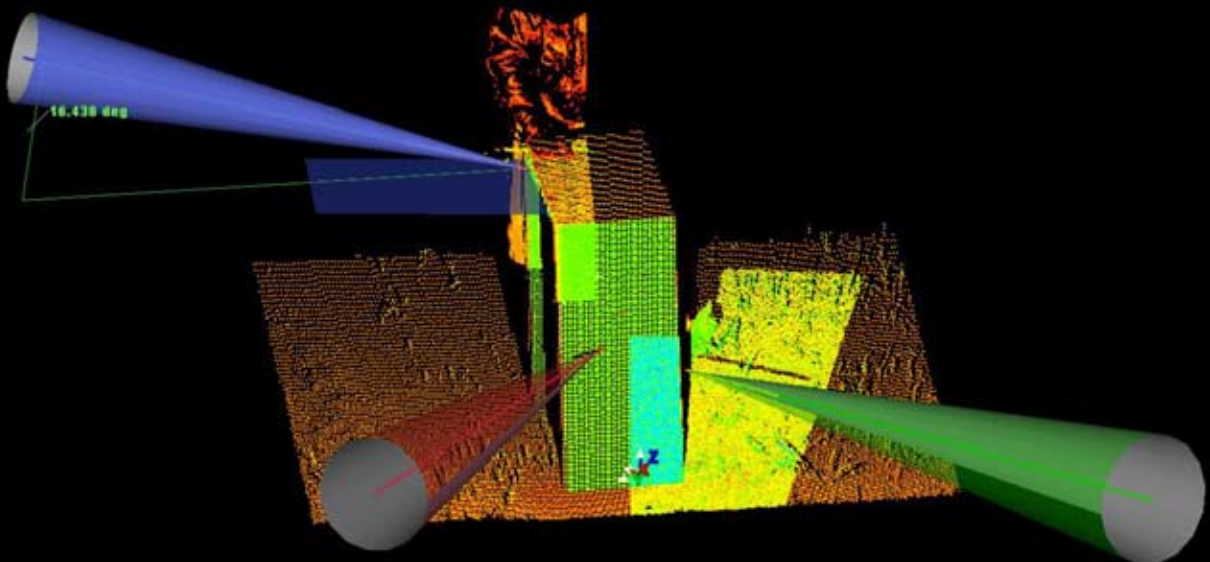


The CACNews

News of the California Association of Criminalists • Third Quarter 2010



THE CAC SPRING SEMINAR IN YOSEMITE



The President's Desk

Laws, Codes & Enforcement

This is the first of my "President's Desk" messages and I want to begin by thanking the membership for electing me last year. And I thank the board of directors, especially Immediate Past President Mary Hong, for helping me get up to speed during the first few weeks of my presidency. And I'd also like to thank those members that have volunteered to fill committee positions that were vacant. There are still some available positions; please contact me if you are interested. Now on to the message!

A couple of issues have come up that have caused me to review the CAC Bylaws, the Code of Ethics, and the Code of Ethics Enforcement. Surely we all have read these, since we indicated on our application forms that we agree to the Bylaws and Code of Ethics. But several members have asked me questions about these documents in the past couple of months, so I think it would be a good time for a little refresher.

The origin of the CAC began with discussions among crime lab employees that led to the first seminar in April 1953. The founding members created the Bylaws of the CAC, which are our guiding principles. Article I of the Bylaws establishes the purposes of the CAC:

"Foster an exchange of ideas and information within the field of criminalistics.

Foster friendship and cooperation among the various laboratory personnel.

Encourage and, if possible, financially support worthy research projects. Encourage the compilation of experience data of value in the field.

Promote wide recognition of the practice of criminalistics as an important phase of jurisprudence.

Promote a high level of professional competence among criminalists.

Encourage uniform qualifications and requirements for criminalists and related specialists.

Disseminate information to the law profession concerning minimum qualifications for physical evidence consultants.

Provide a board of review in cases involving differences of professional opinion when requested.

Encourage the use of improved testing procedures and methods of presentation of conclusions.

Encourage the recognition of this Association and its purposes among other appropriate groups and societies.

Lend assistance, whenever possible, in the formulation of college curricula and law enforcement programs.

When appropriate, to review and act upon any pending legislation which appears to be related to the field of criminalistics.

Establish, maintain, and enforce a code of ethics for criminalists.

Establish, maintain and manage an Endowment Fund to fund scholarships, research projects, special classes and other activities in keeping with the objects and purposes of this Corporation.

Support certification testing programs for individuals engaged in the practice of criminalistics."

The Bylaws go into detail on membership and the board of directors, but the rest of the Bylaws is largely administrative: the requirements for the CAC business meetings, the CAC seal, the fiscal year, the procedure for amending the Bylaws, and the Rules of Order and Procedures. But even some of the administrative sections can create issues. For instance, there was some concern that we would not have quorum for the meeting this past April that included the election of new officers and the approval of new members.

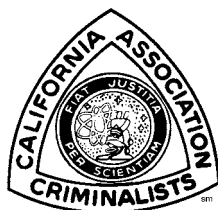
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Ours was one of three codes of ethics that the National Academy of Science highlighted in their report on forensic science last year. But they did note that there is no uniform code of ethics for forensic science.



Adam Dutra
CAC President

THIRD QUARTER 2010



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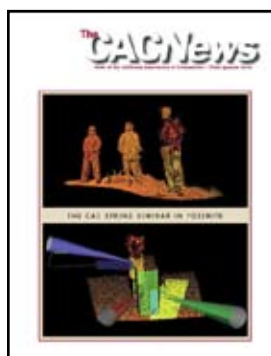
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Submissions should be made in the form of Windows compatible files on CD or by e-mail. Alternatively, text files may be saved as plain ASCII files without formatting codes, e.g. bold, italic, etc. Graphics, sketches, photographs, etc. may also be placed into articles. Please contact the editorial secretary for details.

The deadlines for submissions are: December 1, March 1, June 1 and August 15.

The CACNews

www.cacnews.org



On the cover...

The laser-scanned version of a recent CAC Spring seminar workshop. Scans performed by the Leica C10 and annotated by Mike Haag. More photos inside...

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CACBits



CAC member Ricci Cooksey discusses trace evidence recovery inside the automobile of a murder suspect. First Aired in October of 2007 on Forensic Files, truTV. The episode, titled "Wheel of Misfortune," follows the 2005 murder of Christie Wilson who disappeared after leaving a California casino. Mario Flavio Garcia was convicted in 2006 of killing Wilson after meeting her at the casino and spending time drinking and gambling with her.



New Face Added to CAC BoD

At the January CAC Board meeting, Janet Seaquist-Anderson announced that she would be leaving her board position as Regional Director North and relocating to another state. The board then appointed Mey Tann, Riverside DOJ, to fill out the remainder of Janet's term.



Overlid, Franks 2009 E. F. Rhodes Winners

Nathaniel Overlid (left), Solano Co., and Christina Franks, CA DOJ Riverside, each received the Edward F. Rhodes III Memorial Award for 2009. This award sponsors new criminalists who wish to attend major national scientific meetings. Visit www.cacnews.org for more information on this and all of the CAC awards.



The CAC 2009-10 board discusses the issues of the day. (clockwise from left) Jamie Miller, Recording Secretary; Michael Parigian, Treasurer; Mey Tann, Regional Director South; Mary Hong, President; Jeanette Wallin, Regional Director North; Adam Dutra, President-Elect; Pat Huck, Membership Secretary and Editorial Secretary Greg Matheson. Not present is Immediate Past Pres. Jennifer Mihalovich.

The Editor's Desk

Resisting the “Factory Label”

The semi-annual seminars of the California Association of Criminalists have always been valuable enhancements to my career. They provide an opportunity to learn new things, both technical and philosophical, they give us a better understanding of our profession while creating a feeling of community, they give us the opportunity to share time with colleagues we have known for a long time and those we have just met. The Spring 2010 seminar, hosted by the Department of Justice Fresno Laboratory, fulfilled all of those purposes, and more. I have attended over 50 seminars during my career; this one was unique because it was the first one where we were snowed in, even if it was for a short time. It lasted just long enough for the attendees to enjoy the uniqueness and beauty of the weather and for the seminar planners to become concerned their speakers might not get to the meeting. Good times.

I became a member of the CAC in 1979. Between 1979 and the late 1990's I attended all the CAC seminars except a select few. One of the ones I missed was the Spring 1983 seminar following the birth of our daughter, as good a reason as any. I missed one or two more, I don't remember why I missed them, but I'm sure the reasons were important. In the mid 1990's I transitioned from a supervisor to a manager, which caused me to focus on other aspects of our profession, unfortunately moving me away from the CAC.

Three years ago, I rediscovered my interest in the CAC by attending the seminar in San Diego. I found that as a manager of a criminalistics laboratory, I enjoy the CAC seminars as much as ever. For the same reasons as before, plus a few more. Though I don't entirely grasp all the nuances of the technical sessions like I once did, I enjoy hearing case histories, discussion on casework philosophies and generally getting a feel for the challenges and capabilities of today's criminalists. A perspective that is hard to get from my office chair. But most of all, I enjoy watching presentations by criminalists from the LAPD Crime Lab. As a manager you generally spend a majority of your time dealing with problems and the mechanics of keeping the lab going. Seeing people from your lab stand in front of an audience of their peers and present their research or share their experiences, makes me proud to serve them as their lab director and reminds me why I need to work to remove obstacles so they can do their job.

The final presentation of the seminar was “The Criminalistics Laboratory as a Mere Testing Facility” presented by Dr. Peter DeForest. I had the opportunity to sit on a panel following Dr. DeForest's powerpoint. My role was to provide the audience with an overview of our experience in the LAPD with a field investigations unit staffed by criminalists. I was

very pleased to see how many people stayed through the end, though I'm not sure if it was the allure of the presentation, or the chance to win a new digital camera. Whatever the reason, the room was well filled.

Dr. DeForest's presentation discussed the differences between a crime laboratory whose focus is similar to a testing facility, completing task defined by requests initiated by non scientists, versus a crime laboratory whose focus is problem solving and approaching our work as scientists and not just technicians. Unfortunately, for a lot of reasons, many crime laboratories have shifted toward the testing facility paradigm. In many respects, it is the easier way to go. Because of

increased specialization, the need to meet stiff accreditation standards and being required to meet high productivity expectations it is more and more difficult to find the time to look beyond simply completing requests.

