Northeastern Association
of
Forensic Scientists

Proceedings

of the Northeastern Association of Forensic Scientists November 2014

Contents

Northeastern Association
of
Forensic Scientists

Drug Chemistry Abstracts

"The Heroin/Narcotic Rx Crisis: A Six Year Case Analysis" Jim Wesley*, Monroe County Crime Lab, Rochester, NY; Mike Grillo, Robert Wesleyan College; Gianna Favro, University of Albany

Although the overdose deaths of several celebrities in 2013 and 2014 from heroin focused the public's attention on this lethal street drug, follow-up discussions revealed a more insidious problem. Heroin use had skyrocketed in America, and those using it and dying from it were not forty or fifty as in the past, they were in their 20's, and even teens! The current heroin epidemic is seen my many as a crisis that needs to be addressed but in order to address it, we must first look at statistics of prescription use and heroin use. Although reports state that heroin has increased because narcotic prescriptions have been placed on tighter control, no data has been presented to support this. The most current DAWN data is from 2011 a year that represents peak narcotic prescription use. NFLIS data is more current and includes data through June 2013. This data does seem to indicate the start of a downturn in both oxycodone and hydrocodone use but more data is needed for a proper evaluation.

We reviewed every case submitted to the Monroe County Crime Laboratory that contained any reported prescription drug or heroin from 2009 through June 2014. Regarding Heroin cases; aggregate weights, weight ranges and number of decks per case were tabulated. All identified substances were tabulated including other controlled substances as well as cutting agents such as procaine, caffeine and xylazine. Regarding prescription drugs; all drugs were tabulated including controlled, non-controlled Rx and OTC. Tablet imprints were also recorded. The cases were all entered into a spreadsheet which allowed sorting by County (we serve seven), year, and even by tablet type.

We present a comprehensive evaluation of the current Heroin/Narcotic Rx crisis. The results can be used in several ways; Crime labs can use them to help manage identification resources, Toxicology labs can use them to aid in overdose evaluation and Law Enforcement and Public Health can use them in case evaluation and management including allocation of limited rehabiliations services.

QuEChERS : A Fundamental Study for the Extraction of Caffeine from Tea and Its Future Use in Forensic Applications," Michelle Schmidt*; Nicholas Snow, Seton Hall University

QuEChERS is a popular extraction technique for the analysis of complex samples; however, there has been very little work in the area of forensic science, for instance in blood or urine analysis. This study aims to determine the fundamental chemistry involved in QuEChERS via the extraction of caffeine from tea. Understanding the technique can lead to possible future applications in forensics. QuEChERS (Quick, Easy, Cheap, Effective, Rugged, and Safe) is an extraction that involves a liquid-liquid microextraction and a dispersive solid phase extraction (d-SPE), making it suitable to samples with complex matrices by removing matrix interferences, providing a clean sample for GC-MS. In this study, a model analyte, caffeine, was used to investigate fundamental chemistry parameters including partition coefficients and extraction conditions. Tea was chosen as a model complex matrix as it has qualities of both food and plants with many possible matrix interferences. Throughout the literature there have been many application studies involving QuEChERS; however, an investigation of the fundamental aspects of this method have yet to be performed in detail. The optimization of the extraction method, such as salt type and amount, sonication time and temperature, and solvent system used will be discussed as well as the extraction kinetics and depletion study used to calculate

extraction ratios for the determination of partition coefficients. This study will demonstrate the fundamental chemistry of QuEChERS and will aid in determining possible forensic applications.

"Analytical Method Development for Gas Chromatographic Analysis of Piperazine Designer Drugs,"
Kathleen Luo*, The Pennsylvania State University

Developing a method to analyze and detect piperazine compounds (ca. BZP and TFMPP), will aid the screening for emerging synthetic piperazine drugs on the market. The objective of this research is to optimize the conditions and parameters for a method to detect and screen for piperazine-derived compounds, by using gas chromatography (GC) coupled to mass spectrometry (MS), a flame ionization detector (FID) and a nitrogen phosphorus detector (NPD). Due to the amine group of the piperazine, an NPD has higher sensitivity than a FID and a single quadruple MS system, which provides a lower level of detection. Additionally, the NPD is likely to exhibit less instrumental drift than the MS, making it a potentially better choice for quantification. Piperazines exhibit chemical reactivity in the GC sample pathway. A series of commonly used piperazine drugs were evaluated as part of a study to investigate the chemical reactivity. During the course of this research, the impact of the deactivation chemistry of the inlets and columns was evaluated, with results ranging from poor to excellent. This method increased the accuracy of the analysis by comparing the chemical reactivity in the GC pathway and increased the sensitivity and selectivity by coupling MS, FID and NPD. This complete investigation of the chromatographic variables as directed to both native piperazines, and their relevant metabolites, in both recreational drug samples and human urine will allow for a consolidated analytical methodology that is more efficient.

"A Practical Approach to Determining Limits of Detection (LOD) for Controlled Substances, Tiffany Ribadeneyra*, Nassau County Office of Chief Medical Examiner, Department of Forensic Sciences

In chromatography, the detection limit is the injected amount that results in a peak with a signal height two to three times as high as the baseline noise level. The signal-to-noise ratio, abbreviated S/N ratio or simply S/N, depends on how noise is defined. A simple way to formulate a quantitative measure of the S/N is to take the magnitude of the noise to be the difference between the highest and lowest noise responses. This measure is called the peak-to-peak, or P2P, noise. A more common measurement of noise, which requires a digitized signal and a computer, is the root-mean-square, or RMS, noise. To determine the RMS, the random noise is treated as a sinusoidally varying potential. For a large number of data points, the RMS noise is the standard deviation of the noise.

The Nassau County Department of Forensic Services will present a method for determining the limit of detection during gas chromatography/mass spectrometry analysis of seized drugs. Both peak-to-peak and root-mean-square evaluations of the noise were conducted since both measurements can be found in literature. Assessments were conducted for blank (solvent) and analyte (controlled substance) samples at low and high temperatures using modified Agilent ChemStation Data Analysis Performance Reports. This practical approach can be undertaken by laboratories during method validation or thereafter using minimal resources.

"Application of Organic Impurity Profiling to Seized MDMA Samples Using GCMS with Hydrogen Carrier Gas," Lisa Stevens*, Arcadia University

Since the emergence of impurity profiling, several studies have been performed involving synthesis of MDMA and subsequent analysis for the identification of organic impurities present. However, in most of these studies, adulterants, fillers, and other substances found in real-world samples were not considered. Studies have also been performed on MDMA tablets seized in Europe, although those results varied and could not be expected to accurately predict what might be found in American samples. To date, not many studies have been performed on MDMA samples seized in America, and information from seized tablets may vary.

This study provides information on real-world MDMA tablets seized in the Philadelphia area, using an optimized liquid-liquid extraction (LLE) procedure paired with qualitative gas chromatography/ mass spectrometry (GC/MS) analysis using hydrogen carrier gas. The instrumental method was optimized to overcome sensitivity issues expected from using hydrogen carrier gas and, along with NIST's ADMIS deconvolution software, was capable of detecting trace-level impurities. When available, reference standards of expected impurities were analyzed to confirm identities of impurities present; otherwise, presumptive identities were determined based on comparison to available known spectra in public MS databases. In some cases, GC/MS results detected multiple impurities allowing inferences to be made about the starting materials or synthesis pathways of the real-world tablets.

This project will show attendees several synthesis pathways used for the manufacture of illicit MDMA, as well as educating attendees on the strengths and weaknesses of the use of hydrogen as a carrier gas and AMDIS deconvolution software, specifically as they apply to the detection of trace-level MDMA impurities. Finally, attendees will see GC/MS data from expected impurities associated with specific origins and synthesis pathways and for impurities detected in real-world MDMA tablets.

"Synthetic Cannabinoid Analysis with GC-MS," Joseph Guttieri*, Hofstra University

Gas Chromatography (GC) with Mass Spectrometry (MS) was used to identify synthetic cannabinoids present in sixteen "Spice" herbal incense samples. GC-MS Analysis was performed on a HP 5890 Capillary GC with a methyl/phenyl-functionalized ZB-5MS column and GC-MS/MS analysis was carried out with a Bruker Scion TQ and a phenyl/dimethyl arylene siloxane-functionalized Bruker BR-35ms column. After methanol extraction and paper filtration, the herbal sample extract solution was directly injected through GC injectors at 280 ℃. Each Spice sample contained one or more cannabinoids that were identified in various amounts except for the Skunk Blueberry sample. Two isomer mixtures of RCS-04 and JWH-122 were also analyzed in order to study differences in separation and fragmentation of cannabinoid isomers. The isomers were well separated through gas chromatography column and there were enough fragmentation differences to distinguish between the isomers. Several stable fragments, such as the 264 fragment, were used as precursor ions for the MS/MS analysis and can be used for identification of indole cannabinoids. A 0.5 pg RCS-04 standard was detected with the GC-MS/MS running in the single GC-MS mode. The synthetic cannabinoids in herbal samples were identified using SWGDRUG mass spectral library. The specific isomer can be identified by comparing to the retention time of the standard. Currently we are working on the quantification method using the GC-MS/MS.

"Marijuana Validation: The Duquenois-Levine Test," Jim Wesley*, Monroe County Crime Lab, Rochester, NY; Amy Komarek, York College

The identification of Marijuana in Forensic Labs has recently been the topic of much discussion. Unlike other controlled substances which typically utilize Gas Chromatography/Mass Spectrometry or FTIR for identification,

marijuana can be identified by a combination of Microscopic (Botanical) examination, The Duquenois Levine Color Test and Thin-Layer Chromatography using Fast Blue B. (SWGDRUG). The argument has been that these three tests do not provide structural identification and that they also have never been properly validated. Given that much of the original marijuana identification work was completed many years ago, it seems appropriate to examine each of the three identification procedures again.

This research is one part of a comprehensive validation of Marijuana Identification project. The intent is to validate each of the four methods (including GC/MS) and then combine the validations into one comprehensive Marijuana Identification protocol. Our microscopic identification was presented at the NEAFS 2013 meeting.

In the near future, NIST OSAC guidelines will be developed to enhance training and standardize operating methods within forensic laboratories. This presents an opportunity to develop a training model that can benefit the industry. By working together, crime labs and schools can develop validation protocols which can be universally applied, thus saving resources, enhancing training and avoiding duplication of effort. The goal is to use NEAFS as a portal to circulate and evaluate this training within our 55 laboratory system.

Over 100 common herbs and spices were tested using the (Duquenois Levine) DL Test. We also included some chocolate, coffees and other foods that have been reported to produce false positive DL results. Research into the DL procedure uncovered several variations. In our procedure we placed ~ 50 mg of each item into a test tube with ~ 1 ml of methanol and evaporated the methanol on a heat block. We then discarded the plant material and reacted the extract sequentially with ~ 1 ml DL reagent, 12N HCl and Chloroform. The tube was agitated slightly to insure proper color development and extraction into the lower chloroform layer. All tests were then photographed with a blank and positive Marijuana standard. An excel spreadsheet was constructed featuring the name of the material tested, the observed color reaction and the actual thumbnail picture of the reaction. Each thumbnail is hyper-linked to a large picture to allow a more detailed examination of the result.

The goal is to provide both a substantial validation of the Marijuana identification procedure and a training kit of herb/spice samples that could be distributed among forensic labs to enhance procedural development and training.

"Identification of Botanical Evidence by Direct Analysis in Real Time Mass Spectrometry," Ashton D. Lesiak *, University of Albany; Robert B. Cody, JEOL USA Inc.; A. John Dane, JEOL USA Inc.; Rabi A. Musah, University of Albany

With increasing frequency, drug users are circumventing controlled substance laws by abusing unscheduled psychoactive plants. One such alternative is Mitragyna speciosa, more commonly known as kratom. Although endemic to Southeast Asia and Africa, it is now easily available through internet commerce. The escalation in Kratom abuse in the United States (US) in recent years has resulted in its being labeled a "drug of concern" in 2013 by the US Drug Enforcement Administration. Forensic identification of Kratom is problematic because its morphological characteristics are not well known and its genome has not been mapped. Current hyphenated techniques used in forensic laboratories, such as LC-MS and GC-MS, often employ lengthy extraction procedures and chromatography protocols that dramatically extend analysis time, making routine analysis by these methods impractical in a forensics context.

Here, we show that high resolution-direct analysis in real time-mass spectrometry (HR-DART-MS) can be used to rapidly identify kratom through detection of its psychoactive chemotaxonomic markers mitragynine and 7-hydroxymitragynine. Collision induced dissociation was used to confirm the presence of mitragyinine (or its

stereoisomers), 7-hydroxymitragynine and mitraphylline, another constitutively present alkaloid of significant abundance. By this method, plant material could be analyzed in its native form and no extractions or other sample pre-preparation steps were required. Importantly, statistical analysis of spectra produced by HR-DART-MS allowed differentiation of kratom from other non-drug plant material. This approach also provides a means to differentiate between varieties of M. speciosa species. Ultimately, HR-DART-MS can serve as a method to rapidly identify and classify botanical drug evidence.

"Enhancing the Evidentiary Value of Plant Seed Evidence- Rapid Mass Spectrometric Identification of Jimsonweed and Other Abused Plant Sources of Belladonna Alkaloids," Rabi A. Musah,*, University of Albany; Ashton D. Lesiak, University of Albany; Robert B. Cody, JEOL USA; A. John Dane, JEOL USA Inc

In 2013, the US Drug Enforcement Administration issued a bulletin listing Datura stramonium, (aka Jimson weed) as a "drug of concern." Plants of the genus Datura, most notably D. stramonium, D. ferox and D. inoxia species, are of forensics interest because their abuse as alternatives to scheduled substances has been linked to multiple poisonings and fatalities. Historically, the seeds of these plants, in addition to the seeds of Brugmansia and Hyoscyamus species, have been ingested for the resultant psychotropic effects of their constituent belladonna (tropane) alkaloids. To date, the evidentiary value of botanical material such as the seeds of abused plants is limited, since the rise in abuse cases has outpaced the development of methods for the positive identification of seed material.

Here, we report on how the inherent distinctions between the metabolomes of different seed species provides a fingerprint which can be used to rapidly identify and differentiate seed evidence by high resolution direct analysis in real time mass spectrometry (HR-DART-MS). Seed samples can be analyzed in their native form without a chromatographic step. Furthermore, statistical analysis of the mass spectra was used to enable identification and classification of Datura, Brugmansia and Hyoscyamus seeds. In addition to species identification, atropine and scopolamine, which are the active plant components, were quickly and accurately identified. This method may have utility in the identification of plant-based forensics evidence.

"Using Direct Sample Analysis Time-of-Flight Spectroscopy for Confirmational Identification of Street Drug Samples," Roscoe Bennett*, Pennsylvania State Police Bureau of Forensic Services

A validation study is developed to confirm street drug samples using the accurate mass data of the parent ion and two soft ionization fragments. The discriminatory power will be evaluated across drug classifications and within drug classifications, including closely related compounds. The advantage of direct sample analysis time of flight spectroscopy is speed. With the potential of no sample prep and fast analysis time this technology could help with the ever increasing workload of drug analysis.

"Handheld Narcotics Screening by Raman Spectroscopy (TRUNARC®)," Michael D. Hargreaves,* Thermo Scientific Portable Analytical Instruments

Handheld Raman devices are being utilized around the world by police, fire, customs, pharmaceutical, homeland security and by the military for a multitude of chemical identification roles. Raman spectroscopy is a form of vibrational spectroscopy which allows for robust chemical identification due to its chemical specificity. Coupled to

sophisticated algorithms, Raman spectroscopy has now been realized for street narcotic screening by law enforcement and customs officers.

The presentation will cover the basic principles of Raman spectroscopy, surface enhanced Raman spectroscopy (SERS), which has afforded the ability to screen heroin, sprayed form synthetic cannabinoids and low dose abused painkillers. The global application of TruNarc and its sister products, will be covered, for the identification of narcotic precursors, common narcotics (such as heroin, cocaine, amphetamine) and the emerging or materialized precursors (and even pre-precursors), narcotics; such as synthetic cathinones, cannabinoids, and substituted phenethylamines.

Examples from around the world of deployed TruNarc devices will demonstrate the utility of this device in the hands of end-users.

"Characterization of Methamphetamine and its By-Products by DART-MS," Donna M. Iula, Cayman Chemical Co.; Rabi A. Musah, University of Albany; Marek A. Domin, Boston College, Robert B. Cody, JEOL USA Inc; A. John Dane, JEOL USA Inc.; Brian D. Musselman, IonSense Inc.; Gregory W. Endres, Cayman Chemical Co.; Jason R.E. Shepard*, University at Albany

Methamphetamine is a highly addictive drug and its manufacture, distribution, and abuse are issues of international importance. Enforcement agencies continue to develop methods to characterize methamphetamine samples. In particular, significant efforts have been directed to investigation of the chemical signatures that are characteristic of the starting material and methods used for its synthesis, which can be used to track the activities of clandestine laboratories, distribution networks, and trafficking patterns. These chemical signatures include trace impurities such as residual starting materials and/or by-products from the synthetic method. Methamphetamine was prepared from five different synthetic routes and characterized using direct analysis in real time mass spectrometry (DART-MS). DART-MS is an ambient ionization method that was used to characterize samples in their native form without any preparation. In addition to methamphetamine, dozens of different impurities were identified by accurate mass measurements. These impurities included residual starting material, intermediate products, route-specific identifiers, and other synthetic by-products. Together, these various impurities serve as a specific chemical signature for methamphetamine that is related to the synthetic method and starting materials employed. The DART-MS method used here demonstrates the utility of the technique to rapidly characterize methamphetamine samples in an efficient, informative manner that is complementary to current standard methods.

