensure St Cuthbert's preservation for the first eleven years following death. Although St Cuthbert is claimed to have remained incorrupt until 1538, there is no concrete evidence for the use of artificial preservation techniques. Based on current scholarship, lack of decay following 698 is unlikely.

Adipocere, Preservation, Historical Case Studies

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