To quote Dr. DeForest, “isn't our product a comprehensive, scientifically based, understanding of the physical evidence?” I know this is often a difficult ideal to achieve, but I believe it is possible, regardless of the unit or specific tasks you perform.

As a lab director, I know I am guilty of constantly pushing our limited resources to provide more and more “product.” It is our job to serve the needs of our customers, but we need to do it intelligently. I

believe it is imperative, as managers and supervisors, that we foster the concept of a product involving the comprehensive, scientifically based, understanding of the physical evidence.

cont'd on page seven

...it is imperative to the
successful future of our
profession that you,
the criminalists, help to
change the “testing facility”
paradigm from
your position.



Greg Matheson
CAC Editorial Secretary

Article II of the Bylaws is the section that deals with membership: qualifications for membership, the classes of membership, change of membership classes and termination of membership. The issue of termination of membership for cause states, "A member may be suspended or expelled from the Corporation for unethical conduct, conduct detrimental to the profession of criminalistics or conduct detrimental to the welfare of the Corporation." The issue of termination for unethical conduct is more clearly described in the Code of Ethics.

The CAC Code of Ethics was written a couple of years after the Bylaws. It is very thorough and because it is the oldest code of ethics in the field, it is apparent that the CAC Code of Ethics has been used as a model for the codes of several other professional associations in forensic science. Because of its detail, I believe all practicing forensic scientists, not just CAC members, should be familiar with this important document. Ours was one of three codes of ethics that the National Academy of Science highlighted in their report on forensic science last year. But they did note that there is no uniform code of ethics for forensic science. The CAC has been working to help craft such a document, and it is likely that similarities will be evident between any eventual national code of ethics and ours.

The Code of Ethics has six sections: preamble, ethics relating to the scientific method, ethics relating to opinions and conclusions, ethical aspects of courtroom presentation, ethics relating to the general practice of criminalistics, and ethical responsibilities to the profession. Although I could list numerous areas to highlight in the Code of Ethics, I find that one of the last is one of the most important to me, "It shall be ethical and proper for one criminalist to bring to the attention of the Association a violation of any of these ethical principles. Indeed, it shall be mandatory where it appears that a serious infraction or repeated violations have been committed and where other appropriate corrective measures (if pursued) have failed." This puts responsibility on the shoulders of each member to be knowledgeable of the Code of Ethics and to ensure that they and those around them uphold all of its aspect.

A code of ethics is worthless if it is not enforced. The CAC, much to the credit of John Murdock, created the Code of Ethics Enforcement in 1980. In combination with the CAC Bylaws, it explains the makeup and purpose of the ethics committee and the procedures that are to be followed if an allegation of ethical misconduct or conduct detrimental to criminalistics or the CAC is brought forth. Certainly it is the hope of every CAC president and ethics committee chair that their term passes uneventfully, but allegations do happen every once in a while. It is important and helpful to have the Code of Ethics Enforcement to guide us during the unfortunate times that allegations occur.

These documents have recently been updated and I encourage all members to reexamine them when they get a chance. They are currently available on the CAC website:

<http://www.cacnews.org/membership/handbook.shtml>



Additional CAC Award Recipients

Alfred A. Biasotti Most Outstanding Presentation Award:
Pamela Hofsass, Fall 2009.

ABC Exam: **Vincent Villena**.

CAC Service Awards: **Janet Anderson-Seaquist** (BoD Regional Director), **Jean Arase** (Northern Drug Study Group), **John Bourke** (2009 Fall Seminar Chair), **Juli Buckenberger** (Southern DNA Study Group), **Nathan Cross** (Southern QA Study Group), **Eric Collins** (Endowment Committee), **Jamie Daughetee** (Awards Committee), **Sheltri Hallford** (Financial Review Committee), **Michelle Halsing** (Merchandising Committee), **Patricia Huck** (BoD Membership Secretary), **Meghan Mannion-Gray** (Nominating Committee), **Jennifer Mihaiovich** (BoD Past President), **Alice Neumann-Hilker** (Northern DNA Study Group), **Suzette Sanders** (Ethics Committee), **Jeanette Wallin** (BoD Northern Regional Director) and **Stephanie Williams** (Northern QA Study Group).

A Couple of Interesting Web Finds

Hat-tip, Bob Blackledge

Copy Machines, a Security Risk?

The newer "digital" copy machines in daily use may be secretly archiving every single page in a built-in hard drive. Could this pose a security risk when the machines are surplussed out of government service and sold to the public? Watch the linked report and then look around your lab and see if this issue is a problem for your agency.

www.cbsnews.com/video/watch/?id=6412572n

"... This year marks the 50th anniversary of the good, old-fashioned copy machine. But, as Armen Keteyian reports, advanced technology has opened a dangerous hole in data security. . ." April 19, 2010, CBS News

Fire Debris Analysts, Take Note

Do biofuels leave behind recognizable traces? Would their pyrolysis patterns be different from petroleum-based fuels or maybe they would they look like burned food?

www.newswise.com/articles/biofuel-combustion-chemistry-more-complex-than-petroleum-based-fuels

Alameda CAC Seminar Call for Papers

The 116th Semi-Annual Seminar will be hosted by the Alameda lab from October 3-7, 2010 and announces a call for papers. Papers of all topics and disciplines are welcome. All presentations must be in PowerPoint format. Anyone interested in presenting a paper please contact Technical Program Chair Kristi Lanzisera, kmlanzisera@acgov.org or Heidi Bates, hbates@acgov.org
15001 Foothill Blvd. 2nd Floor, San Leandro, CA 94578
Tel: (510) 667-7700 Fax: (510) 667-7764

But we can only do so much, it is imperative to the successful future of our profession that you, the criminalists, help to change the "testing facility" paradigm from your position.

No matter where you are assigned in a crime laboratory you can improve your work product by expanding your knowledge of all aspects of criminalistics. By attending seminars, talking to your peers in other specialties, learning case approach and philosophies from other laboratories, and gen-

erally going beyond your lab bench and the requests in front of you will professionally grow and by doing so, improve our profession.

It is probably the reality that if you have read this editorial I am "preaching to the choir." But I hope it will help inspire you to reach out and spread the word, to share with your peers the importance of being scientists and not just technicians.

Thank you.



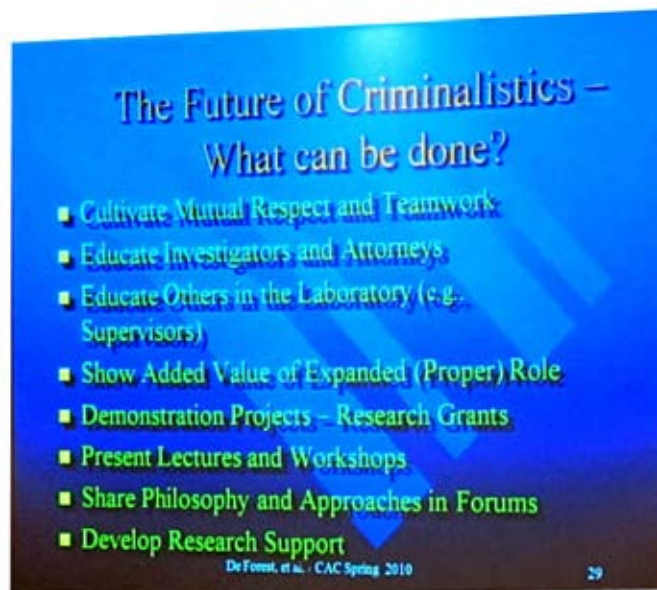
← FEEDBACK

from our readers →

The Answer is US

At the recent seminar, Dr. Pete DeForest (*seated*) led an interesting panel discussion titled "The Criminalistics Laboratory as a Testing Facility." Along with Greg Matheson and Faye Springer, he prodded us with the assertion that many of the problems associated with the public's perception of our profession are rooted in the idea that the crime lab is just a testing facility. One of his slides ("What can be done?") caught my fancy. But as I read down the list it occurred to me that there is a fairly simple and yet profound way to address his concerns. Without belaboring the point, I'll just suggest you read each item on the list and see if you agree: Wouldn't joining (and participating) in the CAC and CAC-related activities satisfy all of the suggestions offered?

—John Houde



Springtime in Yosemite

A person wearing a dark winter jacket and hat is shoveling snow from a path. The background shows a snowy mountain landscape with evergreen trees covered in snow. The scene is viewed from a slightly elevated position, looking down the path.

Dreaming of a white seminar?
A foot of wet snow wasn't
enough to dampen the spirits
of some 139 attendees at
the Spring CAC Seminar
in Yosemite National Park.
Even with "entertaining"
weather, all of the workshops
managed to draw plenty of
participants and although the
class at the outdoor shooting
range was drenched, it still
accomplished its stated goal
of demonstrating a high-tech
scene scanner. Back at the
hotel, cozy and warm, the DUI,
DNA, and Measurement Error
workshops were in high gear
and provided excellent papers
and demonstrations, both
technical and practical.



Despite inclement weather, instructor Mike Haag (middle left) gets a successful scan of his shooting setup at the crime scene workshop. The Leica C10 slowly makes a 360 degree pass, forming a virtual representation of a large area, indoors or out, allowing the analyst to make detailed measurements and establish spatial relationships.











Cowboy Up...

The banquet's entertainment was a rootin' tootin' gunslinger show with world-class gun "gunspinner" Joey "Rocketshoes" Dillon, who was happy to pose with CAC members (after the smoke cleared).



CA DOJ Fresno was your host for the seminar, (l-r) Mindy Crow, Kiffin Nelson, Lora Bailey-van Houten, Nancy McCombs, Mike Appel, Sherrell Hildreth and Jessica Savopolos. Not pictured are Caroline Garcia-Duncan, Greg Masters, Maria Woodcock, Holly Scott and Edwin Vargas.



On these pages are scenes from the new member's reception, checking membership status before attending the business meeting and the varied and always interesting vendor booths.





Counter intuitive

A slide from Luke Haag's presentation at the seminar reveals an interesting quirk of physics: When a bullet penetrates a sheet of glass at an angle, the resulting glass fragments continue traveling perpendicular to the target. This may help to explain the unexpected location of glass trace evidence at shooting scenes involving windows and windshields. *Reproduced here by special permission of Bernd Salziger (original author).*



Your Newly-Minted 2010-11 CAC Board



(Seated, l-r) Editorial Secretary Greg Matheson, Recording Secretary Jamie Miller, President-Elect Kevin Andera. (Standing, l-r) Regional Director North Meghan Mannion-Gray, Membership Secretary Michelle Halsing, Treasurer Michael Parigian, President Adam Dutra, Immediate Past President Mary Hong and Regional Director South Mey Tann.