"Direct Analysis in Real Time Mass Spectrometry (DART-MS) of Cathinone "Bath Salt" Drugs and Mixtures," Rabi A. Musah, University of Albany; Robert B. Cody, JEOL USA Inc; Marek A. Domin, Boston College; A. John Dane, JEOL USA Inc.; Jason R.E. Shepard*, University at Albany

Synthetic cathinones are a class of psychoactive compounds marketed as alternatives to drugs like methamphetamine and ecstasy. Cathinones are addictive and their use has been linked to overdoses and deaths. Although legislation has attempted to restrict these compounds, only a few specific compounds are legislated while others have indeterminate legal status. With new derivatives of cathinones continually surfacing, controlling these substances is challenging.
Ambient MS methods increase throughput of analyses as well as provide more detailed structural information of unknowns. DART-MS is an ambient technique where an unknown white powder can be ionized directly without extraction or chromatography, greatly reducing analysis time. As a preliminary screening tool, DART-TOF-MS has the potential to reduce backlogs and streamline analysis.

DART-MS was used to characterize individual cathinones and mixtures of cathinones and various cutting agents. Simple spectra can provide parent $[M+H]^+$ peaks indicative of the number of compounds present, with high mass accuracy key in predicting formula weights. Cathinones were also fragmented by in-source collision induced dissociation (CID) to produce fragment patterns for structural characterization, used to differentiate isobaric cathinones based on characteristic fragments. Furthermore, a mixture of cathinones shows that individual components can be distinguished within a mixture. The process allows for rapid identification of common cutting agents, providing a means to simplify more complex mixtures. With no sample preparation needed, spectra were obtained in seconds, and the DART-MS is ideal for structural characterization of unknowns.

Finally, DART-MS data is suitable for statistical analysis. Any differences in samples due to degradation or many other factors can be the basis of statistical differentiation against several statistical models and programs, allowing the reporting of results with a higher level of confidence.

Special Session in Drug Chemistry - ***Laws and Legal Issues Related to Emerging Drugs***

"Molly Laws," Jim Wesley*, Monroe County Crime Lab, Rochester, NY

Over 80 hallucinogenic/stimulant compounds are in current use as Bath Salts/Ecstasy/Molly. Joining the parade of Cathinones are Tryptamines, Phenethylamines, Benzylpiperazines and some that refuse classification. Although much simpler in structure than the cannabinoids, over half of those in current use are not specifically listed in any law. We trace the structural history of these drugs and the laws attempting to control them beginning with the 1986 Federal Analog Act. Side by side comparisons of CSA drugs and novel drugs from each class are used during an open discussion of "substantially similar". We then look at successful approaches to controlling these drugs. Handouts will include a summary of current laws and a glossary of terms; both of which should help the chemist if and when she/he is approached by "someone" wishing to craft a law.

"Synthetic Cannabinoid Trends, Resources and Laws," Gregory Endres*, Cayman Chemical Co.

This presentation will focus on synthetic cannabinoids and is divided in four parts: 1. emerging trends, 2. tools and resources 3. recent criminal cases and 4. a new concept for legislation. The emerging trends will cover recently detected cannabinoids and their occurrence based on reference standard sales. New search tools on the Cayman Chemical website including the identification of likely matches to unknown designer drugs by GCMS will be discussed. Forensics Drug Review, a web-based peer-review process for rapid data verification of designer drug monographs will also be covered. Recent criminal cases and expert witness testimony involving K2/spice products will be included. Finally, new ideas for improvements to legislation involving synthetic cannabinoids and other designer drugs will be discussed with the hope of facilitating the prosecution and providing deterrence for illegal activities associated with these emerging substances of abuse.

Forensic Biology Abstracts

"Internal Validation of DNA Extraction Protocols for Forensic Applications: A Comparative Study Between Manual and Automated Systems, " Jennifer Sears *; Thomas Walsh; Heather Mazzanti; Jillian Fesolovich; Britton Morin; Christian Westring, NMS Labs, Willow Grove, PA

Isolation and purification of DNA extracts in forensic applications is a critical factor in obtaining short tandem repeat (STR) profiles that are clean and reproducible. The performances of manual and automated extraction methods were evaluated to determine maximum extraction efficiency. Pretreatment protocols were altered to increase efficiency, maximize DNA recovery, and decrease variability. Total human DNA concentrations significantly increased with increasing incubation times between 2 and 8 hours after an organic extraction. The Qiagen EZ1 Advanced XL and Promega Maxwell 16 were evaluated employing paramagnetic DNA isolation. Different kit options were explored to maximize DNA recovery. The Qiagen EZ1 DNA Tissue Kit displayed equivalent or greater DNA yields across multiple blood dilutions. A comparison between manual and automated methods indicated no significant difference in DNA recovery from forensic-like samples. Utilization of the EZ1 system had the practical benefit of reducing manual processes in the laboratory thereby increasing laboratory efficiency, while minimizing the risk of analytical error.

"An Assessment of in vitro DNA Repair Mechanisms as Related to Damaged Forensic Specimens," David San Pietro*, University of New Haven / PhD Course in Forensic Medicine & Sciences, University of Verona, Italy; Michael Adamowicz, University of New Haven; F. Bortolotti, & Dr. F. Tagliaro, Dept. of Public Health & Community Medicine, Unit of Forensic Medicine, University of Verona

Many samples submitted for forensic DNA analysis are degraded. This damage often prevents the successful amplification and short tandem repeat typing necessary to develop a full DNA profile. Over the course of the last decade research has been directed toward developing protocols allowing for the repair of these damaged DNA fragments. More recently, enzymatic "cocktails" have been developed attempting to mirror in vivo damage repair mechanisms associated with cellular DNA damage in an effort to obtain maximum information from compromised templates.

In this study samples were subjected to defined UV exposure times prior to their amplification and analysis. Profiles were obtained using the Promega PowerPlex 16HS® amplification kit with subsequent capillary electrophoresis on the ABI 3130xl instrument. The results obtained were compared to the pristine DNA sample profiles of the donors.

Damaged samples were subjected to treatment with New England BioLab's PreCR® Mix, and tested to assess the level of repair. Profile information from the damaged samples was compared to profiles obtained from the same samples after repair treatment. Findings relating to observed levels of repair will be discussed.

Repair treatment was assessed as it related to different kinds of forensic samples; for example, mixtures. Repair treatment and its effect on mixture interpretation and deconvolution, when compared to mixtures of pristine samples, was also examined. Samples with stochastic levels of DNA were examined in order to assess the impact of low quantities of amplifiable material in addition to damage.

Discussion of future directions of inquiry and research will also be presented.

"Growth and Adaptation of a Training and Education Program during a Major Laboratory Relocation,"
Mallory Mest *, Armed Forces DNA Identification Laboratory, Armed Forces Medical Examiners System

In 2011, due to the 2005 Defense Base Closure and Realignment Commission's (BRAC) closure of the Armed Forces DNA Identification Laboratory's (AFDIL) parent organization, the Armed Forces Institute of Pathology, AFDIL began a major laboratory relocation of personnel, equipment, and supplies from Rockville, MD to a newly constructed facility on Dover Air Force Base in Delaware. The move affected all sections within AFDIL to include Training and Education (T&E). The Training and Education section provides and manages all training and educational requirements for new and current staff and coordinates the educational outreach program for the local scientific and academic community. The T&E section had many challenges to manage during the move, to include: the increased number of new scientists in training due to the loss of personnel; the lengthy core training requirements for new scientists; preventing mission decrement by maintaining a fully trained laboratory staff; and how to address continuing education requirements in a fiscally challenging environment. To manage the challenges of moving a complete laboratory, the T&E section: added three new scientists to assist in the training of laboratory personnel in auSTR, Y-STR, and mitochondrial DNA processing; requested dedicated training laboratory space and equipment to decrease training time; and improved the quality of scientists by extensively integrating the FBI's Quality Assurance Standards for Forensic DNA Testing Laboratories, the American Society of Crime Laboratory Directors/Laboratory Accreditation Board (ASCLD/LAB) standards, the Scientific Working Group for DNA Analysis Methods guidelines; and ISO 17025 accreditation standards. The improved management and organization of AFDIL's T&E department allowed the laboratory to improve the quality of its scientists and allowed the laboratory to produce quality work without a decrement to mission requirements.

(The opinions or assertions presented hereafter are the private views of the speaker and should not be construed as official or as reflecting the views of the Department of Defense, its branches, the US Army Medical Research and Material Command or the Armed Forces Medical Examiner System.)

"NIJ's Forensic Science Grant Programs," Chuck Heurich*, National Institute of Justice

Since the early 2000s NIJ has provided federal funds for a large number of forensic science programs including the Paul Coverdell Forensic Science Improvement and the DNA Capacity Enhancement and DNA Backlog Reduction programs. The reach of this federal funding has been much greater through additional programs. NIJ staff will give an overview of all of the programs that they support as well as show the impact some of these programs have had on the forensic science community as well as what the future looks like.

"High-Throughput Processing of Sexual Assault Kits," Camilla Green*, Sorenson Forensics

With new legislation and media scrutiny to process sexual assault evidence collection kits in a more timely manner, many labs are forced to take a second look at their laboratory processing steps for sexual assault case submissions.

Sorenson Forensics has implemented and optimized a high-throughput serology process which has significantly increased our laboratory's capacity to analyze more sexual assault evidence collection kits on a monthly basis. This presentation will focus on the validation of a highly sensitive Y-screening procedure that is a viable alternative to traditional serology methods, such as microscopic examination, for the detection of male DNA. As a follow-up to the Y-screening analysis, a p30 and amylase test can be performed for all positive swabs and/or samples contained in a sexual assault evidence collection kit.

And lastly, the presentation will also include how Sorenson Forensics has utilized our Lean Six Sigma expertise to create guidelines and thresholds throughout the serology and DNA testing process in order to identify and focus on the success rates of obtaining a DNA profile for comparison and/or CODIS upload.

"Separating Familial Mixtures, One Genotype at a Time," Ria David; Martin Bowkley*, Mark Perlin, Cybergenetics, Pittsburgh, PA

TrueAllele Casework can separate out genotypes from complex mixtures that contain multiple family members. Genotype separation overcomes high allele sharing and produces simple likelihood ratios (LR).

One recent father-daughter rape case had multiple cuttings from a blanket, with evidence items that were two person mixtures. TrueAllele first assumed that two unknown people contributed their DNA to the evidence, and inferred genotypes matching the father and daughter with statistics in the tens of trillions. Next, assuming the father as a known contributor to the evidence, the added information better separated the genotypes, more strongly matching the daughter at the hundred quadrillion level. A sister reference was excluded via a negative log(LR) value.

TrueAllele's "peeling" method separates genotypes layer-by-layer from a complex mixture. Cybergenetics has used peeling in several cases containing extremely complex mixtures of family members having up to five related contributors. Peeling away major contributors before minor ones lets TrueAllele separate out the genotypes, even when family relationships exhibit many shared alleles.

This talk illustrates the peeling method through casework examples, and shows how it can increase genetic identification information.

"Validation of a Homebrew Assay for Mitochondrial DNA Amplification," Andrew J. Schweighardt*; Jessica Harris; Neha Desai; Paul Goncharoff; Mark Desire; Timothy Kupferschmid, New York City Office of Chief Medical Examiner

The NYC OCME Dept. of Forensic Biology uses a commercial PCR amplification kit to amplify the HVI and HVII regions of mitochondrial DNA. The kit contains a biotinylated primer mix and a reaction mix with all other essential PCR components. The kit is also sold with Linear Array strips which provide a way to deduce the mitotype by probing ten regions of the HVI/HVII region. OCME no longer performs Linear Array testing, opting instead for the more discriminative method of sequencing the entire HVI/HVII region of the amplification products. The expense of the commercial kit and the accumulation of unused materials sold with the kit prompted the OCME to develop a Homebrew reaction mix, containing optimized amounts of custom primers, dNTPs, magnesium chloride, PCR buffer, and Taq polymerase. The Homebrew assay was successfully used to amplify the HVI/HVII region in various sample

types. Based on quantification of sample nuclear DNA, an amplification input of 0.5 ng/20 uL using the Homebrew method yielded comparable results to an amplification input of 0.1 ng/20 uL using the commercial method. Therefore, with the higher input of template, the Homebrew method is suitable for use in most mitochondrial DNA missing persons casework. The Homebrew assay is currently online for OCME missing persons casework. Future work is planned to improve the sensitivity of the Homebrew assay.

"A Novel Method for Human Semen Identification: Using High Resolution Melt Analysis to Ascertain DNA Methylation Status," Caitlyn Deppen*; K. Joy Karnas, Cedar Crest College

It has previously been noted that the methylation status of DNA is used to regulate gene expression; thus, it is tissue-specific and can be used to identify body fluids. In contrast to earlier studies that were based on the fairly expensive and time-intensive technique, pyrosequencing, our research uses real time PCR amplification and high resolution melt analysis, making it both cost-effective and compatible with equipment commonly found in crime labs. Body fluids (blood, saliva, urine, semen, and vaginal fluid) were obtained from volunteers and DNA was isolated using either organic extraction (saliva, urine, and vaginal fluid) or Chelex® 100 extraction (blood and semen). The samples were then subjected to bisulfite modification in order to convert unmethylated cytosines to uracil, consequently creating sequences whose amplicons have melt curves that vary depending on their initial methylation status. When primers designed to amplify the promoter region of a semen-specific gene were used, DNA from semen samples was distinguishable from other fluids by a shift in melt temperature that was found to be statistically significant using a one way ANOVA with a 95% confidence interval ($p=5.02x10^{-05}$). In addition, DNA isolated from a blood sample stored at room temperature since 1998 generated a melting temperature consistent with fresh samples, indicating that this method of analysis can be used on both recent and historic case samples. This method is also STR typing compatible due to DNA extraction prior to methylation analysis, and there is on-going research to extend this study to the identification of other fluids.

"Internal Developmental Validation of a DNA Differential Extraction Protocol for Forensic Application," Allison N. Miller*, Arcadia University; Meghan A. Troy, NMS Labs; Britton Morin, NMS Labs; Christian Westring, NMS Labs; Heather E. McKiernan, Center for Forensic Science Research and Education

Sexual assault samples are generally composed of a mixture of epithelial cells and spermatozoa from both the victim and suspect. The separation of this mixture is necessary to distinguish single-source DNA profiles which are easier to interpret and yield greater statistical significance. Current methods used for differential extraction have been shown to lose sperm cells during the wash steps required for separation. This loss of biological material could mean the difference between generating a DNA profile or not in samples with low levels of semen.

This study aimed to develop and validate an in-house differential extraction protocol which would reduce cell loss by finding a buffer which creates a barrier to protect the pellet. Various density liquids were assessed; selection was based on how effectively the fractions were separated while ensuring no inhibition was detected. Mock sexual assault samples were created and STR profiles were developed following four different extraction methods (treatment 1: in-house optimized phenol:chloroform protocol, treatment 2: manufacturer guidelines for a commercially available differential extraction kit, treatment 3: modified phenol:chloroform extraction plus barrier buffer, treatment 4: paramagnetic extraction plus barrier buffer). Wash steps were saved and viewed microscopically to assess spermatozoa loss and

effectiveness of the selected buffer. Results indicate treatment group 2 consistently recovered the lowest yield of DNA while treatment group 1 yielded the greatest recovery, samples in treatment groups 3 and 4 recovered only slightly less than group 1. Additionally, preliminary work suggests the addition of the barrier buffer lends itself to automated extraction.

"Can 'Direct' PCR Method Improve DNA Analysis of Fingerprints?" Lana Ostojic*; Elisa Wurmbach, New York City Office of Chief Medical Examiner

Biological samples with low amounts of DNA have been proven to be challenging for the forensic community. They are often obtained from items that have been touched, grabbed or with no apparent biological staining. Sometimes these items are the only evidence available in a criminal investigation for homicides, sexual assault or property crimes. Therefore, it would be preferable to gain STR profile information from such samples. Usually, forensic DNA samples are analyzed through a process that contains multiple steps. First, DNA is recovered from biological material (DNA extraction). Samples are then quantified, in order to proceed with the last step which utilizes a commercially available PCR kit for STR amplification using appropriate amounts of DNA. The completeness of the STR profiles correlates with the amount of DNA extracted from these challenges samples.

In our study we compared "direct" and "non-direct" PCR methods. In the "direct" PCR method, DNA extracts were directly used for quantification and STR amplification. Conversely, in the "non- direct" method the extracted DNA was purified and concentrated prior to proceeding with further steps. In our study, we collected fingerprints daily from unrelated individuals and immediately processed using both "direct" and "non-direct" PCR methods. The study was conducted over six months in order to account for the variability in quality and quantity of the extracted DNA from such samples, leading to over 700 usable fingerprints.

We found that purified and concentrated DNA of the "non-direct" PCR method obtained more DNA. However, additional pipetting steps included in this method may have sheared the DNA and the DNA profiles were less complete. Using both methods, most of the STR profiles obtained from the fingerprint were partial. We considered profiles that were at least 70% complete usable since they could be used to search databases. The outcome between the two methods was comparable and approximately 50% of the fingerprints led to database eligible profiles.

"Detection of "Herbal Highs": a Multiplex PCR Assay for Species Differentiation Through Melt-Curve Analysis," Anjelica C.U. Perez*; Kelly M. Elkins, Towson University

The international prevalence of legal highs necessitates the development of a quick and low-cost method for detection of such novel psychoactive substances and the sources of these substances. This project aimed to develop and optimize a high-resolution, multiplex PCR assay to detect plants, specifically morning glory, marijuana, jimson weed and poppy, that naturally produce psychoactive substances. Species-specific primers that aligned with and amplified DNA from each particular species were used to detect the presence of each plant. The primers were designed to produce small fragments of varying length. Amplicons specific to each plant were visualized through high resolution real-time PCR melt-curve analysis. Each amplicon melted at a different temperature, and identification of the each plant species was possible. The PCR assay was optimized (for specificity, selectivity and sensitivity) to obtain reproducible results. The results will be presented.