Chemical and Instrumental Tests of Suspected Bullet Impact Sites

Lucien C. Haag* and Mahesh Patel**

Abstract

Known ricochet marks produced by a variety of 9mm pistol and .38-caliber revolver bullets were tested for copper and lead via the transfer technique. Small areas from positive 'lifts' for copper residues via the DTO test and lead residues via the sodium rhodizonate test were excised and examined by SEM-EDS. This not only allowed for a confirmation of copper and lead in these 'lifts' but also permitted the detection and identification of other metals associated with the construction and/or design of the bullet producing each impact site. This enhanced information included the detection of various levels of zinc alloyed with gilding metal and brass bullet jackets as well as the constituents of alternate bullet jacket compositions such as copper-plated steel jackets, aluminum jackets, and nickel-plated jackets. Trace amounts of copper from Lubaloy-plated lead bullets could also be detected by SEM-EDS examination of positive sodium rhodizonate 'lifts' of a ricochet impact site produced by a copper-plated Winchester .38 Special Lubaloy bullet. Both tungsten and copper could easily be identified in a ricochet mark produced by a 9mm frangible bullet composed of these two metals in a plastic matrix.

These SEM-EDS results extend and enhance the information otherwise hidden amid the copper and lead residues in bullet impact sites and bullet holes. This additional information waiting to be revealed in traditional wet chemical tests of suspected bullet impact sites by the application of this non-destructive and non-consumptive technique can be of significant benefit in certain cases as will be demonstrated in this article.

Keywords

Copper, brass, dithiooxamide, DTO, elemental analysis, gilding metal, iron, lead, Lubaloy, nickel, ricochet, scanning electron microscopy-energy dispersive x-ray spectrometry, SEM-EDS, sodium rhodizonate, tin

Introduction

Chemical tests for copper and lead using lifting or transfer techniques on suspected bullet holes and impact sites are well known and frequently employed during the investigation of shooting scenes and selected items of evidence submitted to the laboratory. The most common test for copper is the dithiooxamide (DTO) test and for lead, the sodium rhodizonate test. These reagents form characteristic colors with trace amounts of copper and lead that have been transferred to a suitable medium such as filter paper previously moistened with an appropriate solvent for each of these metals.

The transfer technique presented here provides a check of the substrate for possible interferences, pattern information associated with a bullet impact deposit and the direction of travel of the projectile when a positive response is obtained.

Additional information of considerable significance can be derived from the SEM-EDS examination of small, excised areas of Cu- and/or Pb-positive lifts. This non-consumptive analysis not only provides for the confirmation of the target elements of copper and lead but can also yield specific data regarding:

- other elements often alloyed with lead and copper (e.g.- tin, antimony, zinc),
- evidence of special coatings on certain bullets (e.g.- nickel),
- alternate or uncommon bullet and bullet jacket compositions not normally detected by the transfer technique (e.g.-tungsten, steel, aluminum),
- and certain morphological features of the target elements (e.g.- lead deposited in a molten state ("lead splash") as a result of an energetic impact).

Procedure

A selection of commercially manufactured 9mm Luger and .38 Special cartridges was assembled to provide a variety of projectile compositions and construction. Table 1 provides a complete description of the ammunition and bullet construction for these tests along with their approximate impact velocities. One handloaded .38 Special round containing a hard cast, lead-tin-antimony alloy bullet was also incorporated in this group since such bullets are commonly available to amateur and commercial ammunition reloaders. Figure 1 shows the initial lineup of cartridges and bullets selected for this study.

Two sections of concrete from a commercial property renovation site in north Phoenix were collected and the top surfaces (once a sidewalk in both cases) cleaned with dilute HCl followed by water. These slabs of concrete were ultimately positioned approximately 20-feet down range of the test firearms in a remote and pristine desert area where there was no evidence of any previous recreational shooting. One slab became the target for the 9mm shots and the other for the .38 Special shots. The firearms consisted of a Beretta 92FS (9mmL) and a Smith & Wesson Model 15 revolver (.38 Spl.) each mounted in a Ransom Rest. The incident angle for all projectile strikes to the flat concrete surfaces was held constant at 12.5 degrees. The ricocheted projectiles were trapped in a container filled with loose panels of Kevlar taken from used police vests. Figure 2 provides an illustration of the experimental design and setting. This arrangement produced visible impact marks on the two concrete slabs and allowed the ricocheted bullets to be recovered without suffering further damage. [See Figure 3 and Figure 4] In this way it was possible to see if the jackets of the jacketed bullets had been breached to expose their lead cores to the concrete during the ricochet process.

Initial Approach

It was first thought that a direct sampling of the bullet impact sites with a carbon tape stub would be a useful approach particularly when applied to the very beginning of the mark produced by the bullet where traces of jacket coatings (such as nickel) or the thin Lubaloy-type copper plating on some lead bullets might be detected. This was done with

*Forensic Science Services, Carefree, AZ USA

**Phoenix Police Crime Laboratory, Phoenix, AZ

sticky carbon tape stubs designed for primer gunshot residue (PGSR) along with the sampling of a non-impacted control area of the concrete. These samples were subjected to SEM-EDS analysis using a Leo 435vp SEM equipped with an EDAX EDS system. No carbon or gold coating was necessary with this modern system. A manual search routine with variable pressure and backscatter detector was used to look for elements of interest. The SEM settings were: 25kv accelerating potential, probe current set to 1nA and a working distance of 18mm.

This direct sampling approach was generally successful but subsequently found to be unnecessary. It also presented difficulties in those instances where the impact of the bullet produced any sort of depression in the substrate. The flat, non-flexible stub could not reach down in such depressions whereas this was easy using the transfer technique with filter paper or BenchKote®. In retrospect, the only situation the authors can envision where a direct stubbing of a suspected bullet impact site might still be useful would be a smooth, unyielding surface such as polished marble or granite in places where such surfaces are common (airports, banks, hotel floors). The usual wet chemical lifting technique for lead and/or copper would follow a direct stubbing with the resultant SEM stub only being analyzed if it became clear that the mark was bullet-caused.

Final Procedure

As explained in reference 4, if both copper and lead are to be tested for, the test for copper should be carried out first. This was done using BenchKote® paper with the filter paper side moistened to a glossy sheen with a 2:5 dilution of concentrated ammonium hydroxide and pressed firmly against the target surface for at least 30 seconds. In actual casework (as well as in this study) an area well beyond the impact site should be processed with reference and orientation marks added to the transfer paper before removal from the surface. The contact side of the transfer paper was then sprayed with the DTO reagent (0.2% in absolute ethanol). A dingy greenish-gray color develops in the presence of copper.

Once any residual ammonia solution had evaporated from the impact surface, the sodium rhodizonate test was carried out with the same lifting technique using a new piece of BenchKote® treated with pH 2.8 aqueous tartrate buffer (3%w/v solution) followed by application of the sodium rhodizonate solution. The tartrate buffer solution is just as effective as the dilute acetic acid solution used by some forensic scientists in transferring lead residues and offers several added advantages the foremost of which is that it is non-volatile whereas traces of acetic acid tend to persist with the original method. Few, if any SEM operators would appreciate the further degassing of acetic acid vapors inside their SEM. Additionally, the use of the tartrate buffer results in a rapid decolorizing of the brown color of the sodium rhodizonate reagent making the positive pink color complex with lead much easier to see. For those that feel the need to carry out the so-called HCl confirmation test, the authors would suggest applying one or more very small drops of the 5%HCl solution to selected sites in the pink areas on the 'lift' and both noting and photographing the resultant blue-purple color obtained with lead.

One of the advantages to these color tests produced by the lifting or transfer technique is the *pattern* information that becomes apparent. The *direction* of the responsible bullet's travel is often discernable with an ellipsoidal transference of

lead and/or copper at the beginning of the impact mark. This would be a desirable area from which to cut a small sample for SEM-EDS analysis since it is the most likely place to find traces of any special plating or coating that fail to respond to either of the chemical tests. "Lead splash" occurs where the impact velocities and energy loss is sufficiently high to momentarily vaporize some of the lead in a bullet. A very dramatic demonstration of this can be seen in some of the video films from Werner Mehl on his website, www.kurzzeit.com wherein lead bullets impact hard objects at relatively high velocity. In the case of high energy ricochet events involving lead bullets and jacketed bullets whose jackets fail during impact, spattered and vaporized lead can often be seen in the sodium rhodizonate lift as a fog or diffuse deposit of lead just beyond the *departure* end of the ricochet mark. SEM analysis and imaging of an excised sample from this area of the lift can not only verify that it is elemental lead but that it was deposited in a molten or liquid state as evidenced by its morphology. It should also be pointed out that this phenomenon of lead splash may occur in other situation where certain bullet types strike hard objects at relatively high velocity producing vaporous deposits of lead that can, and have been confused with close proximity gunshot residues. [See Ref. 8] Here again careful examination under the SEM with an attached EDS system will allow these two very different sources of lead to be differentiated.

Sampling of 'Lifts' for SEM-EDS Analysis

Once the 'lifts' from the copper and lead tests were completely dry, one or more small areas (ca. 2x2mm to 2x4mm) of the positive responses for copper and/or lead as well as at least one adjacent non-reactive area of the lifting medium are excised with a scalpel [see Figure 5] and mounted on an SEM stub. A slight modification of this sampling procedure involves the cutting of a rectangular area from the filter paper that includes the color-positive area and a color negative area. An example is shown in Figure 6. The addition of a simple notch cut out of the edge of the stub's carbon tape serves as a reference and orientation mark along with a written description of the samples for the SEM analyst.

Results

Chemical tests for copper on concrete slab 1 struck with the 9mm bullets produced positive DTO results for all of these jacketed projectiles. This was somewhat surprising for the ricochet marks produced by the nickel-plated S&B bullet and the Wolf bullet since the source of copper in both of these bullets was of a very limited nature. A cross-sectional SEM view of the jacket of the S&B bullet revealed an extremely thin plating of nickel over a very thin layer of gilding metal (Cu/Zn alloy) on an otherwise mild steel-jacketed bullet. The jacket of the 9mm Wolf bullet (manufactured at the Tula facility in Russia) possesses a thin layer of gilding metal over a mild steel jacket. These thin layers of gilding metal were the only source of copper in these 9mm bullets. The assessment of direction of travel was easy to see in these lifts by means of the ellipsoidal deposit of copper at one end (the beginning point) of the impact mark.