"Saliva versus Nectarine: The Ultimate Battle Between Humans and Fruits," Jennifer Coffman*; and Reena Roy, Pennsylvania State University

The ability to detect saliva at crime scenes and in the forensic laboratory is important in legal system involving violent crimes. Saliva identified at the crime scene is important for the identification of the donor of the body fluid.

The Seratec® Amylase Test is an immunochromatographic assay for detection of α-amylase, an enzyme present in very high concentrations in saliva and in much smaller concentrations in other body fluids in humans. The developmental study by the manufacturer indicates that this test targets the isoform of amylase specific to human saliva, thus making it a confirmatory test for amylase present in forensic evidence. The presence of β-amylase, another isoform of amylase, in a wide variety of plants and fruits, which are commonly found at crime scenes, makes it important to examine the applicability of the immunoassay devices, prior to presenting the results in the legal system.

This research project is a validation study of the immunochromatographic devices available in the forensic community. Since α-amylase is also present in other body fluids in smaller quantities, it is important to test the cross reactivity of the system. The current study included body fluids other than saliva from humans and animals and tissues from humans. The assays also included fruits and vegetables.

The results of this validation study indicate that this device cross reacts with fruits such as nectarines and vegetables, as well as with some other body fluids and tissues of humans.

"A Comparison of the Ratio of DNA in Cell-Free and Cellular Extracts in Low Template Analysis," Kayla M. Baylor*; Michael S. Adamowicz, University of New Haven

This study aimed to determine the ratio of cellular to cell-free DNA via low template analysis from a buccal swab taken from the gums of seven participants. Participants were chosen to contribute to this study based on their shedder status. Five samples were collected from each participant. All microcentrifuge tubes were sterilized using a UV Spectrolinker to reduce contamination. The current study involved extraction of the low template samples from their cellular and cell-free components. Extraction of each component was performed following the Qiagen QIAamp® DNA Investigator Protocol for the Isolation of Total DNA from Small Volumes of Blood or Saliva. Following extraction of the cellular and cell-free components, all samples were quantified with an Applied Biosystems™ Quantifiler™ Human DNA Quantification Kit. The samples were subsequently typed by Short Tandem Repeat (STR) analysis using the Promega Powerplex® 16 HS System STR kit. STR analysis was used in order to determine the quality of the profile at all of the loci tested. Results indicated that the amount of DNA in each of the cellular and cell-free components varies; the cellular component contained higher quantities of DNA compared to the cell-free component. The ratio of cellular to cell-free DNA within the samples was as much as 10 fold higher. This study demonstrates the presence of quantifiable DNA in a cell-free state and therefore it is crucial to ensure techniques used in DNA collection and analysis are adequate to utilize to capture this additional source of DNA.

"Discrimination of Human and Animal Blood traces via Raman Spectroscopy," Kyle Doty*; Gregory McLaughlin; Igor Lednev, University at Albany, State University of New York (SUNY)

The characterization of suspected blood stains is important to forensic science. In particular, determining the origin of blood stains is a critical, yet overlooked, step in establishing its relevance to the crime. Currently, assays for determining human origin of blood are time consuming and destructive to the sample. Our research demonstrates that Raman spectroscopy can be effectively applied as a non-destructive technique for differentiating human blood from a wide survey of animal blood. A Partial Least Squares-Discriminant Analysis (PLS-DA) model was built from a training set of near infrared Raman spectra from 11 species. Various performance measures, including a blind test and external validation, confirm the discriminatory performance of the chemometric model. The model demonstrated 100% accuracy in its differentiation between human and nonhuman blood. Additionally, discrimination between blood from individual animal species was shown to be possible. These findings further demonstrate a great potential of Raman spectroscopy to the field of serology, especially for species identification of a suspected blood stain.

"Columnar-Thin-Film Development Technique Allows for Generation of DNA Profile from Fingerprints," Stephanie Plazibat*; Stephen Swiontek; Akhlesh Lakhtakia; Reena Roy, Pennsylvania State University

The columnar-thin-film (CTF) technique is a new method of fingerprint development. In this method, an ensemble of parallel nanoscale columns is deposited atop a fingerprint, thereby entombing the fingerprint. This allows for visualization of the topology of the fingerprint, as well as preservation of body fluids and DNA contained within the fingerprint. In this research study, the CTF technique is utilized for fingerprints wetted with body fluids. The developed fingerprint is photographed and its quality is graded both objectively and subjectively. The developed fingerprint is then swabbed to remove the residue comprising the fingerprint, the body fluid, and the CTF. The DNA is extracted from the collected residue using the BioRobot® EZ1™ automated extraction system from Qiagen. An optimal amount of DNA is amplified using the Identifiler® Plus amplification kit from Applied Biosystems®. DNA from the amplified product is detected by capillary electrophoresis injection on the Applied Biosystems® 3130xl Genetic Analyzer. The generated data is analyzed using GeneMarker® HID Software from SoftGenetics®. Complete DNA profiles have been generated from samples that have been exposed to the CTF technique. These profiles were concordant with reference profiles of donors. The CTF technique does not appear to inhibit DNA analysis. The CTF technique may prove useful to the forensic science community, as both fingerprint development and DNA analysis can be performed on the same sample for improved identification.

"PowerPlex Fusion 6C: Combined Autosomal STR and Y STR Multiplex System," Danielle J. Brownell*, Promega Corporation

The PowerPlex® Fusion 6C System is a 6-color STR system for simultaneously amplifying 23 autosomal loci, three Y-STR loci, and Amelogenin. The twenty required (Amelogenin, D18S51, FGA, D21S11, D8S1179, vWA, D13S317, D16S539, D7S820, TH01, D3S1358, D5S818, CSF1PO, D2S1338, D19S433, D1S1656, D12S391, D2S441, D10S1248, DYS391) and three recommended (TPOX, D22S1045, SE33) proposed expanded CODIS core loci are combined with Penta D, Penta E, DYS570, and DYS576 to give this system a discriminatory power (PI = 1.80 x 10-32) that is over 108-fold higher than that for the twenty required expanded CODIS core loci (PI = 9.35 x 10-24). With DYS391 and

nine autosomal loci being less than 250bp, the additional genetic information obtained with this 27-loci STR system will be extremely useful for analyzing degraded samples, where even a partial profile would be informative.

After attending this presentation, attendees will be able to evaluate the potential benefit of using a combined autosomal STR and Y-STR marker set for analyzing mixture samples.

"Validation of Direct PCR Amplification From Fabrics Using Y-STR's," Amanda Dargay*; Reena Roy, Pennsylvania State University

The goal of this research was to generate DNA profiles from saliva and blood deposited on different fabric substrates. Each substrate containing a body fluid was amplified with or without buffers and reagent prior to amplification with the Powerplex® Y23 amplification kit. DNA profiles generated were compared for concordance within and between the substrates.

Blood and saliva samples from male donors were deposited on different fabrics substrates and punched using a 1.2mm Harris Micro-Punch®. Five batches of substrates were completed with either no washing reagent or one of the following buffers and reagent; Prep-n-Go™ buffer, PunchSolution ™ kit, SwabSolution ™ kit, or ECS ™ reagent.

Amplification reagents from PowerPlex® Y23 amplification kit were added directly to all of the punches in every batch. Analysis of the amplified products was performed by capillary electrophoresis injection on the Applied Biosystems 3130xl Genetic Analyzer. The generated data was analyzed using GeneMarker® HID Software from SoftGenetics®. Y-STR profiles were successfully obtained from all of the substrates containing a body fluid. Concordant profiles were generated between the substrates treated with or without washing reagents and at both reaction volumes.

This research study demonstrates that crime scene samples, such as fabrics containing body fluids, can be amplified directly. Concordance profiles were obtained with or without washing these substrates. Therefore, implementing the use of direct PCR amplification of body fluids would be valuable in the forensic science community.

"Obtaining DNA Profiles from Preserved Tissue Samples Using PowerPlex® Systems," Maryam Alqaydi*; Reena Roy, Pennsylvania State University

In some forensic cases, the victim's body might be missing. Obtaining DNA profiles from evidence samples at the crime scene and comparing them with clinically preserved tissues can help to determine if the body fluids obtained from the crime scene originated from the missing victim or the suspect.

The objective of this research was to investigate the quality of the DNA profiles obtained from human tissue samples that had been preserved in various fixatives such as formalin and alcohol, and to determine if one tissue type better DNA profiles than others.

Tissues sample were obtained from two female and one male-deceased individuals. A defined amount of each tissue sample was preserved in formalin and alcohol. The time the samples were left in the chemicals ranged for 4 weeks, 8 weeks and 12 weeks. Tissue samples were extracted using Qiagen EZ1 BioRobot instrument and DNA Investigator Kit.

An optimum amount of extracted DNA was used for amplification with primers and reagents contained in the PowerPlex® Fusion kit from Promega Corporation. The volume of the reaction was reduced to half of the recommended amount. Also, samples from the male individual was amplified using the PowerPlex®Y23 kit following the manufacturer's recommended protocol except that the volume was reduced to half of the recommended volume.

Analysis of the amplified products was performed by capillary electrophoresis injection on the Applied Biosystems 3130xl Genetic Analyzer. The generated data was analyzed using GeneMarker® HID Software from SoftGenetics®. Concordance study was conducted to determine the effect of the fixative type and the fixation period on the percentage of alleles recovered and the peak height ratios in the DNA profiles.

It was determined that DNA profiles from tissues preserved in alcohol were of better quality compared to the profiles obtained from tissues preserved in formalin. Partial profiles were obtained from tissues fixed with 10% Neutral Buffered Formalin when preserved for 13 days. The use of tissue homogenizers has also increased the number of alleles recovered from formalin-fixed tissue samples. Complete and concordant profiles were generated from tissues fixed in alcohol for at least twelve weeks using the PowerPlex® Fusion System.

"The Prevalence, Pattern and Reliability of Mitochondrial Genome Heteroplasmy: Insights from Recent Studies," Rebecca Just*, Armed Forces DNA Identification Laboratory, American Registry of Pathology, University of Maryland, College Park; Jodi Irwin, FBI; Walther Parson, GMI and Penn State University

Though more than 20,000 human mitochondrial genome (mtGenome) haplotypes are now publicly available, it is only within the past few years – and concurrent with the expanding use of massively parallel sequencing (MPS) technologies for full mtGenome sequencing - that detailed reports on mitochondrial DNA (mtDNA) heteroplasmy outside of the control region have begun to emerge. In contrast to heteroplasmy rates determined from carefully generated and thoroughly vetted Sanger-based datasets, a very high incidence of mtGenome heteroplasmy has been claimed in some recent studies that utilized MPS data. This presentation will detail the use of the human mtDNA phylogeny to examine published reports on mtGenome heteroplasmy, and will present information on the prevalence and pattern of mtDNA heteroplasmy (especially within the coding region) gleaned from analyses of data combined from reliable studies. An understanding of the expected rate and distribution of heteroplasmy across the complete mtGenome, and awareness of methods to distinguish true intraindividual variation from contamination, will become increasingly important as highly sensitive MPS-based typing methods are more widely applied to develop full mtGenome haplotypes for forensic purposes.

(Disclaimer: The opinions or assertions presented herein are the private views of the authors and should not be construed as official or as reflecting the views of the Department of Justice, the Department of Defense, its branches, the U.S. Army Medical Research and Materiel Command, the Armed Forces Medical Examiner System, the Federal Bureau of Investigation, or the U.S. Government.)

"Evaluating the Effect of Arson Analysis Procedures on the Recovery of DNA from Molotov Cocktails," Samantha Mulhern* and Madison Kubilis*, Western New England University; Amy Barber; John Biello; John Drugan; Lynn Schneeweis; Roberta Westerman; Marisa Westlin, Massachusetts State Police Crime Laboratory

Arson cases involving Molotov cocktail devices often have no identified suspect associated with the incident. The Massachusetts State Police Crime Laboratory Trace/Arson and Explosives Unit routinely test these devices for the presence of ignitable liquids, but in the absence of additional evidence material or investigative leads, these cases may remain unsolved. Therefore, the ability to develop a DNA profile suitable for CODIS upload from these devices has the potential to provide significant investigative information for law enforcement personnel. However, the procedures traditionally employed to identify accelerant present in these devices often require exposing the evidence material to high heat for several hours, in addition to the heat exposure already incurred by the material if the device successfully burned. This exposure to high heat may cause significant damage to any biological material present on the item. Consequently, the Massachusetts State Police Crime Laboratory Trace/Arson and Explosive Unit and DNA Unit designed a study to evaluate the potential recovery of DNA from the Molotov cocktails as well as determine the effect of the laboratory's current arson analysis procedures on the recovery of DNA from these devices. This presentation will discuss the results of this study and considerations for multiple unit analysis procedures in these types of cases.

"Obtaining DNA Profiles from Simulated Crime Scene Samples using the RapidHIT™ System," Aamer Alshehhi*; Reena Roy, Pennsylvania State University

The RapidHIT™ System was designed to analyze buccal swabs. This research project involved bloodstains and saliva samples. This study involves generation of DNA profiles from simulated crime scene samples using the RapidHIT™ System through testing the sensitivity and robustness of the newly introduced "Run Other Samples" instrument protocol. The cartridges used in this study contain the PowerPlex® 16 HS system from Promega Corporation.

Varying amounts of blood and saliva were deposited on different types of substrates. The substrates chosen for this study are commonly found in crime scenes in the United Arab Emirates (UAE). The results indicate that the RapidHIT™ System is able to generate full and concordant DNA profiles from both types of body fluids when they are deposited on various types of substrates.

"The Use of the Microbial-Vac in the Collection of Low Template DNA from Handled Fabrics," Danielle Weinstein*; Janine Kishbaugh, Cedar Crest College

The term 'low template DNA'(LTDNA) refers to samples containing less than 100 picograms of DNA and these samples are often found at crime scenes in the form of 'touch DNA', or DNA originating from the hands. A wet vacuum collection system called the Microbial-Vac (M-Vac) has been used to collect Forensic DNA samples. The purpose of this study is to introduce the M-Vac as a new option for LTDNA collection. The Microbial-Vac collection method studied herein is hypothesized to collect LTDNA better than swabbing, taping, and cutting. This study utilized ten fabric substrates including cotton, polyester, rayon, wool, and cotton/spandex blend. Fabric was handled by participants and touch DNA was successfully collected using the M-Vac. Using a two-way analysis of variance (ANOVA, 95% CI), the quantitation values were compared and it was found that there was a statistical difference between the 10 fabric types and the 3 participants ($p<0.01$). For example, more DNA deposits on and is collected from wool fabric when compared with rayon fabric. Also, one participant shed more DNA than the other two which likely accounted for the statistical difference. This study involved 150 touch DNA samples and resulted in 30 full DNA profiles out of the 59 samples that were genotyped. In a t-shirt application study, the wearer's touch DNA was collected from inside the collar and right underarm areas of cotton t-shirts worn by participants. An ANOVA (95%

CI) showed there was a statistically significant difference between areas sampled ($p<0.05$) but no difference between participants. The collar samples showed high amounts of DNA while the majority of underarm samples showed no DNA. Seventeen out of 30 samples were genotyped which resulted in 13 full DNA profiles. Overall, 29.3% of samples (44 samples out of 150 total) in the touch DNA study and 43.3% of samples (17 out of 30 total) in the t-shirt study were suitable for CODIS database inclusion meaning the profiles contained 10 loci or greater. Ultimately, the M-Vac was successful in collecting touch DNA and providing DNA profiles; however, it cannot be compared directly to swabbing, taping, and cutting without further research.

"Development and Validation of a DNA Quantitation Assay for Loxodonta Africana," Meredith Rohrbaugh*; Jillian Fesolovich; Heather McKiernan, Arcadia University

Wildlife forensics involves the application of forensic science to the conservation of non-domesticated animals. Species in need of increased conservation efforts include African and Asian elephants. The number of African and Asian elephants has been on a steady decline due to poaching for their ivory tusks and meat. The objective of this study was to develop and validate a quantitation assay for African and Asian elephant nuclear DNA. This assay will then be coupled with proposed genotyping assays which could be used for species identification and individualization. These methods could aid in prosecution of crimes against elephants. To begin designing a quantitation assay, a unique sequence was found using NCBI BLAST in the African elephant gene for testis, prostate and placenta expressed protein. Primers were designed using NCBI Primer BLAST. Primers functionality was assessed using African elephant DNA to ensure binding and amplification of the target gene. While the TEPP primers failed to produce amplicon under a variety of PCR conditions, primers previously described by Wozney and Wilson (2012) for the Cytochrome b gene in African and Asian elephants and Woolly Mammoth, were successful. Separate fluorescently labeled probes were designed for each species. These primers and elephant probes were then used to develop the quantitation assay. Following development of the assay, a developmental validation was conducted. This validation included studies for sensitivity, specificity, reproducibility, and repeatability. Preliminary data from this research will be presented including primer selection, optimization of primers and probes for the quantitation assay, and developmental validation data.

*=presenting author

Toxicology Abstracts

Special Toxicology Session on New Psychoactive Substances: Toxicological Challenges and Case Studies

"Synthetic Cannabinoids: Identification in Various Matrices and Legal Concerns," Brandon C. Presley*, NMS Labs

Synthetic cannabinoids are a growing class of designer drugs intended to mimic the effects of THC, the major psychoactive component of marijuana. Over the last several years, various types of these compounds have emerged making it difficult for forensic practitioners to keep up with trends as well as the many analytical and legal challenges that they pose. A discussion of the history of synthetic cannabinoids, current trends, adverse effects and their identification in biological and non-biological samples by various methods will be discussed. Legislation and expert testimony challenges for both forensic chemists as well as forensic toxicologists will be reviewed.