The DTO results on concrete slab 2 struck by the .38 Special bullets yielded positive results for the copper jacketed 125-gr. Remington bullet and the copper/tungsten frangible bullet but not the copper-plated Lubaloy bullet. This was in keeping with past experience for this latter bullet.

Sodium rhodizonate tests on tartrate buffer lifts of the five 9mm impacts produced weak or partial positive tests for the 115-gr. Winchester FMJ bullet and the Remington brass-jacketed *Golden Saber* bullets. This came as no surprise since the jackets on both of these bullets were breeched thereby exposing their lead cores. This is evident in lower portion of Figure 4. The jackets of the other two, jacketed bullets remained intact during the impact and ricochet process and the frangible bullet contained no lead in its make up. The impact sites for these three 9mm bullets gave no response for lead.

All of the .38 Special bullets produced strong lead responses in the bullet-to-concrete contact area with downrange "lead splash" detected in three of the strikes.

SEM-EDS testing of DTO and Sodium Rhodizonate-Positive Lifts

One or more samples were excised from the copper-positive and lead-positive areas from each of these 'lifts' as previously described and, along with a control sample taken from the same 'lift' (from a site showing no color reaction to the particular reagent), were placed on a carbon tape stub and subjected to manual SEM-EDS examination for elements of interest.

Discrete particles of copper (copper/zinc) were invariably found in the samples from the DTO-positive areas. Particles from the brass jacketed Remington bullet could be differentiated from those derived from the more common jackets and platings composed of gilding metal. [See Figure 7] Additionally, and somewhat -surprisingly, lead particles were also found in the DTO-positive 'lifts'. This was the consequence of a simple physical transference. Moreover, in those instances where the responsible bullet jacket possessed another metal (nickel plating and mild steel in the case of the S&B bullet and mild steel in the case of the Wolf bullet), these metals were also detected and identified by SEM-EDS.

It should be pointed out that the amounts of copper and lead that produced the color reactions on the surface of the filter paper are well below the detection level of the EDS system, and that one is actually finding particles of bullet metal that have been physically transferred to the filter paper. This increases the importance of an analysis of the adjacent control area and a search for particles that might be confused for bullet constituents. This analysis also stands to provide information on the makeup of the impacted surface. Since we are actually looking at transferred particles (and not an EDS spectrum of the DTO or rhodizonate color complex on the filter paper) it could be important to consider and examine morphological features of such particles. This is particularly true when one encounters iron and aluminum during the spectral analysis of transferred particles since these elements are also relatively common to concrete and other similar materials such as bricks, rocks and cinder blocks. In addition to morphology, other elements typically associated with potentially confusing mineral-derived particles should be sought. In the case of aluminum (particles of the aluminum jacket from a Winchester *SilverTip* bullet vs. aluminum in concrete), aluminum in the latter will invariably be due to aluminosilicate minerals consequently the EDS spectrum will display a silicon peak of similar height to the aluminum peak. An example of this is provided in Figure 8a depicting a typical EDS spectrum of a representative particle of concrete from slab 2 versus an actual particle of aluminum jacket material from the Winchester .38 Special *SilverTip* bullet [Figure 8b]. Note the companion

element, silicon in the first figure and the stand-alone aluminum peak in the second figure. If uncertainty remains in an actual case, the adjacent control area should be searched for particles containing the elements whose source is in doubt. Iron is the other potentially troublesome element since it is often found in mineral sources and, of course, mild steel bullet jackets. Particle morphology and companion elements associated with the two radically different sources should allow the SEM analyst to discriminate between these two sources. Finally, if still available, the impacted surface could be revisited, sampled and tested.

The 'lift' from the impact site of the frangible 9mm bullet gave a strong DTO response as expected but the SEM-EDS examination of this 'lift' revealed particles with the signature copper/tungsten composition unique to this type and source of projectile.

Locating and identifying lead particles in 'lifts' of the sodium rhodizonate tests was relatively straightforward. The heavy lead-containing particles could readily be seen as bright particles on a field of subdued light element particles (particles of the concrete substrate composed of calcium compounds, quartz particles, aluminosilicates, feldspars, etc.). SEM-EDS analysis of these 'lifts' also allowed an impact from the hard cast lead bullet (Lyman #2 alloy nominally composed of Pb:Sn:Sb at 90:5:5) to be discriminated from the relatively soft commercial lead bullets and bullet cores by the clear presence of tin in the spectrum. [See Figure 9]

Just as with the DTO 'lifts', unexpected particles of copper and/or brass bullet jacketing were often found amid the lead particles in these sodium rhodizonate 'lifts'. As before, these were the consequence of simple physical transference during the lifting process.

Figures 10, 11, 12 and 13 provide representative examples of the results for several of the more complicated bullets. A study of these figures will reveal that traces of the very thin copper plating on the Winchester .38 Special Lubaloy bullet was found in the lift of its ricochet mark; that copper was identified in the lift of the ricochet mark produced by the Russian steel-jacketed bullet; that both iron and nickel were found in the lift of the S&B 9mm bullet's ricochet mark; and that tungsten as well as copper was identified in the lift of the ricochet mark produced by the 9mm Winchester frangible bullet.

Additional Applications and Findings

The application of SEM-EDS analysis of positive color tests for lead and/or copper may be useful in other situations where there may be some doubt or concern about the source of these metals. The example of lead splash vs. close proximity GSR has been previously mentioned. In one recent case a subject was shot and killed by a police officer after the subject was alleged to have pulled a revolver from under his shirt. The claim by friends and family of the decedent was that the gun found near the body (with obliterated serial number) was a "throw down gun" deposited there by the police in an effort to make a bad shooting a justifiable shooting. The entire lower area of the decedent's white shirt was sprayed directly with the pH 2.8 tartrate buffer followed by the aqueous sodium rhodizonate reagent whereupon multiple areas of diffuse lead deposits became visible. Small, representative areas of these deposits were excised and mounted on a carbon tape SEM stub and analyzed revealing not only the presence of lead but GSR (lead-barium-antimony) constituents as well. This effectively foreclosed any suggestion that the sodium

rhodizonate test was the consequence of some non-firearms source of lead (e.g.- battery cables). During this work co-author Patel observed that it was unnecessary to excise portions of the clothing and, in fact, a simple stubbing (lifting) of the pink, lead-positive areas of the shirt along with adjacent negative areas produced the same result and even obviated certain problems caused by the clothing fibers.

Summary, Observations and Conclusions

Much stands to be learned regarding the composition of the bullet as well as the impacted surface from a further examination of the traditional color tests for lead and/or copper in suspected bullet impact marks and bullet holes. There is considerable variety in bullet construction and composition with the clear likelihood that the transferred residues from the bullet-substrate interaction contain telltale traces of the bullet. Lead bullets vary from commercial, swaged bullets composed of nearly pure lead with a small percentage of antimony as a hardener to hard cast bullets formed from alloys such as Lyman No. 2 bullet metal containing 90%Pb, 5%Sb and 5%Sn. The cores of jacketed pistol bullets are usually composed of dead soft lead. Only the lead from any of these bullets will be detected by the sodium rhodizonate test but the SEM-EDS system used in this study easily detected both tin and antimony in a small excised section from the sodium rhodizonate lift of the impact site for the hard cast bullet used in this study. The sodium rhodizonate test by itself would not distinguish impacts by these very different lead compositions.

Bullet jackets may be composed of gilding metal (ca. 90% to 95%Cu and 5% to 10%Zn) with or without coatings of nickel or tin on some very old bullets manufactured in the early 1900s. Bullet jackets may also be constructed from brass (ca. 70% Cu and 30% Zn), mild steel with a thin copper or gilding metal coating or from pure aluminum (certain Winchester *SilverTip* loadings). Particles of all of these metals could be found in either or both of the chemical lifts carried out for the DTO and sodium rhodizonate tests. In another investigation related to the historic Huey Long homicide case of 1935, tin could be detected in bullet wipe produced by vintage tin-plated .32Automatic bullets that perforated clothing. The further characterization of the elemental composition of bullet wipe beyond simply containing lead stands to be useful where a gunshot victim sustains a perforation wound and the limited universe of responsible bullets contains two or more distinct types, e.g., a lead bullet, a copper jacketed bullet and an aluminum jacketed bullet. With energetic impacts between lead bullets or bullets with exposed lead tips, a phenomenon called "lead splash" occurs with the partially vaporized lead being deposited immediately downrange of the impact site [See the lower portion of Figure 5]. Information that can only be revealed through SEM-EDS analysis of a bullet impact site may have significant reconstructive value depending on the facts and issues in the case under investigation. Since the colors developed by the DTO and sodium rhodizonate tests are stable and will typically persist for many years if the lifts are adequately protected, SEM-EDS examinations can be carried out long after the lift was prepared and only when deemed desirable or necessary.

A bullet ricocheted from most any surface will carry away particles of that substrate. This too stands to be of considerable importance and reconstructive value when such a bullet goes on to produce an injury or death. In the final analysis, a partnership between the conventional colorimetric

testing of suspected bullet holes and bullet impact sites and SEM-EDS analysis in selected cases provides the best of both worlds.

The 'lifting' technique used with the DTO and/or sodium rhodizonate tests provides pattern and directionality information for bullet impacts as well as a test of the impacted surface for any background contamination by lead or copper.

SEM-EDS analysis of small, excised areas of positive DTO and sodium rhodizonate 'lifts' can provide a means of confirmation for the presence of copper and lead.

Such analyses can be carried out at any time (including months to years after the original lift was taken) after the potential need or value of such testing is decided.

SEM-EDS analysis of such excised areas from positive DTO and sodium rhodizonate 'lifts' can detect and

identify *additional* metals such as zinc, nickel, iron, tungsten, tin, antimony and/or aluminum associated with the projectile that produced the impact mark.

This further elucidation of the responsible bullet's character through an SEM-EDS analysis of a traditional DTO or sodium rhodizonate 'lift' may be the most important factor in a case under investigation.

No particular advantage was seen in conducting a direct SEM stub 'lift' of a suspected bullet impact site with the possible exception of bullet metal transfers on smooth, undamaged surfaces such as marble and polished granite.