Why the "NBOMe" are not "The Bomb," Sabra Botch-Jones*, fTox Consulting, LLC; Robert D. Johnson, Tarrant County Medical Examiner's Office

As potent serotonin (5-HT2A) receptor agonists the NBOMe class of drugs including 25B-, 25C-, 25D-, 25H-, 25I-, and 25T2-NBOMe, are frequently abused due to the intense hallucinations that they induce. From the limited literature available, the concentration of these NBOMe compounds reported in forensic casework is exceedingly low. In most instances, published concentrations are below 0.50 ng/mL. Therefore, the need for a sensitive, rapid, and comprehensive analytical method for the quantification of these compounds imperative. This presentation will explore the pharmacology of these compounds as well as the current impact these compounds are having on our forensic toxicology and drug chemistry laboratories. We will also examine the results of research examining the stability of these compounds in biological specimens. In addition to the more publicized analogue 25I-NBOMe, this research evaluated 25B-, 25C-, 25D-, 25H, and 25T2- in whole blood, plasma, and urine. This presentation will include the data obtained from the validation of a ultra performance liquid chromatography-tandem mass spectrometry (UPLC/MS/MS) method for the simultaneous quantification of these 6 NBOMe analogues. Three cases will presented highlighting the challenges the NBOMe compounds pose to our forensic toxicology laboratories.

"Molly Misses MDMA: Everything but the Drug," James Wesley*, Monroe County Crime Laboratory

The summer 2010 concert season featured a tan powder in small zip-lock bags. Advertised as "Molly", it was identified as 50% MDMA. By October, Molly continued to be submitted to crime labs for testing but the MDMA had all been replaced with 4-Methylmethcathinone. And now four years into the current "Molly" resurgence we have over 80 hallucinogenic/stimulant compounds to deal with, many appearing for the first time at concert events. Joining the parade of Cathinones are Tryptamines, Phenethylamines, Benzylpiperazines and some that refuse classification. Amid

reports of deaths from "Tainted Molly" in 2013, a Level 2 Mass Casualty Incident at a June 2014 EDM (Electronic Dance Music) concert in Boston, and a half dozen Summer 2014 concert deaths, we have no plan in place to identify or report Molly/E drugs or address the causes of the intoxications and deaths. We cover: 20 years of Ecstasy/Molly use (complete list provided), Molly=Ecstasy=Bath Salts, The Concert Rave scene, Heat Stroke, Excited Delirium etc. Included is an identification and treatment plan.

General Toxicology Session

"Forensic Toxicology Yesterday and Today," Robert DeLuca*, DESPP Scientific Services

This presentation will cover analytical techniques used in forensic toxicology labs from the 1980's through today. The emphasis will be to compare and contrast the drugs found in the past, the analytical techniques used then to the commonly found drug combinations found today. It will include examples of cases analyzed using methods of the past, as well as examples of recent cases. The presentation will discuss how the some of the challenges toxicology labs faced years ago are being addressed by today's sample preparation, instrumental, and data processing techniques.

"Evaluation of Ethanol Tolerance in CT DUI Arrestees," Kayla Benvenuto*, Western New England University; Robert Lockwood, CT DESPP Division of Scientific Services &University of New Haven; John Drawec, Western New England University; Robert Powers, University of New Haven

Alcohol tolerance is well-accepted in society, often without differentiation between simply enhanced alcohol metabolism, and a true mechanistic tolerance to ethanol. To evaluate such tolerance based on blood alcohol content (BAC), as opposed to amount of alcohol ingested, we conducted a retrospective study relating standard field sobriety test (SFST) data of Connecticut drivers arrested for driving under the influence (DUI) to BAC. We hypothesized that ethanol-tolerant drivers would produce lower SFST scores than would be expected based on solely on their BAC.

DUI arrest cases (*n=395*) where both SFST's and two breath tests had been performed were randomly selected and evaluated for study criteria compliance, including at least thirty minutes elapsed time from cessation of drinking to time of stop, elimination rate of at least 0.01 g/dL/hr, and complete documentation of the SFST process and observations. In qualifying cases, an aggregate SFST score was correlated with BAC (back-extrapolated to the time of SFST evaluation). The basic relationship between impairment (SFST performance) and BAC was estimated as the line of best fit between zero and twenty-one points with BAC's > 0.25 (assumed to be reflective of alcohol alone). The validity of this line was evaluated by elimination rates of the constituent points. The inherent variation of those points established an estimated confidence interval for the line.

Initial evaluation of the study raw data showed that of the 138 points meeting the study acceptance criteria, eighty-seven points (63%) were more than 2 SD (mean value of 5.45 SD) greater than the line, suggesting that these individuals had some CNS-active drug present in addition to the alcohol determined in the breath alcohol tests. Interestingly, there were only five points (3.6%) more than 2 SD below the line (mean -2.84 SD), suggesting potentially tolerant drivers were rare in this study. In conclusion, alcohol tolerance, demonstrated by a markedly lower SFST score than would have been expected based on the BAC, was not readily demonstrable in this study.

"Database of a Decade of Post-Mortem Drug Levels Useful for Quantitation," Wayne Moorehead*, Penn State University; Ines Collison; Nick Casassa; Jan Jones, Orange County Crime Laboratory, Santa Ana CA

Orange County in California has a population base of approximately three million people with a Sheriff-Coroner Department as the primary law enforcement agency with a full service laboratory. The crime laboratory, in addition to conducting typical criminalistics and forensic chemistry analysis, also conducts post-mortem toxicology analysis of tissues obtained from autopsy.

From a ten-year period, fifty-three commonly encountered drugs with their metabolites, as appropriate, were detected in decedents from a variety of categories of death and compiled into a database consisting of monographs. The concentrations of the drug/metabolite were sorted by sample type submitted (central blood, peripheral blood, liver, brain, etc.) and category of death. Select ratios were determined, as well as other information useful for toxicologists.

The presentation will detail how to use the monographs for post mortem toxicology quantitation and compare drug levels relative to the drug level range found for the particular drug over ten years. This presentation was given at the AAFS (2011) meeting and the California Association of Toxicologists meeting.

"A Case of Suicide with Injected Xylazine," Priya Banerjee*; Paul Iwuc; Christina Stanley; Laurie Ogilvie, Rhode Island Office of State Medical Examiner

Xylazine is a veterinary anesthetic in the alpha 2 adrenergic agonist family. It acts on the central nervous system with sedative, anesthetic, and muscle relaxing properties. The injectable solution consists of the hydrochloride salt. Currently, it is not a scheduled drug and there is no approved use in humans. We report a fatal case of injected xylazine and ketamine in the setting of asphyxia in a 26 year old male. Investigation revealed that the decedent had a history of depression without prior suicide attempts. At the scene, he was found with a plastic bag tightly secured over his head, two connected but closed helium tanks, an open vial of xylazine and used needles/syringes by him. Literature on suicide was open on the computer but no suicide note was present. Additionally, a single fresh needle injection site was found at autopsy. Quantitations of postmortem samples by GC/MS revealed the following findings for xylazine: 1.2 mcg/mL in femoral blood and 1.0 mcg/mL in the heart blood. Xylazine was present in the liver but below the level of quantification for the reference lab (NMS). Ketamine was 120 ng/mL and norketamine was 56 ng/mL in the femoral blood; ketamine was 94 ng/mL and norketamine was 63 ng/mL in the heart blood. Additionally, citalopram/escitalopram was 55 ng/mL in the femoral blood and 889 ng/g in the liver. GC/MS testing of the used needle and syringe found was positive for xylazine and ketamine. Review of the current literature shows that xylazine is a rare cause of sudden death alone or in combination with other drugs. This study reports levels higher than those previously reported. Furthermore, this study adds to the understanding of xylazine as an emerging drug of abuse and highlights the importance of toxicological testing of postmortem specimens for this veterinary drug.

"Detection of the Synthetic Hallucinogen 25I-NBOMe in Two Post-Mortem Cases," David J. Nemeth*; Jeanne Beno; Donna R. Nemeth; Michelle Salamone, Monroe County Office of the Medical Examiner

"The toxic effects of the synthetic hallucinogen phenethylamine 25I-NMBOMe [2-(4-iodo-2,5-dimethoxyphenyl)-N-[(2-methoxyphenyl)methyl]ethanamine] are increasingly well documented, but concentrations of the drug in post-mortem samples are rarely reported. We present concentrations of 25I-NBOMe found in two fatalities attributed to acute drug intoxication. In both cases, witnesses stated that the decedent had consumed LSD (lysergic acid diethylamide). Both subjects then collapsed with seizure-like activity. Resuscitation by emergency medical services was unsuccessful. In one case, amphetamine and THC and its metabolites were found; in the other, only ethanol was found. However, no LSD was detected in initial screening in either case. An LC-MS-MS screen for drugs of the NBOMe family, which are available as a synthetic alternative to LSD, was developed. 25I-NBOMe was then found in both cases. Further testing by LC-MS-MS gave quantitative results for 25I-NBOMe in blood, urine, bile and gastric samples and qualitative results in brain and liver.

"Blood Toxicology Measurement Uncertainty," Na Liu*, Division of Scientific Services, Department of emergency Services and Public Protection, Connecticut State Government

As an ASCLD/LAB accredited Laboratory, we need to report the uncertainty value and probability for quantitatively reported drugs as of December 31, 2013. With the support of our lab's historic quantitative control data, we managed to calculate all quantitatively reported drugs uncertainty. Our uncertainty calculation includes standard drug preparation uncertainty and Combined control uncertainty. The total procedural combined uncertainty can then be determined using the technique of root-mean square of the above two uncertainties: $\mu_0 = \sqrt{\sum_{i=0}^{n} \mu i^2}$. To achieve about 95% Probability Interval (PI), a tolerance factor also called K factor is introduced to give the expanded procedural uncertainty as $\mu_e = K * \mu_0$. Taking into consideration the absolute weighted bias of those control values (absBias), the final uncertainty of the target drug is decided in the following equation: $\mu = \mu_e + absBias$.

"Development of an Analytical Method for Nootropic "Smart" Drugs in Biological Fluids," Mollie Mares*; Karen S. Scott, Arcadia University; Donna Papsun, NMS Labs; Barry K. Logan, The Center for Forensic Science Research and Education

Smart drugs, also known as nootropics, are stimulants that allegedly boost brain function and cognition. The media attention on these drugs has increased within the last few years. The drugs have developed an underground following and are commonly sold online and in illicit supply chains. Most have not been approved or scheduled in the US, and are therefore of concern to regulators such as the Food and Drug Administration (FDA) and Drug Enforcement Administration (DEA). There are ongoing investigations in the applications of smart drugs in the treatment of Alzheimer's disease, Huntington's disease, and attention deficit hyperactivity disorder (ADHD). The stimulant properties of the drugs have led to their use in academic doping and as drugs of abuse. Some drugs are also prohibited by the World Anti-Doping Agency (WADA).

The goal of this project was to develop a single analytical method for screening, confirmation, and quantification of a series of the more widely known smart drugs in blood and urine using supported liquid extraction (SLE). Gas chromatography/mass spectrometry (GC/MS) and liquid chromatography/mass spectrometry (LC/MS) were investigated to determine the optimum approach for sensitivity and ability to detect a broad range of compounds, specifically piracetam, pramiracetam, aniracetam, modafinil, adrafinil, ciproxifan, and noopept. Due to the thermal instability of the compounds and the inability to produce single, stable chromatographable analytes, LC/MS provided a

superior means of analysis. All seven analytes were successfully extracted from blood at low levels, providing an effective method for the analysis of nootropics in biological fluids.

"The Importance of Entomotoxicology in a Forensic Context: Why is Larval Development so Important?," Jennifer Rosati*, Jason Byrd, John Jay College of Criminal Justice

Understanding the effects of chemical compounds on larval development and the potential impact on estimation of the MTC (minimum time of colonization) is of utmost importance to a forensic entomologist. Blow fly species are known to be primary colonizers of decomposing remains, which makes their development important in the determination of the MTC. It is a common occurrence in forensic entomology cases to have dipteran larvae exposed to chemicals for which developmental effects are not yet known. This presentation will highlight forensic entomology cases with respect to chemical nature, experimental design, developmental effects and implications for MTC estimations. Future implications and benefits of entomotoxicology will be discussed as well as the potential for direct behavioral and non-developmental effects. Given the use of dipteran and other insect larvae as forensic indicator species, it is necessary to investigate compounds and factors that can delay or enhance development, as these effects could have significant impacts on MTC estimations.

"Application of the Use of Dried Blood Spots in Forensic Toxicology," Andrea Jones*; Thomas A. Brettell, Cedar Crest College

Drug impaired drivers harm or kill thousands of people each year in the United States. A selective and sensitive analytical method for the detection of drugs in small blood samples would be exceedingly beneficial to the field of Forensic Toxicology.

The use of dried blood spots (DBS) as a substrate for collection of blood for the purpose of detecting drugs in DUI cases has many advantages. The technique uses less blood, typically 10 – 50 uL of capillary blood which can be obtained through minimally invasive techniques such as a finger prick instead of a blood sampling via venipuncture. The cards are easy to handle, transport, and can be stored at ambient temperature in the laboratory with minimal analyte loss. This makes sampling much faster, less complex, and less invasive.

A sensitive and selective HPLC-MS/MS method was developed for the analysis of ten benzodiazepines from 10 uL of blood (10-250 ng/mL) spotted on chemically untreated FTA®DMPK-C cards (GE Healthcare). The analysis was performed using an ABI Sciex 3200 QTRAP triple quadrupole mass spectrometer interfaced with a Shimadzu LC system consisting of two Shimadzu LC-20AD Prominence liquid chromatography binary pumps, two Shimadzu DGO-$20A_3$ Prominence degassers, and a Shimadzu SIL-20AC Prominence auto sampler. Chromatographic separation was achieved using an Ultra® Biphenyl LC Column (5.0 cm x 3.0 mm i.d., 2.7 µm particle size). The HPLC method was isocratic with 30:70 0.1% (v/v) formic acid/methanol and the total run time was 9.50 minutes.

"Detection of Ketamine in Black and White Hairs," Cassandra Prickett*; Alysia Kosmach; Karen S. Scot, Arcadia University

Ketamine, which was originally marketed as an anesthetic, has become a recreational drug causing similar effects to phencyclidine (PCP). The objective of this research was to apply a solid phase extraction (SPE) method to extract ketamine and metabolites from rat hair samples that have been dosed with three different concentrations per drug.

Rat hair was collected on the first day of dosing and the last day of dosing from each rat. The black and white hair was separated prior to analysis. The hair samples were combined by the low dose, medium dose and the high dose for each drug. Three rats were dosed with saline and served as the control group. Once the hair was collected, the samples were washed and digested in hydrochloric acid (0.5M) overnight at 45^{o}C. The samples were then neutralized in sodium hydroxide (0.5M) and buffered in ammonium buffer (0.5 M, pH 8.0). The samples were extracted by a solid-phase extraction method using a C-18 cartridge. For GC analysis, the extract was then evaporated, and derivatized using pentafluoroproprionic acid (PFPA):ethyl acetate (2:1). For LC analysis the extract was reconstituted in mobile phase The method was linear from 0.1ng/ml to 5ng/ml (r^2>0.99).

As predicted the black hair incorporated all drugs to a higher degree than the white hair and a dose-dependent concentration increase was observed in the black hair.

"Analysis of Maggot Pupae for Basic Drugs," Lisa Mundy*, Philadelphia Medical Examiner's Office Toxicology Laboratory

When decomposed bodies are presented to the medical examiner, there may not be any useful soft tissue available for toxicological analysis. Maggot pupae are often found around the body in plentiful supply and are potentially useful specimens to analyze for the presence of drugs. Maggots that have been feeding on the body may incorporate drugs into themselves and potentially into their pupae as well. When no other specimen is available, analysis of pupae may assist a medical examiner with assessing the drugs related to the body in question.

To test the applicability of the concept, maggots were grown in the laboratory on several drug-positive liver specimens. Blow fly eggs were taken from postmortem cases and transferred onto the drug-positive liver specimens. The maggots were allowed to feed on the tissue and then move away from the tissue into a separate area to permit pupation. These pupae were collected for analysis.

The analysis of pupae for basic drugs was developed from a previously published procedure (1). This procedure employed acid hydrolysis followed by solid phase extraction. This laboratory analyzed the extracts underivatized in full scan GC/MS-EI mode for general screening, and also derivatized in SIM GC/MS-EI mode for targeted analysis. Data comparing drugs present in the pupae and control positive liver specimens is presented. This study targeted cocaine & benzoylecgonine, with several cases also positive for morphine and methadone. Other drugs present in some of the tissue specimens include mirtazapine, diphenhydramine, fluoxetine, diazepam, propoxyphene, bupropion, fentanyl, olanzapine, amitriptyline & nortriptyline, trazodone, and dextromethorphan.

[1] Miller, ML; Lord, WD; Goff, ML; Donnelly, B; McDonough, ET; and Alexis, JC, *Isolation of Amitriptyline and Nortriptyline from Fly Puparia (Phoridae) and Beetle Exuviae (Dermestidae) Associated with Mummified Human Remains.* Journal of Forensic Sciences, JFSCA, Vol 39, No 5, September 1994, pp.1305-1311

"Metabolic Profile Determination of Novel Psychoactive Substances Using Human Liver Microsomes," Sarah Wolf*; Karen S. Scott, Arcadia University; Sean Yu,RMI International; Amanda L.A. Mohr, Center for Forensic Science Research and Education

Novel Psychoactive Substances have been increasingly abused, particularly within the Electronic Dance Music (EDM) scene. With the continued popularity of "designer drugs," the market is constantly changing, requiring continued research, including the metabolic pathways of these newly emerging drugs. The aim of this research is to identify the metabolites of several novel psychoactive substances that are commonly used within the EDM community, by in vitro metabolism with human liver microsomes.

A method for in vitro metabolism using pooled human liver microsomes was first optimized by incubating the microsomes with diazepam. The optimized incubation mixtures contained a phosphate buffer (pH= 7.4), Magnesium Chloride, 50 μL NADPH (10 mM), 5000 ng diazepam, and 25 μL of microsomes (20 mg/ml), with a final volume of 600 μL, and were incubated for two hours at 37°C. Once it was established that the microsomal incubation mixture was effectively producing metabolites as seen in vivo, this optimized method was used to produce the metabolites of the drugs of interest. Analysis occurred by Liquid Chromatography/ Quadrupole-Time of Flight Mass Spectrometry. After incubation with alpha-PVP, several previously published metabolites were confirmed in human samples. The metabolic pathways observed were hydroxylation of the side chain, hydroxylation of the phenyl ring, or both. Also seen was reduction of the ketone to an alcohol, oxidation of the pyrrolidine ring to a lactam, and degradation of the pyrrolidine ring to a primary amine. An additional metabolite was observed with a molecular composition of C15H23NO2 . Continued work will include the study of designer drug compounds including dimethylone.

"Environmental Forensics Determination of Emerging Contaminants in Wastewater Samples," Sarah Prebihalo*, Franklin L. Dorman, Pennsylvania State University

The objective of this research is to develop an analytical method for the identification of emerging contaminants of concern, such as bio-terrorism analytes, illicit drugs and metabolites and other toxic compounds. Due to the wide range of compounds of interest, the methodology of analysis must be able to successfully characterize compounds in a complex sample. In order to achieve this level of sensitivity and selectivity, both Comprehensive Gas Chromatography coupled with Time-Of-Flight Mass Spectrometry (GC x GC-TOFMS) and High Performance Liquid Chromatography couple with Time-Of-Flight Mass Spectrometry (HPLC-TOFMS) were utilized to analyze wastewater samples obtained from the Pennsylvania State University wastewater treatment facility (WWTF). The ultimate goal is to determine emerging contaminants and define temporal and spatial characteristics of usage at the community level.

In addition to the development of a method for the identification of contaminants, the environmental transport and fate of identified contaminants will be investigated to determine the potential implications of identified compounds. Plant and soil samples from the Pennsylvania State University agricultural fields, which use an open-loop water system, were collected to refine analytical methodology.

Multiple water samples were gathered from different stages throughout the Penn State WWTF and treated with USEPA method 3510c, which uses a liquid-liquid process and Kuderna-Danish to concentrate samples to 1 mL. The normalized background developed in earlier stages was used to identify any new contaminants emerging in the wastewater samples.

*=presenting author

Trace & Pattern Evidence Abstracts

"Evaluation of Chromatography Parameters for Improved Analysis of Explosives by GC-MS, GC-ECD, and LC-TOFMS," Lindsay Mitchell* and Franklin L. Dorman, Pennsylvania State University

The United States Environmental Protection Agency (USEPA) Method 8095 (Explosives by gas chromatography) provides guidelines for the use of gas chromatography (GC) for the analysis of explosive residues. Since its adoption, however, there have been improvements, which may increase sensitivity, or detection, especially of the more unstable analytes such as Pentaerythritol tetranitrate (PETN) and High Melting Explosives (HMX). Previous gas chromatographic studies on the analysis of explosives have focused on variables including column chemistry, inlet temperatures, injection methods, and detector variability.

Among all of these studies in current literature there are no publications that have focused on the effect of surface deactivation, inlet liner geometry or guard column length variability in the gas chromatographic analysis of explosives. While references mention using deactivated inlets, the chemistry of this surface and inlet liner geometry have not been studied. Additionally, Kunz' 2010 [1] paper mentioned the benefits of performing a study focusing on the effects of guard column lengths with relation to explosives analysis. Therefore, a comprehensive study on the combination of inlet geometry, stationary phase chemistry, and guard column lengths is beneficial to the forensics field.

The overall goal of this study, determining more efficient gas and liquid chromatography parameters, for explosives analysis will be discussed in detail. The primary focus of this research project is deactivation chemistry applied to inlet liner geometry and guard column length, which had not been previously studied. Our determination of the ideal method for gas chromatography analysis of explosives and achieve even better sensitivity, especially with the more thermally unstable analytes will be discussed. Additionally we will discuss our testing of this methodology using both known standard explosives samples and unknown post-blast samples.

R. Kunz, K. Gregory, D. Hardy. The Role of Stationary Phase Selection on Performance For Explosives Analysis Using GC-ECD. J.Chromatogr. Sci. 48: 310-316 (2010).

"The Forensic Significance of Aluminum Powders," Ashley LeBlanc*, George Washington University, ATF; Lisa Lang and Doug Klapec, ATF Forensic Laboratory

Aluminum powder is seen in many pyrotechnic mixtures. Depending on the intended performance, the powder particles may have different morphologies. Today pyrotechnic residues are usually identified using Scanning Electron Microscope with Electron Dispersion Spectroscopy (SEM/EDS). This instrumentation is able to identify the elemental makeup and morphology of the particles. The variation in morphology is attained through the manufacturing processes. There are commercial and improvised manufacturing processes for the production of pyrotechnic aluminum powders. Standard commercial, improvised, and case samples were analyzed for morphology and possible manufacturing determination. This article addresses the use of the SEM in the identification of aluminum particle morphology and its link to particle manufacturing processes. The SEM was used to analyze the samples in question for morphology and elemental make-up. It was found that spherical, spheroidal and crescent shaped particles are made through atomization. Crumpled shaped particles are manufactured in one of the many grinding processes. Flaked

particles have a wider range of manufacturing processes including various types of milling or grinding before milling. Improvised powders tend to have larger particle sizes and are usually made by grinding, filing, milling or blending. At the moment, there is no known way to specifically differentiate between commercial and improvised powders with the crumpled or flaked morphology. Atomized particles are only made in a commercial process and can be delineated from improvised aluminum powder.

"The effect of particulate laden water on skeletal trauma," Avery Appleton* and R. Christopher O'Brien, Ph.D., University of New Haven

Bone weathering has been well-studied and documented regarding skeletonized remains in terrestrial environments. However, little work has been published on the process of abrasion to bones that are submerged in dynamic water. Skeletal material under water is subjected to a different set of stresses than bones left on a ground surface and research to fully document these postmortem changes is required. Increasing instances of maritime disasters, such as the sinking of the Italian cruise ship Concordia and the loss of migrant boats in the Mediterranean and Timor Sea, warrant further investigation of the processes of degradation of human remains found in marine environments as a result of both water flow and abrasion by suspended particulate matter. Studying the physical changes that occur over time to bones that may have been injured in a traumatic event such as a shipwreck can provide useful information to investigators. Pig (Sus scrofa) ribs inflicted with sharp force trauma wounds were subjected to an environment simulating an underwater decompositional site using a high particulate water wash. Samples were allowed to abrade for set intervals of time and examined using micrometer caliper and stereomicroscopy. This study characterizes the specific changes that occur when injured bones are left submerged in water for extended periods of time. The information gathered from this research can be applied in several areas, including estimation of time since deposition, trauma site identification, and associating remains with a particular event.

"Investigating the Molecules of Death," Dan Sykes*, Pennsylvania State University; Rachel Bower, Pennsylvania State University, Aegis Sciences Corporation

Decomposition is a very complex process that is not very well understood. Several studies have investigated the volatile organic compounds (VOCs) produced during the early stages of human decomposition. However, our knowledge of the chemistry of decomposition is limited because of poor reproducibility and comparability within and between published studies. Therefore, a comprehensive investigation (with larger and consistent sample sizes) of VOC profiles using pig (Porcus) carcasses has been conducted which provides important information about decomposition. A strategic aim of this study was to utilize a larger data set in order to work towards establishing a more complete profile of the temporal evolution of VOCs released during the decomposition process. Specifically, this study focused on the most prevalent VOCs that are detected during each stage of decomposition. VOCs were collected and identified from decaying pig carcasses using passive headspace collection via solid-phase microextraction (SPME) fibers. The VOCs were analyzed using a gas chromatograph-mass spectrometer instrument. The study consisted of two phases; an indoor phase and an outdoor phase. Control specimens were placed within an indoor enclosure to eliminate uncontrolled environmental factors that affect decomposition. The temporal profiles from the control specimens were then compared to the outdoor specimens in order to evaluate the impact of insect activity and climate, such as rainfall and temperature, on decomposition. A total of 12 specimens were used in this study: 2 indoor and 10 outdoor. Consistent profiles were obtained between each set of pigs.

"Spectroscopy with a camera - is it possible?," John Allison, Ph.D.* and Nicole Renkel, The College of New Jersey

Suppose luminol was used to detect blood at a crime scene, and a digital photograph was taken of the blue light emitted. Could one construct a UV/Visible spectrum of the emission from the data in the digital photo? Unfortunately, digital cameras collect light in three channels - red, green and blue (RGB), and process the data so it can be displayed on a screen or in print. Technically this would provide information at only three points in a visible spectrum, although the response to light of the CCD "electronic film" in the camera is regulated by color filters that cover each pixel.

If one takes a photo of a blue light, and evaluates the RGB data at each point, the values will not all be the same, in part because the camera is attempting to capture the real color as best it can.

While most scientists are used to considering conventional spectra, graphing absorbance or %transmittance as a function of wavelength, there are other ways to represent light of different wavelengths. The CIE 1931 colorspace representation, often used by those who design computer screens, is another interesting way to consider light in the visible spectrum. This representation is three dimensional. If one has a set of RGB values from a camera, they can be converted into the x,y,z coordinates of a colorspace representation. The range of RGB values collected by a digital camera for a single color will fall at different locations in the color space, and each can be related to a wavelength.

We are currently evaluating the possibility that this approach could be used to generate full visible spectral information.

"Forensic Analysis of Hoax Powders Using Morphologically Directed Raman Spectroscopy," Joe Wolfgang*, Malvern Instruments; Josemar Castillo, Ph.D., Malvern Instruments; Deborah Huck-Jones, Ph.D., Malvern Instruments; Andrew Koutrakos, MS, University of Verona, University of New Haven; Brooke Kammrath, Ph.D., University of New Haven

In the wake of the September 11th terrorist attacks, there was an influx of white powder events throughout the United States. More often than not, the attacks do not contain any toxic materials and are carried out for the sole purpose of causing terror and damaging infrastructure. These fake bioterrorism agents consist of white powders that come from a variety of common commercial sources and can be blended to further complicate the analysis and identification of these samples. Commonly, artificial sweeteners, blends of active sweeteners and a dextrose bulking agent are used.

Morphologically Directed Raman Spectroscopy (MDRS) combines Raman microspectroscopy with automated particle imaging. Raman microspectroscopy is used to determine the molecular chemistry of individual particles while automated image analysis removes the subjective element from particle size and morphology measurements. Particle morphology and size information are valuable for differentiating artificial sweeteners that are mixtures of the same components. MDRS enables the collection of physical and chemical information about the components of a mixture that can be used for discrimination and brand identification. This is not possible with bulk Raman analysis. MDRS is a useful tool for the analysis of hoax powders at the particles level that enables criminalists to rapidly and reliably determine the composition of these mixtures to aid in the investigation of white powder attacks.

"Recognition and Identification of Cartridge Cases from Multi-Caliber Firearms," Adam Hartley*, Forensic Firearms Associates

This presentation focuses on expelled cartridge cases from firearms designed to fire several calibers of ammunition. Often times the caliber or type of round could be used as a class characteristic in order to exclude certain rounds from being compared microscopically. Because it is possible to fire several calibers from one firearm, it is important to first understand this is a possibility, but also to recognize different artifacts that can aid in the identification of a cartridge case that has been fired from multi-caliber in order to not exclude a possible match. A popular trend has emerged with firearms than can shoot rimmed revolver rounds, semi-auto rounds, and shot shells. Some revolvers are machined to use moon clips, allowing the cylinder to accept five or more calibers. These different rounds would all share the same breech face markings, but would have different obturation artifacts, striations from moon clips, or chamber marks that would prompt an examiner to compare two unlike cases to each other. In addition to using these artifacts as a recognition aid, some can be used to individualize cartridge cases, such as moon clip striations.

"Toward the Development of a Method for the Comparative Analysis of Magnetic Wire," Angelica Graver* and Lawrence Quarino, Ph.D., Cedar Crest College

Magnetic wire is a major component in the theoretical design of electromagnetic bombs (e-bombs). E-bombs are weapons that create an electromagnetic pulse capable of disrupting or destroying electronic devices. The comparative analysis of magnetic wire may be helpful in the determination of possible origins of e-bomb components. Magnetic wire is typical composed of a copper core surrounded by either a bi- or trilayer of polymer.

This study is one of several that will focus on this topic. Data will be presented on the variation in electrical, physical, and chemical components of magnetic wire from the same spool as well as from different spools from the same manufacturer. Variation based on the thickness of polymer, composition of polymer, resistance, and resistivity as a function of gauge (10, 20, and 28 gauge wire was tested) will be presented.

Stereomicroscopy was used to measure polymer thickness (including the ratio of the polymer to that of the entire wire) in cross sections, micro-infrared spectroscopy employing attenuated total reflectance was used to determine polymer composition, and a circuit board combined with a precision multimeter was used to measure resistance and resistivity using both Pouillet's and Ohm's law.

Both intervariation and intravariation were considered between the wire samples. One-way ANOVA testing at the 95% confidence interval indicated significant differences between the resistance and thickness values for both the 20 and 28 gauge wire samples from different spools from the same product line. No significant difference was observed with the 10 gauge wire samples with these parameters. Ratios of polymer thickness to that of the entire wire similarly did not produce significant differences. All wire samples tested showed a bilayer consisting of poly trimellitamide-imide and polyethylene.

Although the results presented represent data from the first part of the study, they offer the potential that magnetic wire may be differentiated from different sources.

"It's Not What You Know It's What You Can Prove," John A. Reffner, Ph.D.*, John Jay College of Criminal Justice

Forensic scientists are challenged to present investigators, the court and jury the things they know from their examination of evidence and ethically express the relevance of these facts to the case. The scientist's responsibilities extend beyond their validation of analytical procedures; they must challenge what they know as facts by questioning what these facts prove. A single piece of evidence or a single analysis is rarely enough to establish proof of guilt. Matching a bullet to a gun does not place that gun in a suspect hand. Matching a latent print found at a crime scene to an individual is factual but it is not proof that the individual was at the crime scene when the crime was committed. Often results of the laboratory examination of physical evidence play a major role in determining the outcome of a criminal investigation. However, observing evidence at a crime scene, documenting and preserving this evidence are the critical steps in the criminal justice process. The forensic laboratory is totally dependent upon the evidence it receives. Improper packaging may contaminate the evidence.

"The Utilization of Forensic Science Principles and Microscopic Trace Evidence Techniques to Unequivocally Prove that a Long Suspected Painting by Jackson Pollock was crafted at the Pollock - Krasner Home and Studio a National Historic Landmark located at 830 Fireplace Rd., Springs in the Town of East Hampton New York ," Nicholas Petraco, MS, D-ABC*, Forensic Investigation Division of NYPD, John Jay College of Criminal Justice, CUNY Graduate Center; Mary Eng, BS, NYPD Police Laboratory, Melvin Shaw, MS, NYPD Police Laboratory, Lisa Faber, MFS, NYPD Police Laboratory, John Jay College of Criminal Justice; Colette Loll, MHDA, Art Fraud Insights, Inc.; Jonathan Cramer, BFA, Pennsylvania State University; Davey Frankel, BA; Lawrence Kobilinsky, PhD., John Jay College of Criminal Justice

Normally, questioned works of art are authenticated by considering an array of factors. First, an object's or painting's history of ownership or provenance is typically of prominent importance. Next, features such an artist's technique, marks, patterns and designs formed by placement of the medium with a palette knife or paint brush are crucial to their endorsement. Other important aspects including microscopic and chemical analyses of the types of materials (i.e. canvas, paint pigments and resins) used to produce a work are vital to its legitimacy. Fractal analysis has also been employed to authenticate some artists' works. Often less scientific forms of proof, such as, the analysis of an artist's signature or the identification of a partial fingerprint leads only to confusion, misinformation and misidentification. These types of problem often arise because the examinations are conducted by self-trained individuals who lack the required known standard such as handwriting exemplars, fingerprint standards and DNA specimens. Finally, scholarly opinion and connoisseurship if given by an accepted expert can often be the deciding factor.[1-31]

When questions still remain concerning a work's authorship, forensic methods involving a systematic evaluation of the potential trace evidence embedded in the questioned work still remain a very valuable, yet untapped source of valuable data and unbiased proof of its creator.

Dr. Edmond Locard, the founding father of forensic trace evidence analysis, noted in 1929 that whenever a person commits a crime there is always a mutual transfer of trace evidential materials between the people, places and things involved in the crime.[32-33] Forensic literature is filled with case studies where various categories of trace evidence transferred between the principals, places and objects involved in a crime are used to reconstruct the crimes itself.[34-50] Dr. Locard's principle holds true when an artist creates a work of art.

An artist's intimate contact with his or her work permits the primary, secondary and tertiary transfer of trace materials between the artist, the environment within which the work is created, and the work itself. Materials such as hairs,

fibers, skin cells, fluid droplets, soil, dust, mineral fragments, glass fragments, seeds, plant materials, and other debris can be intentionally and/or inadvertently transferred and subsequently embedded into the work. This can occur in a variety of ways: from the artist to the painting, the painting to the artist, the environment to the artist, the environment to the painting, from the environment to the artist then to the painting, and so on. These tiny traces of particulate matter, hairs, fibers, and fluid droplets can be a valuable source of unbiased, scientific data and proof relating to who created the work, the time period the work was created, and where the work was created.

In this study, a painting believed to be the last known work of Jackson Pollock was forensically examined and processed for trace evidence. Items of trace evidence were removed from the painting and compared to materials obtained from the Pollock home and his personal property. Hairs, fibers, and other particles of trace evidence collected from the painting provided unbiased scientific data and proof that the work was produced at the Pollock compound.

References

Cellini, B., The Treatises of Benvenuto Cellini on Goldsmithing and Sculpture, Translated by C. R. Ashbee., Edward Arnold, London, 1898.

Lent, F.A., Trade Names and Descriptions of Stones, New Stone Publishing Company (the magazine Stone) 1925.

Laurie, A.P., The Painter's Methods and Materials, Philidelphia, PA, 1926.