Note: Any reader desiring a copy of a PowerPoint file containing over 80 slides depicting this work and the SEM-EDS results for each bullet impact site should send a blank CD with self-addressed and stamped envelope to Luke Haag, P.O. Box 5347, Carefree, AZ, 85377

References (Arranged alphabetically)

- [1] Bashinski, J.S., J.E. Davis and C. Young: "Detection of Lead in Gunshot Residues on Targets Using the Sodium Rhodizonate Test", *AFTE Jour.* 6:4 (1974) pp. 5-6
- [2] Fiegl, F.: *Spot Tests in Inorganic Analysis*, 5th ed., American Elsevier, New York 1958.
- [3] Haag, Lucien C.: "A Microchemical Test for Copper-Containing Bullet Wipings," *AFTE Jour.* 13:3 (1981) pp. 22-28
- [4] Haag, Lucien C., *Shooting Incident Reconstruction*, Elsevier/Academic Press (2006), Chapter 4, pp. 41-62.
- [5] Haag, Michael G.: "2-Nitroso-1-Naphthol vs. Dithiooxamide in Trace Copper Detection at Bullet Impact Sites" *AFTE Jour.* 29:2 (Spring 1997), pp. 204-209.
- [6] Jungries, E.: *Spot Test Analysis- Clinical, Environmental, Forensic and Geochemical Applications*, John Wiley & Sons, NY (1985).
- [7] Lekstrom, J.A and R.D. Koons.: "Copper and Nickel Detection on Gunshot Targets by Dithiooxamide Test," *JFS* 31:4 (October 1986) pp. 1283-1291.
- [8] Shem, R.J.: "The Vaporization of Bullet Lead by Impact," *AFTE Jour.* 25:2 (April 1993) pp.75-78.

FIGURE 1

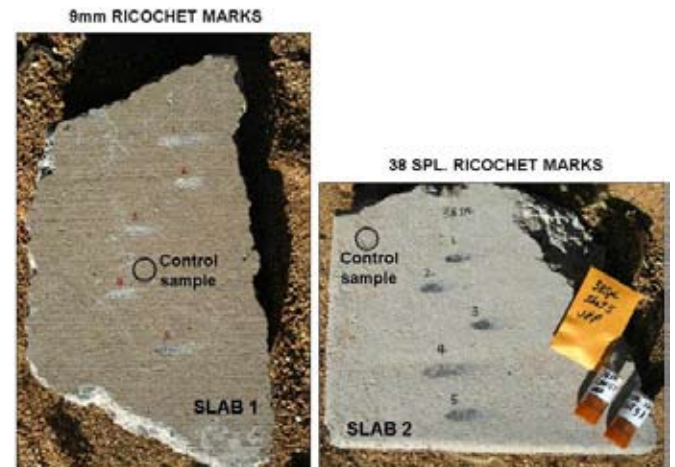


FIGURE 2



FIGURE 3

Concrete Slabs With Ricochet Marks



The direction of travel for all shots was from left to right.

FIGURE 4

RICOCHETED BULLETS

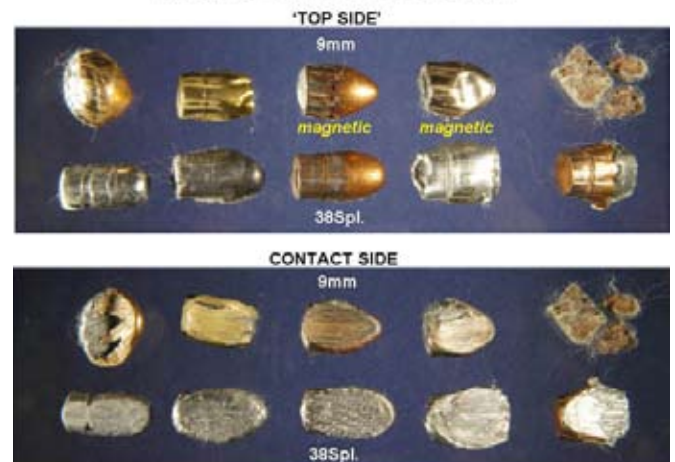


FIGURE 5

Representative 'Lifts' on Benchkote®

The direction of travel for both shots was from left to right.

Rectangular areas cut out of each containing Cu and Pb-positive and negative responses. Note the large area of "lead splash" on the right half of the NaRh test.



FIGURE 6
Representative Samples Of 'Lifts' On An Sem Carbon Tape Stub

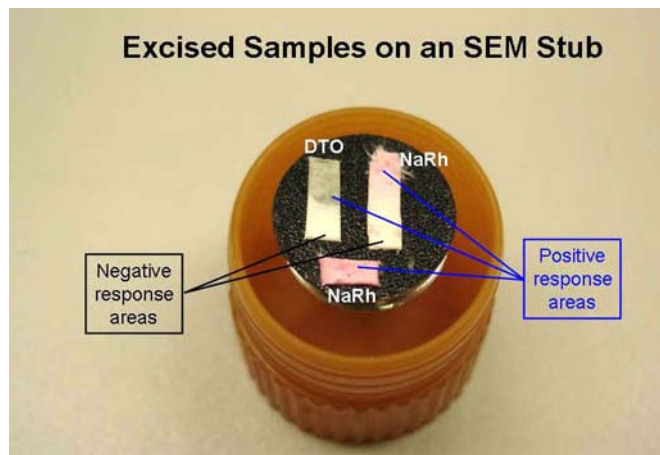
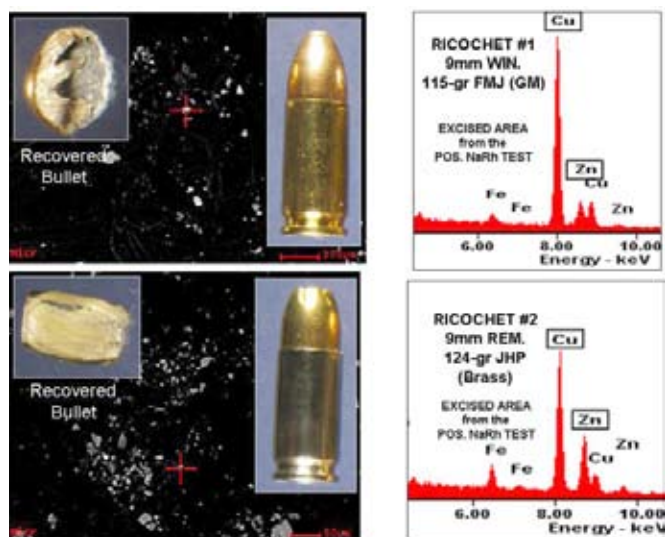


FIGURE 7
SEM-EDS Results from the DTO 'Lift' of the 9mm Winchester FMJ Ricochet Mark and the 9mm Remington Golden Saber Ricochet Mark

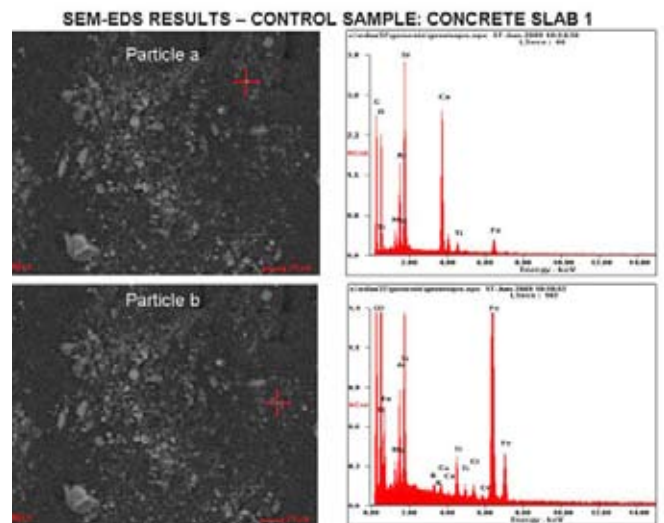


The recovered bullets are shown in the upper left of this two-part figure. Note the obvious differences in the Cu and Zn peak ratios for these two jacket compositions.

FIGURE 9: SEM-EDS Results and Detection of Tin in the Hard Cast Lead Bullet Ricochet Mark

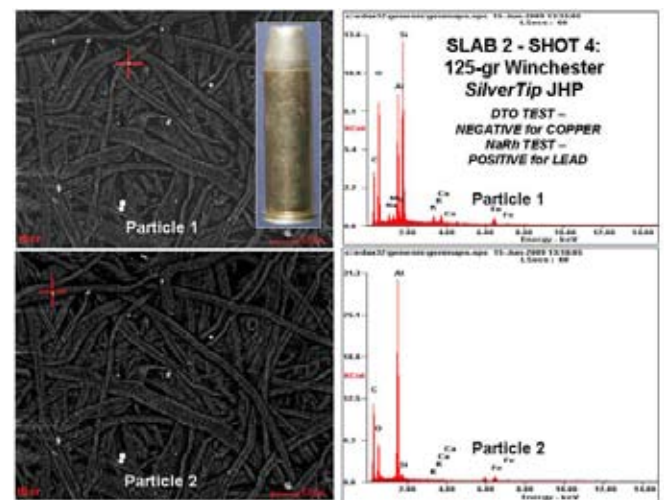
.38 SPL Ricochet 1: 158 gr Hard Cast Lead Bullet, alloyed w/Sn & Sb to give BHN hardness of 19. Note: No tin or antimony was detected in the lead deposits from any of the other bullets.

FIGURE 8a
SEM-EDS Results for a Control Sample of Concrete



Note the large silicon and aluminum peaks in this mineral material.

FIGURE 8b
SEM-EDS Results for the Aluminum-jacketed .38 Special Bullet Ricochet Mark



EDS analysis of particle 1 shows it to be of mineral origin (due to the large accompanying silicon peak). Particle 2 is likely a piece of bullet jacket (to be confirmed by higher magnification and morphology). Note the absence of any detectable silicon in the results for particle 2.