Fink, C. G. and Eldridge, C. H. The Restoration of Bronzes and Other Alloys, Metropolitan Museum of Art, New York, 1925.

Beaufort, T.R., Pictures and How to Clean Them, Frederick A. Stokes, New York, 1926.

De Wild, M.A., The Scientific Examination of Pictures, Translated from the Dutch, G. Bell, London, 1929.

Toch, M., Paint, Paintings, and Restoration, Van Nostrand, New York, 1931.

Lucas, A., Antiques, Their Restoration and Preservation. Revised edition, Edward Arnold Company, London, 1932.

Thompson, D.V., The Materials of Medieval Paintings, London 1936.

Technical Studies in the Field of the Fine Arts, Cambridge, Mass., Fogg Museum, Harvard University. Published from 1932 to 1942.

Plenderleith, H.J., The Conservation of Prints and Drawings, The Museums Association, London, 1937.

Gettens, R.J. and Stout, G. L., Painting Materials - A Short Encyclopedia, D. Van Nostrand, NY, 1942, reprinted by Dover, NY 1966.

Stout, G.L., The Card of Paintings, Columbia University Press, New York, 1948.

Kurz, O., Fakes. A Handbook for Collectors and Students, London, 1948, 2nd ed. Paris, 1983.

Bradley, M.C., The Treatment of Pictures, Art Technology, Cambridge, Mass., 1950.

Studies in Conservation," The journal of the International Institute for Conservation of Historic and Artistic Works (IIC), now published quarterly, Vol. 1, no.1, National Gallery, London, October 1952.

Gettens, R.J. and Upsilon, B.M., Abstracts of Technical Studies in Art and Archaeology 1943-1952, Freer Gallery of Art, Washington, D.C., Smithsonian Institution, 1955.

Cennini, Cennino d"Andrea, I1Libro dell" Arte (The Craftsman's Handbook) written in the 15th Century, Translated by Daniel V. Thompson Jr., for Yale University Press, 1933, republished by Dover, NY, 1954.

Keck, C.K., How to Take Care of Your Pictures, The Museum of Modern Art and the Brooklyn Museum, New York, 1954

Art and Archaeology Technical Abstracts, New York University, Center for Conservation of Historic and Artistic Works, 1955 to 1965, Center for Conservation, New York University, NY.

Savage, G., Forgeries, Fakes and Reproductions,. A Handbook for Collectors, London, 1963, 2nd ed., 1976.

Keck, C.K., Handbook on the Care of Paintings, Watson-Guptill Publications, New York, 1965.

Ruhemann, H.,The Cleaning of Paintings: Problems and Potentialities, Faber and Faber Inc., London, 1968.

Conservation of Antiquities and Works of Art: Treatment, Repair, and Restoration, H. J. Plenderleith and A. E. A. Werner. New York, Oxford University Press, 2nd edition, 1971.

Clapp, A.F., Curatorial Care of Works on Paper, Paperback edition, the Intermuseum Laboratory, Oberlin, Ohio, 1975/1987.

Bromelle and Smith, eds., Conservation and Restoration of Pictorial Art, Butterworth, London and Boston, 1976.

Mayer, R. The Artist's Handbook or Materials and Techniques, 5th Ed., Viking, NY, 1991.

Marijnissen, R.H., Paintings, Genuine – Fraud – Fake, Modern Methods of Examining Paintings, Elsevier, 1985.

Artist's Pigments, A Handbook of their History and Characteristics, R. L., Feller, Editor of Volume 1, 1986; A. Roy, Editor of Vol. 2, 1993; E. W. Fitzhugh, Editor of Vol. 3, 1997; B. H. Berrie, Editor of Vol. 4, 2007, National Gallery of Art, Washington, DC, Cambridge University Press, Cambridge.

Taylor, R.P., Micolich, A.P. and Jonas, D., "Fractal analysis of Pollock's drip paintings," Nature 399, 6/1999, p. 422.

Katherine Jones-Smith, K., and Mathur' H., "Fractal Analysis: Revisiting Pollock's drip paintings," Leonardo, April 2012, Vol. 45, No. 2, pp. 149-54.

Locard, E., "L' analyse des poussieres en criminalistique," Revue Intenationale de Criminalistique, 1 (4) Juillet 1929, pp. 176-249.

E. Locard, E., "The Analysis of Dust Traces," American Journal of Police Sciences, 1 (1930), Part I 276-98, Part II 401-18, Part III 496-514.

Smith, S. and Glaister, J. Recent Advances in Forensic Medicine, 2nd edition (Phil., Penn., Blakiston's Son & Co. Inc., 1939), pp. 118- 124.

Kirk, P.L., "Microscopic Evidence-Its Use in the Investigation of Crime, "Journal of Criminal Law, Criminology and Police Science, 40 (1949-1950), p. 362.

36. Burd, B. and Kirk, P. L. "Clothing Fibers as Evidence," Journal of Criminal Law, Criminology and Police Science, 32, (1941), pp. 353-57.
37. Nickolls, L.C., "The Identification of Stains of Nonbiological Origin," in Methods of Forensic Science, vol. 1, F. Lundquist, ed., New York: Interscience Publishers, 1962, pp. 335-71.
38. Frei-Sulzer, M., "Colored Fibres in Criminal Investigation with Special Reference to Natural Fibres," in Methods of Forensic Science, vol. 4, A.S. Curry, ed., New York: Interscience Publishers, 1965, pp. 141-76.
39. McCrone, W.C."Particle Analysis in the Crime Laboratory," in The Particle Atlas, Vol. 5, W.C. McCrone, J.G. Delly and S.J. Palenik, eds., Ann Arbor, Mich: Ann Arbor Science Publishers, 1979, pp. 1379-1401.
40. Grieve, M.C. "The Role of Fibers in Forensic Science Examinations," Journal of Forensic Science, 28, 1983, pp. 877-87.
41. Fong, "Fiber Evidence: Laboratory Methods and Observation from Casework," Journal of Forensic Science, 29, 1984, pp. 55-63.
42. Deadman, H. "Fiber Evidence and the Wayne Williams Trial," FBI Law Enforcement Bulletin, March 1984, pp. 12-20; May 1984, pp. 10-19.
43. Gaudette, B.D., "Fibre Evidence"R.C.M.P. Gazette, 47, No. 12, 1985, pp. 18-20.
44. Petraco, N., "The Occurrence of Trace Evidence in One Examiner's Casework" Journal of Forensic Sciences, 30, 1985, pp. 486-93.
45. Schaeffer, H.F., Microscopy for Chemist, Van Nostrand Co., New York, 1953.
46. Feigl, F., Qualitative Analysis by Spot Tests, 3rd Ed., Elsevier, New York, 1946.
47. Jungreis, E., Spot Test Analysis, 2nd Ed., Wiley –Interscience, New York, 1997.
48. Petraco, N. "Trace Evidence - The Invisible Witness" in Journal of Forensic Sciences, 31, 1, 1986, pp. 321-28.
49. Petraco, N. and DeForest, P.R., "Trajectory Reconstructions I: Trace Evidence in Flight," in Journal of Forensic Sciences, 35, 6, 1990, pp. 1284-96.
50. Petraco, N. and Kubic, T., Color Atlas and Manual of Microscopy for Criminalists, Chemists, and Conservators, CRC Press, Boca Raton, FL, 2004.

"Discussion of ASCLD/LAB'S Guiding Principles," Peter A. Pizzola, Ph.D., D-ABC*, Pace University, Peter A. Pizzola, Inc.

Because of relatively recent events and the nature of our profession the practical application of ethical principles for bench scientists, supervisors and top management of forensic laboratories remains essential. Ethical guidelines that can be readily integrated into a laboratory operation and cover a wide array of critical areas can be a valuable asset to our profession. For approximately 25 years ASCLD/LAB has provided the forensic science community with such a document entitled "ASCLD/LAB Guiding Principles of Professional Responsibility for Crime Laboratories and Forensic Scientists." This dynamic set of principles will be reviewed and discussed; how they can be utilized in a forensic laboratory will also be considered.

"Is there a scientific method," Ed Bernstine, Ph.D.* and James M. Wilson, III, Ph.D., Bay Path University

Although the 'scientific method' is represented as being the basis for the reliability of a variety of results obtained in the natural sciences, many, if not most, contemporary philosophers of science do not believe that such a method exists. In this talk we will review various perspectives on this important matter. Our aim is to open discussion that is likely to involve ethical issues in testimony and the ethics of non-scientists referring to rote formulations of 'the scientific method' to support their testimony.

"The Creeping Inversion," Peter R. De Forest, D.Crim.*, Forensic Consultants; Brooke W. Kammrath, Ph.D., University of New Haven

The roles of criminalists and law enforcement investigators in the modern American criminal justice system are trending towards a complete inversion. Increasingly scientists in forensic science laboratories are becoming more and more specialized and are being cast into the roles of technicians. They are becoming marginalized with respect to the overall physical evidence investigation. At the same time, law-enforcement investigators are tasked with defining and circumscribing the scientific problem presented to the laboratory in complex cases. Most such investigators lack the scientific preparation to allow them to pose relevant and addressable scientific questions. Curiously, the scientists find themselves playing a reactive rather than a proactive role. Readily available local expertise is not being cultivated and utilized to anything approaching the extent possible. This presentation will offer and discuss case examples that highlight the role of a criminalist in criminal investigations by examining cases where this expertise was not appreciated and as a result significant evidence was lost and gone forever. We are convinced that there are many more examples that would support our thesis but for the fact that they went unrecognized because items bearing the crucial evidence were not preserved. By way of contrast, in the cases cited here, the relevant evidence was preserved inadvertently because it was associated with items that were collected for another purpose

"Select Refractive Index Stability: Cargille Series AA, A, B, and E," Wayne Moorehead*, Pennsylvania State University; Kaycee Fontes, OC Crime Lab, CA; Cassandra Hayes, OC Crime Lab, CA

Refractive index liquids are used in the trace evidence laboratory to assist in the identification of unknown materials using the polarizing light microscope. Each of the liquids is checked for their value by lot before being packaged for shipment from the manufacturer. The literature from the manufacturer cites 2.5 years or 5 years as the shelf life for various liquids. Questions arose regarding the longevity of the liquids over time. Several sets of different series (AA, A, B, and E) were collected for the study. Some of the bottles within the sets were more than 30 years aged.

A digital Leica Abbe refractometer was used to determine the refractive index of the various series of liquids. The refractometer has a 5 digit display with resolution to 0.0001 and included temperature measurement. Prior to use, the refractometer was equilibrated for at least one hour before use then calibration checked with 18 mega-ohm water. Measurements above nD = 1.700 were not possible due to the limitations of the refractometer.

The liquids studied maintained reasonable stability up to thirty-three years with a few exceptions. Whenever refractive index for a particle is critical, using a refractometer to determine the specific refractive index of the liquid(s) is recommended.

"The Effect of Walking on the Evidentiary Value of Soil Taken From Footwear," Heather Moody* and Lawrence Quarino, Ph.D., Cedar Crest College

This study examines this question of whether the particle size distribution of soil in footwear is altered while walking on an asphalt surface as a function of distance.

Soil was collected from along a tree line, mixed, and homogenized. Particle size distribution was performed on five samples of the soil using a previously published method[1]. Cumulative weight graphs were generated from size fractions weighed at sieves with mesh sizes measuring 2000 μm, 500 μm, 250 μm, 125 μm, and 63 μm. Results served as the zero mile trial, representative of the point of origin or site of casting. Soil from the same sample was moistened and applied to the grooves of sneakers (by stepping into the soil) from two volunteers weighing 110 and 130 pounds respectively and collected after each of five trials at four walked distances (0.5, 1, 1.5, and 2 miles) on dry asphalt. The same type of sneaker was worn by both volunteers. After each trial, soil remaining on the treads of the sneakers was collected from four regions: right heel, right toe, left heel, and left toe and approximately 1.2 g of the soil was analyzed using the particle size distribution method and compared against the zero mile trial. Mean cumulative weight graphs were converted to semi-log graphs from soil collected from each region of the sneaker from both volunteers at each distance and compared to mean semi-log graphs generated from the zero mile trial. The Kolmogorov-Smirnov test, a non-parametric statistical test, was used at the 95% confidence interval to determine differences between the semi-log graphs from the zero mile samples and the distance trials. This test showed that all ten of the 0.5 mile trials, eight out of ten 1 mile trials, and nine out of ten 1.5 mile trials were indistinguishable from the zero mile samples. Of the two differing 1 mile trials, only one region out of eight was found to be indistinguishable from the zero mile samples. Of the single differing 1.5 mile trial, one-half of the regions were found to be indistinguishable from the zero mile samples. The 2 mile trials did not yield enough soil for analysis.

Although several other parameters are being examined (volunteers of different weights, running, different surfaces), results of the present study show that false exclusions are not likely to occur when comparing soil from footwear from a point source after walking up to a distance of 1.5 miles.

[1]Johnson WH. Soil Particle Size Analysis. UNLV Health Physics Program Laboratory Operating Procedure. 1996:1-16.

"The Determination of Preservatives in Cosmetic Products by Liquid Chromatography Tandem Mass Spectrometry (LC-MS/MS)," Emily A. Myers*, Thomas H. Pritchett, M.S. and Thomas A. Brettell, Ph.D., F-ABC, Cedar Crest College

Preservatives are commonly added to products, including cosmetics, in order to prevent spoilage and undesirable chemical changes, ultimately extending the product's shelf life. A LC-MS/MS method has been developed which identifies and quantifies multiple preservatives in cosmetic products. LC-MS/MS data was acquired using an ABI Sciex 3200 QTRAP triple quadrupole mass spectrometer interfaced with a Shimadzu LC system. The instrument utilized electrospray ionization (ESI) and all samples were run in positive-ion mode monitoring. Chromatography was performed on a 5.0 cm x 3.0 mm x 2.7 μm Raptor® biphenyl capillary column (Restek®). The strong mobile phase used was 0.1% formic acid in 2-propanol and the weak mobile phase used was 0.1% formic acid in HPLC grade methanol.

Various cosmetic product samples including, foundations, lipsticks, lotions, and toothpaste were prepared by adding approximately 100 mg to 5 mL of methanol:acetonitrile (1:1) and sonicated for 10 minutes. After sonication the solution was placed into centrifuge tubes and centrifuged for 5 minutes at 3000 rpm. After centrifugation the supernatant was carefully removed using disposable pipettes and filtered using a 0.2 μm Millipore filter. Approximately 1 mL of the supernatant was added to a vial along with 60 μL of the internal standard (BHA). Lastly, 2.0 μL of sample was injected onto the LC column.

This method has the potential to be used in a forensic setting to compare and differentiate evidential cosmetic samples.

"AAS Trace Metal Analysis of Solder," Sean T. Block* and Lindsey A. Welch, Ph.D., Cedar Crest College

Solder is a relatively common mass-produced material that can be used in the construction of improvised explosive devices. Trace elemental analysis of solder fragments found on such devices may be able to provide investigators with information about the brand or lot that the solder originated from, and can also be used to establish a profile match to materials in a suspect's possession. A rapid, simple, and easily accessible method for obtaining a trace elemental profile would therefore be of great assistance in explosives investigations. While other methods for trace metal analysis involving inductively-coupled plasma techniques are available, this study looks to investigate methodology that would currently be more commonly found in forensic laboratories.

This study examines an analytical method utilizing digestion of solder in nitric and hydrochloric acid, and subsequent trace metal analysis using atomic absorption spectroscopy (AAS). Twelve brands of 60/40 tin/lead solder were profiled to test differentiability of samples; to examine consistencies within brands, multiple spools of several brands were also analyzed. Sample concentrations of copper, silver, and bismuth were then analyzed using discriminant analysis in R statistical software. Sample-source identification was accurate at over 90% overall, indicating that AAS trace elemental analysis of solder may be used to establish a match between an evidentiary sample and a suspect's exemplar.

"An Analysis of Elemental Content in Various Brands of Cigarette Ash By Atomic Absorption Spectroscopy: AN UPDATE," Kaitlin Hafer* and Lindsey A. Welch, Ph.D., Cedar Crest College

Very little work exists studying cigarette ash to benefit forensic science. This study quantified element concentrations (ppm) in cigarette ash to investigate distinguishability of American cigarettes through four comparisons: inter-brand, intra-brand, menthol/non-menthol, and pack. Acid digested ash samples were quantified with atomic absorption spectroscopy. Four elements were chosen for analysis: potassium, calcium, magnesium, and zinc. Within the inter-brand study, separation occurred between three of the four brands studied using Linear Discriminant Analysis (LDA). Upon generation of a confusion matrix, it was determined that 82% of the samples were classified with their proper identity. Therefore, the LDA model was not good enough for complete discrimination. LDA revealed more overlap between brands in the intra-brand study. A confusion matrix for intra-brand samples indicated 59% of samples were correctly classified. This shows that when comparing cigarette ash from the same brand, discrimination is less likely than when comparing cigarette ash of two different brands. Like the inter- and intra-brand studies, an LDA model for menthol/non-menthol comparison could not completely discriminate between the two types of ash. However, a confusion matrix showed that 79% of samples were classified correctly. For pack comparisons, a nested analysis of variance demonstrated all four elements produced a significant effect on pack variance; however, variance between packs of brands was not enough to affect the variance between brands. Based on the results, the composition of cigarettes does not vary enough for discrimination using this method.

*=presenting author

Poster Session Abstracts

"**Comparison of Cartridge Casings from a False Positive/False Negative Error Rate Study,**" Mackenzie Beyer*, Cedar Crest College; David Baldwin; Stan Bajic; Ames Laboratory, Iowa State University and United States Department of Energy: Office of Basic Sciences

The firing pin impression, breech face mark, and drag mark found on empty cartridge casings after being fired from a firearm all have striae, which an examiner can use to determine if two casings came from the same source or different sources. In a previous study, firearms examiners active in the field were sent casings fired from a Ruger SR9 handgun and asked to draw conclusions such as identification, elimination, or inconclusive. Casings from this study were re-examined using an Alicona InfiniteFocusSL 3D light microscope. Casings discovered most likely to have been considered suitable for comparison were casings with the significant comparable striae on the breech face. It was also discovered that when there were minimal striae within the entire set of casings, errors were made by the examiners either as a false- positive or a false-negative. Inconclusive results were not considered and error, but were also observed to be due to poor quality markings.

"**Development Studies and Substrate Effects on the Use of Lawsone for the Enhancement of Fingerprints on Paper and Pottery Substrates,**" Mackenzie Beyer*; Emily Williamson*; Erin Schaeffer; Jeanne Berk, Cedar Crest College

Many new compounds and techniques have recently been investigated for the enhancement of fingerprints via a reaction with the amino acids in the oils of the print in the field of forensic science. One newer reagent reported in the literature is lawsone, the main component found in *Lawsonia inermis*, which gives Henna its dying property. In considering the previously published methods of using lawsone as a reagent we hope to show that greater enhancement can be produced by altering the solvent system and development methods used. This newer reagent system using methanol, water and sodium hydroxide as the solvent was compared to the commonly used reagent ninhydrin. Lawsone is primarily used on porous substrates such as paper; therefore fiber content, brighteners, coatings and the base weight of the paper was examined to see what effect these factors have on the lawsone reagent enhancement. Furthermore, results show that the use of lawsone can be used to enhance fingerprints on pottery substrates as well.

"**Stability of Cathinones in Biological and Non-Biological Matrices,**" Heather Ciallella*; Stephanie Oddi; Karen S. Scott, Arcadia University

Cathinone, an alkaloid found in the shrub Catha Edulis (khat), causes the release of dopamine and is chemically similar to amphetamines and ephedrine. It is a Schedule 1 drug due to its ability to cause severe psychological or physical dependence. Many derivatives of cathinone have been synthesized to produce so called "bath salts" and LSD-type recreational drugs, such as NBOMes. These drugs appear frequently in forensic casework and it is critical that the stability of these substances is understood so that the best storage conditions may be used but also so that the results of unstable drugs can be interpreted. This research focuses on the stability of the cathinone derivative mephedrone in biological and non-biological matrices.

Samples of matrix (human blood and urine, methanol, acetonitrile, carbonated soda and water) were spiked at 1 mg/L of drug and stored in the dark at room temperature, 4°C (fridge) or -20°C (freezer). Samples from each batch were extracted on day 0, 3, 7, 14 and 30 to determine how stable the drugs were in each matrix under each storage condition. The analyses were carried out by GC/MS.
Results of this research have shown that mephedrone is more stable in acetonitrile than in methanol at all three storage temperatures, and more stable in human urine samples than in blood. The human urine samples have similar stability at 4°C and -20°C, and human whole blood samples show an increase in stability with decreasing storage temperature. Results from spiking water and Coca Cola have shown that mephedrone is more stable in the water samples and is more stable overall at -20°C.

"**Determination and Use of Diazonium Ions for the Presumptive Testing of Narcotics Containing an Activatied Aromatic Ring,**" Amber Fontanez*; Jeanne Berk, Cedar Crest College

Azo dyes, while commonly used commercially, are not often used in the field of forensic science. Azo dyes are produced through a chemical reaction where a diazonium ion is formed from an aromatic amine and then coupled with another activated aromatic compound. Narcotics typically contain rings in their structures with both activating and deactivating groups attached and may be able to react with the diazonium ion to produce a colored azo dye. This reaction could prove to be useful in the presumptive identification of various narcotics. While there are a myriad of presumptive narcotic tests available, many of the reagents involved are only useful in detecting a small number of narcotics. It is the goal of this research to determine if diazonium ions can be used to presumptively identify multiple narcotics based on colorimetric properties of the dye produced. To produce the diazonium ions, a polymer bead support was used, resulting in low waste generation and a rapid diazonium formation. The produced solution was then reacted in small amounts with various narcotics to induce azo coupling. The reactions have so far produced similar yellow colors and precipitates of different intensities. It was determined that the uniform yellow color may be due to a reaction of the diazonium with the sodium hydroxide that is being used to deprotonate the narcotics during the coupling reaction. Further study is being completed to determine the effect that the solvents used in the reaction and the order of the reaction steps may have on the reaction.

"Divining the "Diviner's Sage"- DART-MS Facilitated Metabolome Profiling for the Identification of Botanical Forensic Evidence," Justine E. Giffen*; Ashton D. Lesiak, University at Albany; Robert B. Cody, JEOL USA Inc.; John Dane, JEOL USA; Rabi A. Musah, University at Albany

The need to identify botanical forensic evidence is critical due to the dramatic rise in the abuse of unscheduled psychoactive plants. Current methods used for plant identification such as microscopy, are of limited utility when the plant material in question is dried or powdered, as this diminishes the plant's distinguishing physical characteristics. Furthermore, although DNA analysis can enable species identification, the absence of genomic information for many abused plants makes this approach impossible for most species.

Salvia divinorum, known as "Diviner's Sage", is one such plant used as a "legal" alternative to scheduled drugs. It is one of hundreds of species in the Salvia genus which includes non-psychoactive plants such as garden sage. Using high resolution DART-MS, we demonstrate the principle that the metabolome profiles of various sage species are unique enough to enable species differentiation. Thus, S. divinorum can be identified by the presence of the psychoactive component Salvinorin A, and can also be distinguished from non-psychoactive members of the Salvia genus based on

their individual mass spectral profiles and chemometric processing of the mass spectral data using principle component analysis and hierarchical clustering.

DART-MS analysis was conducted on plant material in its native form without extraction or other sample pre-preparation steps. Using this method, results are generated in seconds, whereas the equivalent analysis by GC-MS can take several hours. DART-MS can be used as a means to rapidly identify botanical evidence and discriminate between different psychotropic plants to facilitate the development of effective legal restrictions on their use.

"**Determining the Effect of Bleach on the DNA Genotyping of Bloodstains,**" Chandler Grant*; Lawrence Quarino, Cedar Crest College

Forensic scientists often face the potential loss of the evidentiary value of bloodstains from crime scenes due to the attempted removal with cleaning agents. One of the most common cleaning reagents used to remove bloodstains at crime scenes is bleach. This study was conducted to determine if DNA could still be genotyped from bleach-contaminated bloodstains. Bloodstains were deposited on drywall and brick and contaminated with various concentrations of distilled water and bleach prior to collection and testing. In addition, smears of blood placed on these substrates and washed with these solutions were also tested. Also, the effect of luminol on washed bloodstains was assessed. All samples underwent 5% Chelex® DNA extraction followed by quantitation using the Alu-based SYBR-Green qPCR method as described by Nicklas and Buel [1]. Amplification and genotyping were performed using the Promega Geneprint® Fluorecent CTTv STR System. All profiles were generated using an ABI 310 genetic analyzer and analyzed with Life Technologies™ GeneMapper® ID-X software. In addition, mini-STRs at the D18S51 and CSF1PO were generated using primer sequences as described by Butler [2].The profiles analyzed from this study have shown that less concentrated cleaning agents obtain more positive results; 47.06% when contaminated with distilled water and 30.00% when contaminated with 10% bleach. High concentrated cleaning agents obtained less positive results, 5.00% when contaminated with 50% bleach and 5.00% when contaminated with 100% bleach. Mini-STRs did provide an additional 29.41% of profiles for distilled water and 10.00% for 10% bleach. In addition, it was found that luminol negatively impacted the ability to generate DNA profiles from test samples.

[1] Nicklas JA, Buel E, Development of an Alu-based, real-time PCR method for quantitation of human DNA in forensic samples, J Forensic Sci 48 (2003); 936-944

[2] Bulter JM, Shen Y, McCord BR, The Development of Reduced Size STR Amplicons as Tools for Analysis of Degraded DNA, J Forensic Sci 48 (2003); 1054-1064

"**Infrared Microspectroscopy of Fingernail Polish,**" Ashley Jackson*; Monica Joshi, Department of Chemistry, West Chester University of PA

Nail polish as trace evidence may be encountered in the form of small chips, smears, as part of the substrate on a broken nail or as transfer evidence. Our study is an exploratory study of the chemical and microscopic nature of the coating and its additives. Infrared microspectroscopy is used to study various nail polish formulations and we discuss its capabilities in discriminating between nail polish samples. In this poster, we report the study of 12 brands of classical nail polish formulations each with multiple finishes. All these brands are nitrocellulose based formulations and the spectroscopic bands observed are predominantly due to the nitrocellulose. However, there are minor spectroscopic features that can be used to discriminate between the samples. Our study also includes five novel formulations of

newer nail polishes that do not contain harsh chemicals and toxins. We picked representative colors from all formulations of interest to our study and analyzed them for within brand and between brand differences. The analysis method is entirely non-destructive with no sample preparation steps. The method uses a germanium crystal attenuated total reflectance (ATR) accessory for analysis of the samples. The aperture size used is 20 x 20 micrometers and the sensitivity is greatly enhanced using a cooled MCT detector. We use microscopic images in combination with infrared spectra to discriminate between samples. Similar colored nail polish products are microscopically distinct even when the infrared spectra are not largely distinguishable.

"**CMPD (Charlotte-Mecklenburg Police Department) Internship Review,**" Orrin Kumar*, Seton Hill University

The Internship at the Charlotte-Mecklenburg Police Department was undertaken in order to supplement and expand the classical liberal arts education with unique experiential learning. The internship allowed for unique opportunities such as assisting and shadowing a crime scene investigator daily for a period of two months, as well as five ride-a-longs with officers of the CMPD. Shadowing on multiple house burglaries, assaults, theft from vehicles, and even homicides was performed. The tasks required of the internship consisted mainly of assisting the crime scene investigators by retrieving supplies, but also involved practicing and developing skills and techniques such as photography and latent lift printing in between cases. The internship also provided the unique opportunity to familiarize an individual with very unique opportunities, such as talking with victims and suspects, being around heavy decomposition, and the handling of victim's cadaver. Opportunities also arose to work with the new Focus Faro3D and form skills with photography and latent print lifting techniques. Those opportunities are impossible to replace in a purely academic setting and show the importance of the experiential learning this internship presented. The internship provided by the CMPD was a unique experience that which may not be replicated anywhere else.

"Recoverability of Latent Fingerprints on Firearms Evidence at the Boston Police Latent Print Unit," Anneliese Lake*; Amy Brodeur, Boston University Biomedical Forensic Sciences Master's Program; Erik Savicke, Boston Police Latent Print Unit

With increasing frequency, criminalists in the Boston Police Latent Print Unit (LPU) are being asked to explain the lack of results when testifying in cases involving a firearm from which no fingerprints were recovered. During this type of testimony, it may be helpful to present case statistics to the jury that will help them understand that retrieving latent prints from a firearm is not all that common. Firearms cases analyzed by the LPU from January 2006 to July 2014 were examined, yielding a total of 3971 firearms. The number of firearms with any latent prints recovered, latent prints of value (LOV) recovered, and latent prints that led to an identification of an individual (ID) were recorded. Further, the total number and type of latent prints obtained from each firearm examined was also documented. Of the total number of firearms analyzed by the LPU, 38.87% had a latent print recovered, 15.59% had LOV, and 7.58% led to an ID. A total of 3948 latent prints were recovered, with 891 firearms yielding multiple prints.

The type of firearm, as well as the manufacturer for the cases involving semi-automatic firearms was compared to latent print recoverability rates. It was determined that rifles and shotguns had the highest percentage of latent prints recovered (insert % here), though the sample size for this category (n=323) was much smaller than the 2198 semiautomatic firearms analyzed. The LPU encountered 84 different semiautomatic firearm manufacturers over the time period examined, with many encountered only once, making the sample sizes for this type of comparison too small to reliably draw any conclusions.

In addition, the data were examined in an effort to determine if the timeliness of the fingerprint processing affected the recoverability of latent print evidence. For this same time period, the firearms were categorized into those that had been fumed with cyanoacrylate by the detectives who seized it before it was packaged and submitted to the LPU, and the firearms that were fumed once the LPU had taken possession of it. Of the firearms previously fumed (n=2072), 10.09% had a latent print that led to an ID, while only 4.85% of the firearms that were fumed by the LPU (n=1898) led to an ID. This difference was determined to be significant using a Chi Square test (p=.05), and suggests firearms should be fumed upon recovery whenever possible.

"**Confirmation of Phenethylamines in Urine by GC/MS Using a One-Step Simultaneous Liquid-Liquid Dispersive Extraction/Cyclohexanone Derivatization,**" Jennifer Leach*; Thomas A. Brettell, Cedar Crest College; Brandi Skymba, Philadelphia Medical Examiner's Office

Over the last few years the presence of a diverse number of emerging synthetic illicit drugs has spread worldwide. The large number of structurally similar compounds has made the identification of these drugs a challenging task for forensic drug analysts. Crime laboratories are in need of methods to detect and identify these drugs not only in solid-dosage form but also in biological fluids such as urine from subjects of driving under the influence.

A simple one-step simultaneous dispersive liquid-liquid extraction (LLE)/derivatization method has been developed using gas chromatography/mass spectrometry (GC/MS) to identify primary and secondary amines in urine. We have had previously investigated cyclohexanone as a derivatizing reagent for cathinones to form the Schiff-base derivative. Primary and secondary amines will react with cyclohexanone via a Schiff-base reaction to form two distinct different types of derivatives: primary amines form imines with cyclohexanone while enamines are formed with secondary amines. The method was found to be reproducible and can be used to screen unknown samples and identify multiple cathinones in one sample. The derivative which is formed produces larger mass spectral fragments which are more distinctive in helping discern subtle differences in chemical structures which are prevalent with the emerging synthetic amines. This is especially helpful when dealing with designer cathinones because the larger fragments can identify where the substitution have occurred. The procedure provides a fast, simple, sensitive, inexpensive sample extraction method in a one-step procedure to confirm unknown amphetamines and cathinones in urine.

"**Evaluation of the Impact of Expanding ELISA Screening in DUID Investigations,"** Aileen Lu*; Karen S. Scott; Aya Chan-Hosokawa, Arcadia University; Barry K. Logan, NMS Labs

The purpose of this study was to determine what the incidence of CNS depressants carisoprodol and zolpidem are in a DUID population, in order to assess the frequency with which potentially impairing drugs might go undetected.

A large dataset (n=1,672) of drug screen results from DUID investigations between June 2013 and June 2014 was provided by NMS Labs (Willow Grove PA). Toxicology results were obtained on blood samples using a liquid chromatography time of flight mass spectrometry (LCTOF) method that was validated according to SWGTOX guidelines. Positive cases were confirmed and quantified by liquid chromatography tandem mass spectrometry (LCMSMS), or gas chromatography mass spectrometry (GCMS). Zolpidem was found to be positive in 5.3% of cases (n=89). Among the cases which tested positive for zolpidem, 20% were positive for opiates (n=18), 19% for benzodiazepines (n=17), and 18% for alcohol (n=6 (33 of 89 tested)). Carisoprodol and/or meprobamate were positive in 5.9% of cases (n=99). Among the cases which tested positive for carisoprodol and/or meprobamate, 62% contained opiates (n=61) and 53% contained benzodiazepines (n=53).

Following assessment of these results, ELISA screening kits from Neogen for carisoprodol, meprobamate, and zolpidem were validated, and a further 300 random blood samples in DUID investigations that had been tested according to a more limited protocol were subjected to ELISA testing for these three drugs. Positive results were confirmed using an SPE extraction method followed by GCMS.

"Investigating the Polymerization Mechanism of Cyanoacrylate with Fingerprint Constituents," Kassandra McCarthy*; Emily Persson; Andrew S. Dutton, Suffolk University

Cyanoacrylate is a widely used compound for a variety of applications, but the mechanistic details of the polymerization reaction during the development of latent prints are still unknown. The polymerization of cyanoacrylate with individual components is investigated by fuming amino acids and oils with cyanoacrylate then analyzing the extent of polymerization by mass. Serine, the most abundant amino acid in sebaceous secretions that form fingerprints, is used as the model amino acid due to the amino, carboxylic acid and alcohol functional groups. From the data obtained in this experiment, the combination of the amino and carboxylic acid functional groups are responsible for polymerization, while the alcohol functional group generates very little polymerization. The results also suggest that a very basic pH leads to optimal polymerization, while an acidic pH hinders polymerization. Results are further compared to glycine, another amino acid present in sebaceous secretions. The individual functional groups are analyzed using isopropanol, acetic acid, and propylamine. The effect of oils on the polymerization reaction of the amino acids is also presented.

"**Identification of Marijuana Fillers by Morphology using Microscopy,"** Erin Noval*; John Drawec, Western New England University

The purpose of this study is to determine if microscopy alone can be used to identify marijuana and accompanying fillers without a chemical presumptive test. The most identifying characteristics of cannabis sativa are its cystolithic hairs and the presence of resin on the stems and below the leaves in nodules. These characteristics were studied in several samples under light, infrared, polarizing and scanning electron microscopy. Dried samples of oregano, cilantro, basil, and thyme were also studied to see if they could be identified as fillers. It was determined that they could be identified based solely on morphological characteristics. Some of these characteristics include the linear leaf shape and glandular dots of thyme, the entire leaf margin of basil as well as sparse glandular dots, the simple hairs of oregano, and the irregular toothed margin of cilantro. This information can be used to elucidate the purity of suspected samples of marijuana

"**Sticky Business: Understanding the Polymerization Reaction of Cyanoacrylate in Development of Latent Prints"**, Emily M. Persson*; Kassandra McCarthy; Andrew S. Dutton, Suffolk University

The components of fingerprints arise from eccrine, apocrine and sebaceous gland secretions and include water, amino acids, oils, ions, sugars, and many other constituents. Cyanoacrylate fuming or superglue fuming is a widely used technique for developing fingerprints. Crime labs use cyanoacrylate fuming in order to detect latent prints. After the fuming of cyanoacrylate, the fingerprints are slightly opaque and visible to the eye but it can be difficult to adequately view ridge details used in the identification process. The process of cyanoacrylate fuming results in polymerized

cyanoacrylate on the surface of the print; however, the mechanisms of initiation of polymerization are being investigated to provide further information and understanding. We are currently analyzing the various constituents of fingerprints including amino acids and oils to determine quantitatively which constituent results in the most polymerization and which functional groups are responsible for initiation. Future implications include the possibility to result in better substituted cyanoacrylates for more detailed latent prints due to an expanded understanding of the polymerization reaction.