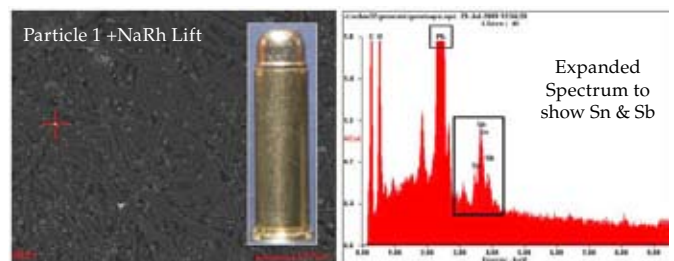


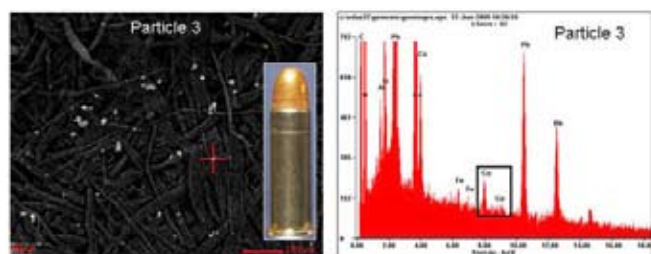
TABLE 1
Bullet Selections and Descriptions

9mm Luger Bullets from a 92FS Beretta			
<u>SHOT #</u>	<u>BRAND</u>	<u>BULLET WT. AND CONSTRUCTION</u>	<u>NOMINAL IMPACT VEL.</u>
1	Winchester	115-gr GM-FMJ	1170f/s (357m/s)
2	Remington	124-gr Golden Sabre brass JHP	1180f/s (360m/s)
3	Wolf (Russian)	115-gr GM over Fe FMJ	1240f/s (378m/s)
4	S&B (Czech)	115-gr Ni/GM over Fe FMJ	1185f/s (361m/s)
5	Winchester	85-gr Cu+W frangible	1430f/s (436m/s)

.38 Special Bullets from an S&W Model 15 Revolver			
<u>SHOT #</u>	<u>BRAND</u>	<u>BULLET WT. AND CONSTRUCTION</u>	<u>NOMINAL IMPACT VEL.</u>
1	Hard Cast	158-gr LRN	980f/s (299m/s)
2	Remington	158-gr LRN	770f/s (235m/s)
3	Winchester	158-gr LRN-Lubaloy	720f/s (219m/s)
4	Winchester	125-gr Al jacket HP	950f/s (290m/s)
5	Remington	125-gr Cu jacket HP	960f/s (293m/s)

Notes: GM = gilding metal FMJ = full metal jacket JHP = jacketed hollow point LRN = lead round nose

FIGURE 10: SEM-EDS Results And Detection of Copper in the Winchester Lubaloy-plated Lead Bullet Ricochet Mark



.38 SPL Ricochet 3: 158 gr Winchester Lubaloy LRN. DTO test negative for Cu.

FIGURE 11: SEM-EDS Results and Detection of Copper in the Russian GM-plated Steel-Jacketed Ricochet Mark

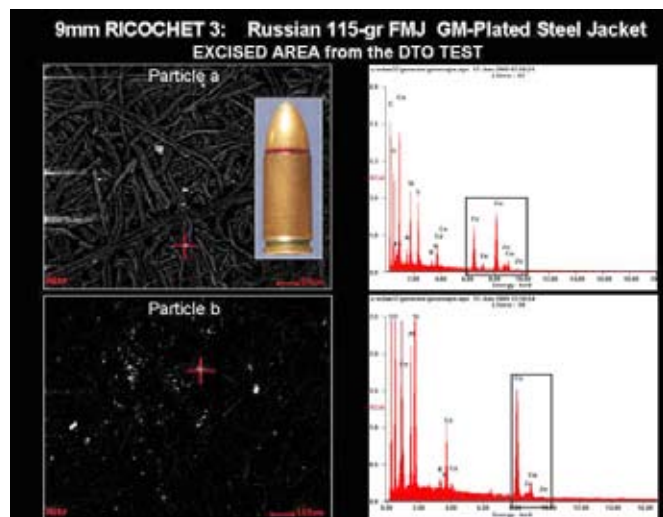


FIGURE 12
SEM-EDS Results and Detection of Nickel and Copper in the Ricochet Mark of the 9mm S&B Nickel & GM-plated Steel-Jacketed Bullet

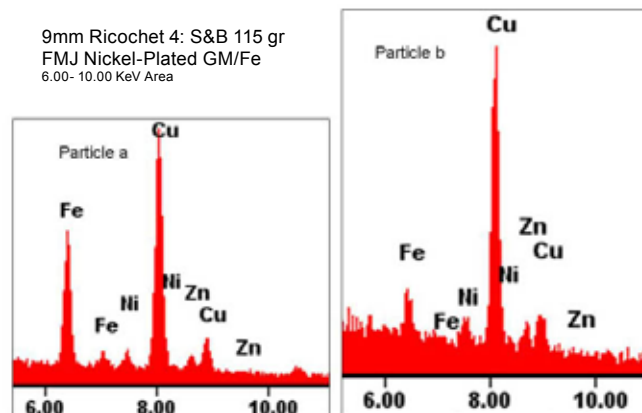
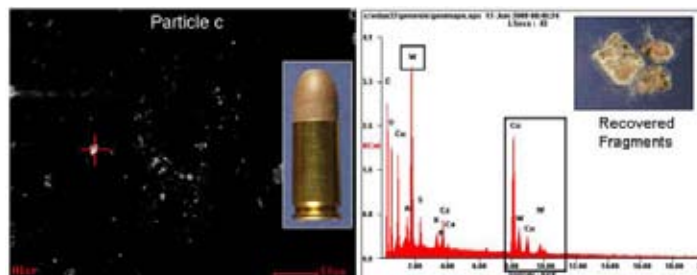


FIGURE 13
SEM-EDS Results and Detection of Copper and Tungsten in the 9mm Winchester Frangible Bullet Ricochet Mark



9mm Ricochet 5: WIN. 85 gr Frangible (Cu/W in plastic). Excised area from the DTO test.

CAC Northern California Firearms Study Group

On March 25, 2010, the CAC Northern California Firearms Study Group (NCFSG) held a meeting at UC Davis attended by 40 local firearm and toolmark examiners. The group was privileged to have seven quality presentations ranging from field updates to case reports to research studies. As one attendee commented, "It was like a one day AFTE meeting."

Todd Weller of the Oakland Police Department opened the session with "The Confocal Microscopy Analysis of Breech Face Marks from Ten Consecutively Manufactured Ruger P95 Pistol Slides." In this report, Todd discussed manufacturing methods of the slides especially those that impact the surface of the breech. He discussed the potential for subclass characteristics and performed a series of 8010 comparisons of known matching and non-matching cartridge cases generated using the provided slides. His study showed a clear, well defined statistical difference to exist in correlation scores among known non-matching correlations when compared with known matching correlations using confocal microscopy.

Terence Wong of the Contra Costa County Sheriff-Coroner discussed case related issues including a crime scene to bench discussion of toolmarks with John Murdock, also of Contra Costa County. In these presentations, they discussed evaluation of toolmarks on various items of evidence and the importance of understanding how they are made and the significance of the interpretations that can be drawn. Terence also discussed a tool for holding items under a microscope, especially larger items that do not normally fit on typical comparison microscope stages.

Andy Smith of the San Francisco Police Department gave a presentation updating the group on the Admissibility Resource Kit on the SWGGUN website, www.swggun.org. The Kit, otherwise known as the ARK, is an excellent starting point for examiners and attorneys preparing for admissibility hearings and it is recommended that examiners not only be aware of its availability but also assist in keeping it updated with current rulings of which SWGGUN members may not be aware.

Mark Bennett of the Oakland Police Department offered a very somber presentation on the shooting deaths of four Oakland Police Department officers on March 21, 2009. Using audio and trajectory analysis, Mark was able to reconstruct the bulk of the shooting, especially that taking place in the apartment where the shooting suspect was hiding after the initial shooting.

Carlos Jiron of the San Mateo County Sheriff's Department reported on his research project, "A Survey of Firing Pin Impressions on SKS and AK-47 Type Rifles: A Feasibility Study as a Requirement for Determining Uniqueness." Carlos performed research to determine the feasibility of applying quantitative criteria for identification to impressed toolmarks using the mathematical model developed by Rocky Stone and the empirical study Eric Collins did on hammer faces.

— Ron Nichols, Chair

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ABSTRACTS

— from the — CAC Spring 2010 Seminar

Effectiveness of Carrier RNA Co-Extraction Methodologies Using the Qiagen BioRobot EZ1® and EZ1® DNA Investigator Kit

Authors: Johnny Upshaw, BS, Colleen Proffitt, MS (KCRCL), and Kevin W. P. Miller, PhD

Presenter: Johnny Upshaw, California State University, Fresno

The Qiagen BioRobot EZ1®, in conjunction with the EZ1® Investigator Kit, allows for robotic extraction of DNA from various forensic substrates in a rapid and reliable manner. Automation of the extraction process has greatly increased case-sample throughput by allowing an analyst to conduct multiple sample extractions simultaneously. DNA extraction is a pivotal part of forensic analysis. Maximizing the efficiency and recovery of DNA obtained in this step greatly affects the success of downstream results and conclusions. Although sample throughput is greatly increased with the use of the BioRobot EZ1®, it has been shown to produce lower DNA recovery quantities from highly degraded and/or low-yield samples, as compared to manual organic extractions (Kilshore 2006). This decrease in DNA recovery is hypothesized to be a result of the magnetic silica beads which the BioRobot EZ1® uses to bind and extract DNA, a practical, yet not overly efficient process. In low DNA-containing samples the efficiency and inherent loss caused by this method greatly affects the amount of DNA recovered. It has been demonstrated, however, that the addition of carrier RNAs to cell lysates, prior to robotic extraction, can greatly increase DNA recovery. Thus, amending the standard procedure to allow for the addition of carrier RNAs can greatly increase the quality and quantity of DNA recovered via automated extraction.

An internal validation of the use of carrier RNAs to increase DNA recovery from highly degraded forensic samples was conducted for the Kern County Regional Criminalistics Laboratory (KCRCL) using Qiagen's BioRobot EZ1® automated DNA extraction platform. The validation study sought to identify the critical aspects of the procedure which must be controlled and monitored while additionally defining the limitations of the new procedure. The method validation also evaluated the robustness, reliability, precision/reproducibility, sensitivity and linearity of the procedure on a host of known and nonprobative case samples. Additionally, concordance and the absence of contamination were also evaluated.

The results of the method validation concluded the addition of carrier RNAs to cell lysates greatly increases the amount of DNA recovered as compared to non-carrier RNA-containing samples. The method is now being considered for implementation in daily forensic DNA analysis, either at the discretion of the analyst or as a step in all extraction procedures.

Use of Canine Mitochondrial DNA Nucleotide Sequence Data in Forensic Casework

Authors: Korie Faber & Kevin W.P. Miller, Ph.D.

Presenter: Korie Faber, California State University, Fresno

Canine mitochondrial DNA (mtDNA) profiles, developed from trace evidence recovered from the scenes of violent crimes, can be very useful to criminal investigations. Canine mtDNA can be helpful because it can generate information for the investigation when other biological evidence is not beneficial in the pursuit of a suspect. Once a profile is developed, nucleotide sequence data is compared to a reference sequence and differences between those sequences are noted. However, if the calls being made regarding the observed differences are not the same from laboratory to laboratory, then inter-laboratory matches are nearly impossible to make; and, we are going to miss important information that could have generated the intended investigative leads.

Standardization of the nomenclature in the canine mtDNA control region can increase the potential usefulness of canine mtDNA evidence. For example, the nomenclature for identifying substitutions, insertions and deletions within the control region is needed. A single reference sequence must also be identified that can be used in forensic cases in which canine mtDNA is discovered. To accomplish consistency between the canine nomenclature callings, a single reference sequence was used and alignments were performed using the same rules as used in human mtDNA alignments. We then noted the haplotypes while performing sequence alignments of all canine mtDNA sequences published to date using the sequence alignment software Sequencher™ version 4.9.

Standardization of these criteria should be implemented across the forensic DNA community to allow forensic investigators to include more canine mtDNA testing in their investigations. Once all labs are consistent when analyzing canine trace evidence in casework, this will ultimately improve the vast possibilities that canine mtDNA can provide in criminal investigations.

Welcome To The Tri-State Psych Ward (Case Presentation)

Presenters: Senior Criminalist Michelle Terra & Senior Criminalist Jennai Lawson, California DOJ, Central Valley Laboratory

In August of 2000, Ronald Ward, a garbage truck driver in his 30's with a troubled past, goes to Montana in search for the mother who had abandoned him at an early age. In the months that follow, three women and one man will ultimately meet their death by Ronald Ward as he drifts from state to state, traveling from West Virginia through Arkansas to Montana and on to California. This talk will cover these four cases, and how the power of the Combined DNA Index System (CODIS) was able to link three of these cases and ultimately solve two of them by providing the law enforcement agencies involved with crucial information. These cases demonstrate how teamwork between agencies and crime laboratories can be bridged by CODIS. In addition, when the four cases are viewed from an overall perspective, they illustrate how wide reaching an effect budget crises and laboratory backlogs can have on real life scenarios.

Case Study: The Madera County Serial Killer

Presenters: Senior Criminalist Mindy Crow, California Department of Justice, Fresno Laboratory & Edmund Gil, Senior Deputy District Attorney, Madera County District Attorney's Office

Between 1995 and 1998, three women were found murdered and abandoned in rural parts of Madera County. Various methods were employed to kill each victim ranging from shooting to stabbing to strangulation. Over the years, the cases grew cold. In 2002, a prisoner named Jose Guerrero made a statement to officers about having killed a woman in 1998. This statement was made just a few days prior to his impending release from Wasco State Prison. Jose Guerrero was in prison for convictions relating to felony DUI charges. This presentation will discuss the individual crimes, the DNA analysis and the subsequent trial and conviction of serial killer Jose Guerrero in 2009.

Developing a New qPCR Assay "Mito Quad"

Presenter: Assistant Laboratory Director Meg Aceves, California Department of Justice, Jan Bashinski DNA Laboratory

Currently the Missing Persons DNA Program (MPDP) at the BFS Jan Bashinski DNA Laboratory relies on a duplex real-time quantitative polymerase chain reaction (qPCR) assay (1) that quantifies nuclear DNA and mitochondrial DNA. This duplex assay has greatly benefited the program by allowing a direct quantitation of mitochondrial DNA (mtDNA) versus the previous estimation that was based on the nuclear DNA amount. Practical experience with casework type samples has found two common limitations in the DOJ "Duplex" assay. First, in very degraded samples, there is a discrepancy between the mtDNA ND1 gene target sequence of 69bp, that is used in the duplex qPCR assay, and the amount of amplifiable DNA available for the 400bp target used for the mtDNA sequencing. The mtDNA quantification may be attained however downstream mitochondrial sequencing often fails due to the level of degradation in the sample. A longer mtDNA target would be predicted to better correlate the sequencing results with the initial quantitation step. Furthermore, if two different length mtDNA targets could be multiplexed, this could provide for an assessment of the level of mtDNA degradation. Secondly, the duplex assay does not utilize an internal PCR control (IPC). The MPDP program often works with very challenged samples such as very old bones. If nuclear or mitochondrial DNA is not detected using the duplex assay, it is not possible to determine if the lack of signal is due to PCR inhibition or the lack of DNA. An IPC would help in the isolation of such problems. The goal of this project will be to incorporate a target of sufficient length into the duplex assay to allow for the assessment of DNA degradation in the sample, and incorporate an IPC into the assay to assess PCR inhibition.

Evaluation of Applied Biosystems AmpF STR® Identifier® Plus and AmpF STR® Identifier® Direct PCR Amplification Kits.

Authors: Mavis Date Chong, Sandra Sheehan, and Martin Buonocristiani, California Department of Justice, Jan Bashinski DNA Laboratory

Presenter: Assistant Laboratory Director Meg Aceves, California Department of Justice, Jan Bashinski DNA Laboratory

Applied Biosystems AmpF STR® Identifier® Plus and AmpF STR® Identifier® Direct PCR Amplification Kits were evaluated. The AmpF STR® Identifier® Plus kit was designed to be more robust and efficient than the current Identifier® Kit, and to provide higher quality data from a wider range of sample types. The AmpF STR® Identifier® Direct PCR Kit was designed to minimize processing of single source database samples prior to amplification.

The AmpF STR® Identifier® Plus PCR Amplification Kit is reported to provide enhanced performance for casework samples. With higher amplification efficiency, sensitivity is increased, performance on samples containing PCR inhibitors is improved, and the minor component in mixtures is more readily detected. To validate these claims, sensitivity, mixture and inhibition studies were performed, comparing AmpF STR® Identifier® and Identifier® Plus kits. Sensitivity studies included the amplification of DNA quantities ranging 31.25 – 125 pg with 28 and 29 cycles. To study inhibition, casework samples previously found to be inhibited, were analyzed. In addition, the effect of hematin (10-300 uM) and humic acid (5-125 ng/ul) were assessed. Mixtures (1:0, 1:1, 1:3, 1:5, 1:7, and 1:10) studies were performed with and without inhibitor.

The Identifier® Direct PCR Amplification Kit was designed for high throughput analysis of database samples on FTA® Cards. This chemistry offers a streamlined "punch and go" approach since DNA is amplified directly from FTA® punches, without prior DNA purification. Offender buccal samples analyzed at the Jan Bashinski DNA Laboratory are collected on Bode Buccal DNA Collectors™. Cells on Bode Buccal DNA Collectors™ (100% cotton paper) remain intact, unlike FTA® Cards on which cell lysis and DNA immobilization occur upon contact. Various means of achieving cell lysis, including heat and lysis buffers, were therefore evaluated with the Identifier® Direct PCR Amplification Kit.

Results of our evaluation of the AmpF STR® Identifier® Plus and AmpF STR® Identifier® Direct PCR Amplification Kits will be presented.

Validation of PowerPlex16 HS

Presenter: Cyndi Cunningham, Idaho State Police

Presentation will detail the Idaho State Police lab's validation and implementation of PowerPlex16 HS. In addition, several casework interesting cases will be highlighted to illustrate the utility and capabilities of PowerPlex16.

Working with Challenging Samples

Authors: Senior Criminalists Carolyn Weigand and Michelle Halsing, California Department of Justice, Jan Bashinski DNA Laboratory

Presenter: Senior Criminalist Carolyn Weigand

The presentation will show many examples of challenging samples and what the outcome of each was. It will also cover ways to combat inhibition, low DNA and degradation. Finally there will be an example of how a new extraction method was used to help combat a sample with both inhibition and low DNA.

The Effects of PreZerve™ on DNA Analysis

Presenter: Jessica Kaut, Alameda County Sheriff's Office

Our laboratory was asked to perform DNA Typing Analysis on swabs submitted to our laboratory by an outside agency. The agency used a reagent called PreZerve™ which claims to improve the collection and preservation of DNA. Our goal was to determine if the PreZerve™ reagent interfered with DNA Typing Analysis.

Let's Talk S'HOP...

Presenter: Senior Criminalist Jennai Lawson, California Department of Justice, Central Valley Laboratory

The Cold Hit Outcome Project (CHOP) is a web based application that has been developed through a partnership between the California Bureau of Forensic Services (BFS) and the Western States Information Network (WSIN). It provides a mechanism for law enforcement agencies to share information and track the status of "cold hit" cases – cases where an unsolved/suspectless case has been linked to a possible perpetrator via a DNA match from an evidence sample to a convicted offender/arrestee/suspect profile in the SDIS database. Every law enforcement agency involved with the case participates in CHOP and plays a specified role: The state CODIS laboratory (SDIS, the Jan Bashinski DNA Laboratory), the local CODIS laboratory (LDIS) doing the work on the case, the law enforcement agency (LEA) investigating the case, and the district attorney's office (DA) prosecuting the case. CHOP facilitates communication between these four agencies and provides an automated system for tracking the status of the case, from the hit through prosecution/adjudication. This talk will cover the working aspects of CHOP, the usefulness of the system, and the projected scope of the project. The first "hit" in CHOP will also be presented.

Forensic Tools for Wildlife Enforcement in California

Presenter: Jeff Rodzen, California Department of Fish and Game

The Department of Fish and Game's Forensics Laboratory has assisted in species identification, analysis and DNA matching of evidentiary samples from a wide variety of wildlife and fish species in California. As with human criminalistics, the use of STRs plays a very important role in wildlife forensic science in the investigation of wildlife crimes. Unlike human criminalistics, however, the WFL analyzes many different species, each of which must have its own unique and species-specific set of STRs and corresponding database of multilocus profiles. Currently the WFL has STR panels for deer, elk, bear, and mountain lions, which are used in forensic analysis of poaching cases and lion attacks on humans. We provide an overview of our research to date on population and forensic genetics of deer, elk, and mountain lions with some case examples. New research projects will also be reviewed that include the development of STRs and population genetic analyses of abalone and sturgeon.