"**A Novel SLE-LDTD-MS/MS Method for the Screening of NBOMe Designer Drugs in Oral Fluid,"** Megan R. Record*; Serge Auger; Pierre Picard; Frank Kero; Victor Vandell; Alex Birsan; Amanda Mohr; Karen S. Scott, Arcadia University

NBOMes are a class of novel psychoactive substances (NPS) marketed as "legal highs." NBOMes are derived from substituted phenethylamines, known as the 2C series. NBOMes contain a 2-methoxybenzyl on the nitrogen backbone of the 2C series, which is believed to cause an increase in potency. NBOMes are primarily administered sublingually via blotter paper and can be confused for and sold as LSD. NBOMes can cause hallucinations, tachycardia, agitation, seizures, and death. Oral fluid is an emerging biological specimen used in drug detection. Insufficient data exists surrounding NPSs in this medium, however, sample collection is noninvasive and primarily contains the parent compound, making it the ideal specimen for analysis compared to blood or urine. Fortified oral fluid samples were spiked with varying concentrations of a mixture of 8 NBOMes and submitted Phytronix for a blind study. Samples were extracted using solid-supported liquid extraction (SLE) and analyzed by laser diode thermal desorption tandem mass spectrometry (LDTD-MS/MS). The results demonstrated a viable method with a high level of sensitivity. LLOQ values were determined to be 0.5ng/mL for the assay. The method was precise and reproducible with percent coefficient of variation of less than 10% (n=4) and linearity greater than 0.99 for all analytes.

"**The Use of QuEChERS for the Extraction of Drugs of Abuse from Urine using Gas Chromatography-Mass Spectrometry,**" Michelle L. Schmidt*; Leanne Mocniak; Nicholas H. Snow, Seton Hall University

Extraction techniques are plentiful; however, determining which technique to implement for analysis can be difficult. Percent recovery, selectivity, ease of extraction, and ruggedness, must all be considered. It is the goal of this study to investigate the viability of QuEChERS for the extraction of drugs of abuse from urine. QuEChERS (Quick, Easy, Cheap, Effective, Rugged, Safe) is a liquid-liquid microextraction combined with a dispersive solid phase extraction (d-SPE) cleanup. Primarily used for the extraction of pesticides from food products, QuEChERS has not yet been thoroughly investigated for forensic samples. QuEChERS has been used in the extraction of veterinary and pharmaceutical drugs from various media such as soil and sewage as well as biological matrices including blood and urine. It is expected that QuEChERS can be applied to forensic samples such as drugs of abuse in urine, yet QuEChERS for forensic samples has not been investigated thoroughly. The optimization of QuEChERS for the extraction of amphetamine, methamphetamine, morphine, benzoylecgonine, methadone, oxazepam, secobarbital, phencyclidine, 11-nor-9-carboxy-Δ9-THC, and nortriptyline from urine will be discussed as well as the sensitivity and selectivity of the method with analysis via gas chromatography-mass spectrometry (GC-MS).

"**Chemical Analysis of Security Documents Using Infrared Microspectroscopy,"** Angelica Szewczak*; Monica Joshi, Department of Chemistry, West Chester University of PA

United States government issued identity documents including passports, travel visas, and driver's licenses are potential targets for counterfeiters. Reports, as recent as September 2014, reveal that there is a large influx of counterfeit drivers licenses from China. To decrease the likelihood of counterfeit documents, government agencies include various security features in the documents to allow for distinguishable authentication characteristics. While many security features such as holograms can be viewed under alternate light sources, there are also hidden security features that require further analysis for confirmation. Forensic document examination encompasses the assessment of these security features and other distinct features of these security documents. When a document is suspected of being fraudulent, the document is subjected to more scrutiny of its physical characteristics and chemical analysis of inks and papers. In this poster, the utility of infrared microspectroscopy for the chemical analysis of the inks and substrates used in these security documents is discussed. The specific materials used to produce these documents as well as an understanding of the visual differences will be explored. We present the chemical analysis of representative documents in the categories of passports, visas, and various state drivers' licenses. We highlight the advantages of FTIR/ATR in conducting rapid, highly discriminatory and non-destructive chemical analysis of inks, laminates, and plastics used in security documents. In the age of counterfeit documents that are very nearly authentic, the use of chemical analysis in addition to the examination of physical features may help government agencies track counterfeiters.

"**Effectiveness of Deception of Serial Killers,"** Melissa Walden*; Samuel McCook*, Syracuse University

This study aims to question the effectiveness of serial killer deception. Specifically this study uses video-clips from an interview of former death row inmate, Theodore Robert "Ted" Bundy, to question the extent of how effectively serial killers in general can deceive other individuals. On methodological and analytical grounds, the paper will reexamine the analysis presented in a pilot study, which uses methodology adapted from Smith (1992) to evaluate the public's perception of Ted Bundy's deceptive statements. The aim is further supported through a statement analysis based on Carlise's (2013) psychological analysis of Ted Bundy. After watching a series of clips of Ted Bundy's final interview on death row, participants' perception of the truthfulness of his statements will be measured through the use of a Likert scale. Following completion of part one from the study, the participant's perception of the overall credibility of the interview will then be evaluated through the administration of a post survey. An example of Bundy's deception from the statement analysis arose when he discusses his childhood. Contrary to Bundy's statement of a normal childhood, he grew up in a broken home without a father; unsure of whom his mother was, where allegations of abuse were common (Carlise, 2013). This study suggests a need for future research in deception to investigate known effective liars, such as Ted Bundy.

"**The Detection of Date Rape Drug Residues Using X-Ray Diffraction,"** Emily Walsh*; Virginia M. Maxwell, University of New Haven

Difficulty in detection of date rape drugs in a drug facilitated sexual assault (DFSA) victim's system, more specifically their blood, hair, and urine has been a predominant problem investigators and forensic scientists have encountered. After a matter of hours, these fast acting drugs have little chance of being detected with modern toxicological techniques due to their rapid metabolism by the body. Proving the use of these drugs can be very hard to establish due to the challenge of detection. This project utilized X-ray diffraction (XRD) in order to detect and identify date rape drugs on various materials.

The date rape drugs used for the purposes of this project were Gamma-Hydroxybutyric acid (GHB), Chloral Hydrate, Ketamine, Flunitrazepam (Rohypnol), and MDMA (Ecstasy). XRD has been implemented in many forensic laboratories due to low cost, versatility, and the non-destructive nature of analysis. The use of XRD for the purpose of detecting date rape drugs residues on clothing and in containers, such as those typically submitted as evidence was the focus of this project.

Plenary Session

The National Commission on Forensic Science and the Organization of Scientific Area Committees

John M. Butler
National Institute of Standards and Technology

The development of a quality infrastructure for forensic science was a key component of some of the reforms anticipated in the National Academies of Science (NAS) 2009 report entitled "Strengthening Forensic Science in the United States: A Path Forward." In response to the NAS report, the National Institute of Standards and Technology (NIST) and the US Department of Justice (DOJ) signed a bilateral agency Memorandum of Understanding (MOU) in March 2013 which specified the establishment of a National Commission on Forensic Science (NCFS) and development of "Guidance Groups" now termed Scientific Area Committees (SACs).

NCFS membership was announced in January 2014 and the first Commission meeting was held February 3-4, 2014 in Washington, DC. From over 300 applicants, thirty-seven individuals were selected to achieve a diversity of experiences, including Federal, State, and Local forensic science service providers; research scientists and academicians; Federal, State, Local prosecutors, defense attorneys and judges; law enforcement; and other relevant stakeholders. The Commission is led by co-chairs James Cole, Deputy Attorney General, and Dr. Patrick Gallagher, NIST Director and Acting Deputy Director for the Department of Commerce. Nelson Santos, Deputy Assistant Administrator for the Office of Forensic Sciences at the Drug Enforcement Administration, and Dr. John Butler, Special Assistant to the Director for Forensic Science, serve as the DOJ and NIST Vice-Chairs, respectively. The NCFS is a federal advisory committee for DOJ and as such follows prescribed rules that include public meetings and a balance of perspectives. Commissioners come from 21 states and represent: professors of biochemistry, chemistry, pathology, physics, sociology, statistics, and law (including a Nobel laureate and National Medal of Science recipient); crime laboratory directors (FBI, DEA, ATF, USPS, DoD, VA DFS, LASD, PBSO); judges, prosecutors, and defense attorneys; and a sheriff, detective, coroner, medical examiner, victims' advocates, and defendants' rights advocates. All NCFS meetings are public and materials are available at http://www.facadatabase.gov/ (enter NCFS name or commission number: 83353).

NIST developed the Organization of Scientific Area Committees (OSAC) to administer and coordinate support for the discipline-specific SACs (see http://www.nist.gov/forensics/osac.cfm). In September 2013, NIST issued a Notice of Inquiry (NOI) in the Federal Register to obtain national and international input on

the establishment and structure of governance models. Eighty-two submissions were received in response to the NOI. The OSAC is designed to provide uniform administration for development, promulgation, and adoption of documentary standards in the forensic science community.

While NCFS is a DOJ advisory group to enact policies, OSAC will be an on-going community effort to improve forensic practices through developing documentary standards that can be used by accrediting bodies in future audits of forensic laboratories. This presentation will review progress made with NCFS and OSAC.

Accreditation and Certification of Forensic Science Service Providers Challenges? Opportunities? Mandates?

Patricia A. Manzolillo
Laboratory Director
Forensic Laboratory Services
US Postal Inspection Service

The National Academy of Sciences (NAS) 2009 report Strengthening Forensic Science in the United States: A Path Forward addressed the complex issues of accreditation and certification in forensic sciences. Efforts since the publication of that report have diligently attempted to address the diverse nature of the many forensic science disciplines, practitioners and organizational structures while suggesting changes to improve forensic sciences as a whole.

This presentation will discuss the challenges and opportunities in the forensic science community that accompany mandatory universal accreditation and certification.

The presentation may address the following questions and ideas. Can universal accreditation and/or certification be accomplished? What is the best path? Should they be mandated? Should disciplines be excluded? How does a mandate for universal accreditation/certification impact the definition of forensic science service provider and forensic discipline? Are there intermediary steps? What role could a national registry play? Do ISO standards meet the needs of forensic science? Does the community need both accreditation and certification? Can one substitute for the other? What models in other fields can we look to for guidance?

Strengthening Forensic Science in the United States: An Update on National Efforts in Research and Development

Gerald M. LaPorte
Director
National Institute of Justice
Office of Investigative and Forensic sciences

Since 2009, the National Institute of Justice (NIJ) has provided more than $120 million to fund more than 300 research and development projects related to forensic science, resulting in more than 600 scientific publications, presentations, and final technical reports. In March of 2009, NIJ immediately began addressing recommendations in a report issued by the National Research Council (NRC) of the National academies titled, ***Strengthening Forensic Science in the United States: A Path Forward***. There were two major recommendations made in the 2009 NRC Report related to scientific research. Recommendation 3 called for more research to address issues of accuracy, reliability, and validity in the forensic science disciplines. Recommendation 6 was to encourage research programs on human observer bias and sources of human error in forensic examinations. More specifically, there was an emphasis on the impression and pattern evidence disciplines such as friction ridge analysis, firearms and toolmark examinations, shoeprint and tire tread evidence, questioned documents, and bloodstain pattern analysis. Therefore, this presentation will focus specifically on progress in the impression and pattern evidence disciplines and discuss various efforts by the forensic science community to bolster the quantity and quality of forensic science research. This presentation will provide an overview of some studies that are beginning to have a positive impact on the perception that forensic science has been lacking in research. Most importantly, the presentation will clearly demonstrate that research and innovation are the core requirements needed to continue the progress that has been attained and to strengthen the science in forensic science.

The Hole in Forensic Science Academia

Victor Weedn
Chair-Department of Forensic Sciences
George Washington University

Forensic science educational programs have mushroomed since CSI aired on television. In fact, a surplus of students has resulted. The quality of the educational programs has increased. Forensic science educational programs are moving to faculties with more than a single member. FEPAC has been launched. Nonetheless, despite significant progress, some problems in forensic science education, discussed in the 2004 TWGED report, have in some ways deepened. There is still too little hands-on laboratory analysis in many programs. But what has received less attention is a faculty knowledge gap. Over and over, forensic science programs are bringing in chemists and molecular biologists into their faculties, but other forensic science disciplines are generally getting short shrift. The result is that research in the underlying foundational science that has been called for in the patterned and impression evidence area is lacking. Universities do not seem to know how to address this. University accreditation commissions require a terminal degree for faculty positions—in particular a PhD degree is sought. Of course there are no PhD programs in questioned documents examination, firearms and toolmarks examination, tiremarks examination, etc. Thus, there is a chicken and egg situation that results in the continuation of this "hole" in forensic science academia. Furthermore, the absence of doctoral students hampers research in the field. The presentation will discuss these issues and the author will share his thoughts on the solution to this problem, involving a proposal for an innovative new PhD program.

General Session

Stress Management for the Forensic Scientist

Scott Shappell
Embry-Riddle Aeronautical University

Just as eating doesn't make you a nutritionist, neither does sleeping make you an expert in sleep and shiftwork. This fast-paced, dynamic, and information packed session takes a light-hearted but serious approach to managing shiftwork and fatigue in the workplace and in everyday life. The principles taught in this session are the same techniques taught to military pilots and Special Forces to enhance performance and reduce fatigue in 24/7 operations. This is one lecture you won't sleep through!

Learn to:

- Manage your sleep/wake cycle by maximizing the restorative nature of sleep and minimizing sleep inertia.
- Optimize strategic napping strategies to sustain performance.
- Create shiftwork schedules that maximize performance and reduce mental fatigue.
- Reduce insomnia and maintain alertness using non-pharmacological and pharmacological means.

Coping with Traumatic Stress in Law Enforcement

Robin Grant-Hall
Trauma Psychologist

There was a silver lining for law enforcement in Connecticut after the Newtown shootings. Law enforcement finally realized that everyone is vulnerable to Posttraumatic Stress (PTS) no matter how seasoned or tough you may think you are. This presentation will explain the brain and what happens over time to professionals who choose careers in law enforcement. Big T's (traumas) and little t's will be discussed as well as what makes an individual vulnerable to developing symptoms associated with PTS. How a breakthrough occurs in the brain and the subsequent neurological changes that occur will be explained. The symptoms of PTS will be outlined along with specific ways to cope with and alleviate PTS over time. Up until now, PTS has leaked out in the form of anger, depression, distance, detachment, alcohol abuse, and problems maintaining family

relationships. The goal for the future of law enforcement will be to be proactive and to practice brain health so that those who choose this esteemed career can maintain emotional and physical health over time.

Author Index

The presenting author index can provide a quick reference to find when and in what section presenting authors were scheduled to present at the 2014 Annual Meeting. The reference table below assists you in finding the section in which the presentation was given. Letters correspond to the scientific discipline/section in which the presentation was made while the number corresponds to the page number of the abstract in this booklet.

A	Drug Chemistry
B	Forensic Biology
C	Toxicology
D	Trace
E	Poster
F	Plenary
G	General

Author Last Name

F

Fontanez, Amber-E40

G

Giffen, Justine E.-E40

Grant, Chandler-E41

Grant-Hill, Robin-G51

Graver, Angelica-D31

Green, Camilla-B11

Guttierei, Joseph-A4

H

Hafer, Kaitlin-D37

Hartley, Adam-D31

Hargreaves, Michael D.-A6

Heurich, Chuck-B11

J

Jackson, Ashley-E41

Jones, Andrea-C25

Just, Rebecca-B18

K

Kubilis, Madison-B18

Kumar, Orrin-E42

L

Lake, Anneliese-E42

LaPorte, Gerald M.-F49

Leach, Jennifer-E43

LeBlanc, Ashley-D28

Lesiak, Ashton D.-A5

Liu, Na-C24

Lu, Aileen-E43

Luo, Kathleen-A3

M

Manzolillo, Patricia A.-F49

Mares, Mollie-C24

McCarthy, Kassandra-E44

McCook, Samuel-E46

Mest, Mallory-B11

Miller, Allison N.-B13

Mitchell, Lindsay-D28

Moody, Heather-D36

Moorehead, Wayne-C23, D35

Mulhern, Samantha-B18

Mundy, Lisa-C26

Musah, Rabi A.-A6

Myers, Emily A.-D37

N

Nemeth, David J.-C23

Noval, Erin-E44

O

Ostojic, Lana-B14

P

Perez, Anjelica C.U.-B14

Persson, Emily M.-E44

Petraco, Nicholas-D32

Pizzola, Peter A.-D35

Plazibat, Stephanie-B16

Prebihalo, Sarah-C27

Presley, Brandon C.-C21

Prickett, Cassandra-C26

R

Record, Megan R.-E45

Reffner, John A.-D32

Ribadeneyra, Tiffany-A3

Rohrbaugh, Meredith-B20

Rosati, Jennifer-C25

S

San Pietro, David-B10

Schmidt, Michelle-A2, E45

Schweighardt, Andrew J.-B12

Sears, Jennifer-B10

Shappell, Scott-G51

Shepard, Jason R.E.-A7

Stevens, Lisa-A3

Sykes, Dan-D29

Szewczak, Angelica-E46

W

Walden, Melissa-E46

Walsh, Emily-E46

Weedn, Victor-F50

Weinstein, Danielle-B19

Wesley, James- A2, A4, A9 C21

Williamson, Emily-E39

Wolf, Sarah-C27

Wolfgang, Joe-D30