Increasing the Efficiency of STR Analysis and Review Using Macros

Presenter: Senior Criminalist Eric Halsing, California Department of Justice, Jan Bashinski DNA Laboratory

Some analysts find it inconvenient to set-up their plate

records for the Applied Biosystems (AB) 3130 in the laboratory using the AB collection software. To address this, an Excel-based macro has been created for the staff of the Jan Bashinski DNA lab to create plate records at any workstation containing Microsoft Excel. At that point, the resulting text file can be imported into the collection software.

Some laboratories include a table of STR results in their case reports and, most often, these are transcribed from printed plots into a word processing program. This practice can be time-consuming and lends itself to typographical errors. An Excel-based Report Table Creator macro was designed to create a table from the tabular data exported from AB's GeneMapper ID software (version 3.2). The resulting table can then be pasted directly into any Windows-based word processing program.

Lastly, the newly updated BFS protocols require Technical Reviewers to state that they reviewed all allelic ladders used in typing and that they confirmed that all allele designations were correct. A macro was designed and validated to make this task simpler. The macro is run during the GMID analysis step and the resulting print-out is added to the case file notes. Then, during technical review, the reviewer need only review, sign, and date the print-out, thus eliminating the time-consuming need for the reviewer to import the project into GMID and manually review all the ladder injections.

These three macros will be demonstrated and copies of the macros will be provided to any who want them.

Developmental Validation of the SPERM HY-LITER™ Kit for the Identification of Human Spermatozoa in Forensic Samples

Authors: Dhaval Waghela, M.S., Brian Fischer, B.S., and Kevin W. P. Miller, Ph.D.

Presenter: Dhaval Waghela, California State University, Fresno

Sexual Assault cases have been the most prevalent violent crime in the United States for the past decade. Almost two-thirds of the cases processed for forensic DNA analysis pertain to sexual assault crimes. Amongst the various presumptive and confirmatory tests for semen detection, microscopic observation of spermatozoa serves as the most often used and acceptable confirmatory method. As a result forensic laboratories devote a great deal of time and labor in viewing prepared microscope slides for the presence of sperm cells. The time required for this process has resulted in a significant backlog of forensic DNA cases, with approximately 300,000 to 500,000 sexual assault kits awaiting further analysis. The purpose of this study was to validate a novel method of sperm cell detection for application towards forensic sexual assault evidence samples.

Sperm Hy-Liter™ is a novel microscopic sperm cell staining kit developed by Independent Forensics in Illinois. The Sperm Hy-liter™ kit uses a fluorescent Alexa 488 dye coupled to a monoclonal antibody that binds specifically to human sperm heads, staining them a bright fluorescent green. The use of human spermatozoa specific antibody technology along with an easily visible dye enables efficient detection of sperm cells even in the presence of sample mixtures containing other cell types (i.e. blood cells, or vaginal epithelial cells). Additionally, the Sperm Hy-liter™ kit incorporates a second 4,6-diamidino-2-phenylindole (DAPI) fluorescent dye for simultaneous viewing of all cell nuclei, regardless of cell

type, in the sample using a DAPI compatible fluorescent filter. Thus under an Alexa 488 compatible fluorescent filter antibody stained sperm cells will fluoresce, while under a DAPI compatible filter all DAPI stained cell nuclei will fluoresce.

Validation of novel procedures is required within forensic laboratories before their incorporation into routine case work. The developmental validation of the Sperm Hy-Liter™ kit was performed using samples of human semen, saliva, blood, and urine, various animal semen extracts, sexual lubricants, and a commercially available spermicidal film. Post-coital vaginal swabs, degraded semen samples, and samples prepared with sample fixation techniques that deviated from the developed protocol, were also tested. In each case, the SPERM HY-LITER™ kit was demonstrated to bind only to human sperm cell heads. Limitations to this fluorescent staining procedure include non-specific staining and increased background fluorescence with extreme heat fixation in some samples.

INTERPOL Match to Three Unsolved Sexual Assault Cases in California

Presenter: Senior Forensic Scientist Mary Hong, Orange County Crime Laboratory

The three unsolved sexual assault cases occurred in Orange and San Diego counties. The man suspected of numerous felony counts of sexual assault in these cases was arrested in Austria following a DNA match through INTERPOL. The suspect, Ali Achekzai is accused of fleeing illegally into Canada and changing his name up to seven times and obtaining identification under those identities before being charged for the sexual assaults. He was suspected to have lived in Afghanistan, Germany, San Francisco, Canada, England, and Austria. Based on the fact that Achekzai had multiple California victims and knowing that he had traveled internationally prior to the crimes, the Tustin Police Department worked with the Orange County Sheriff's Department Crime Lab in December, 2009 to coordinate the submission of the evidence DNA profile to the international police agency, INTERPOL. Achekzai was arrested on January 26, 2010 in the Austrian town of Neukirchen am Grossvenediger and is waiting to be extradited to Orange County, California to stand trial. This presentation will discuss the three sexual assault cases and the process by which a crime laboratory can submit a DNA profile to INTERPOL to be searched against its database.

People v. John Doe DNA: Preserving the Statute, Prosecuting the Guilty

Ann Marie Schubert, Sacramento Co. District Attorney's Office

This session will cover the use of John Doe DNA warrants in the prosecution of criminal cases; specifically, it will cover the law that applies to these cases, the specific types of cases where it can be used in; and it will cover the challenges presented with DNA mixtures.

The Yosemite Serial Murder Case—Sund/Peloso/Armstrong

Jeff Rinek, Retired Federal Bureau of Investigation and Chris Hopkins, Federal Bureau of Investigation

This presentation comprises a case description through the use of crime scene slides, followed by a 25 minute fragment of the killer's confession describing the evidence used in the crimes as previously presented via the crime scene pictures. The case presenters were participants in the actual case and can/will answer all questions. A firsthand account of the confession is also offered.

The Steven Tauzer Murder Case: When Tragedy Hits Home

Gregory Laskowski, Kern County DA Forensic Science Division

Assistant District Attorney Steven Tauzer was found murdered in the garage of his residence in September of 2002. Chris Hillis, a former lieutenant of the Kern County District Attorney's Office Bureau of Investigation was soon developed as a suspect. DNA located on key evidence was crucial in developing Hillis as a suspect. Although the case was investigated by the Kern County Sheriff's Department, the crime scene was investigated by members of the Kern County District Attorney's Office Regional crime Lab. Initial evidence processing was also conducted by personnel from the KCDA Regional Crime Laboratory. Because of the onus of 'conflict of interest', the processing of evidence was halted by KCDARCL personnel, and the evidence was then packaged and shipped to the California State Department of Justice Bureau of Forensic Sciences Laboratory. As a result of the Cal DOJ Laboratories Analysis of the DNA evidence Chris Hillis was arrested and charged with the murder of Steven Tauzer.

This presentation will focus on the evidence collected at the scene, its processing, and the resulting interactions of the presenter with the District Attorney, sheriff's homicide investigators, California Department of Justice personnel. The personal conflicts faced by the presenter having to investigate a high profile murder case of his boss and a colleague, who were both more than just acquaintances will be discussed.

The Behavior of Expelled Glass Fragments During Projectile Penetration and Perforation of Glass

Lucien Haag, Forensic Science Services

Bullets striking common forms of flat glass with an orthogonal intercept angle result in a cloud of ejected glass fragments that are in concert with the exiting bullet's flight path. This is not the case with strikes at angles other than orthogonal. In these situations, the expelled glass fragments follow a different course from that of the exiting projectile. This is both counter-intuitive and a potential source of serious error in the evaluation and reconstruction of shooting incidents involving shots through glass such as windshields, vehicle side windows and windows in buildings. The flight path of the ejected glass fragments is, however, predictable and is dictated by the orientation of the plane of the glass at the exit site.

In all cases, these high velocity glass particles can produce downrange deposits on a variety of surfaces and can produce pseudo-stippling of the skin in individuals located near the projectile's exit site.

These phenomena will be illustrated in this presentation.

Chemical and Instrumental Tests for Suspected Bullet Impact Sites

Lucien Haag, Forensic Science Services and Mahesh Patel, Phoenix Police Dept. Crime Laboratory

Complete paper appears in this issue of the CACNews.

Methamphetamine Enantiomer Enrichment

Todd Davis and Nathan Salazar, Drug Enforcement Admin.

Clandestine methamphetamine laboratories have undergone significant changes for the past couple years. After the US passed the Combat Methamphetamine Act in 2006, additional laws were passed in the United States and Mexico to control pseudoephedrine and ephedrine availability in 2007. Ever since this change, clandestine methamphetamine production strategies have been modified. The lack of pseudoephedrine and ephedrine supplies has led clandestine operators to change synthetic routes and return to the older phenyl-2-propanone (P2P) method. The P2P influence is evident by profiling methamphetamine samples seized throughout the United States and Mexico.

The large increase of P2P produced methamphetamine has more of an impact on potency than the purity. A P2P synthesis produces a racemic mixture of the d-isomer and the l-isomer. The presence of the l-methamphetamine results in a less potent form for distribution. The purity of the methamphetamine samples collected for profiling has been consistently above 90% since 2007. Samples analyzed from 2007 and earlier were almost exclusively d-methamphetamine produced by a phosphorous-iodine method using pseudoephedrine or ephedrine. The P2P produced methamphetamine has surged into the US market, thus increasing the availability of samples that contain l-methamphetamine.

In an attempt to produce a more potent product, the P2P clandestine operators are apparently using tartaric acid to separate the d-isomer from the l-isomer. Evidence from an Enrichment Superlab found in Guadalajara, Mexico will be discussed. This process normally produces unequal d- with l- and further processing can yield d-isomer only and l-isomer only products. This is one of the main reasons why approximately a 30% increase in unequal isomer samples has been identified and profiled since 2007. Amongst the P2P methamphetamine samples profiled at the DEA Special Testing Laboratory, only 5% had the racemic d,l-isomer with 45% unequal and 50% d or l only. This is more evidence that the P2P clandestine operators are using a resolving agent, like tartaric acid, to separate isomers during this process.

The P2P enriched methamphetamine samples have prompted the DEA to produce additional methods of isomer detection with greater sensitivity. A new derivatizing agent, (S)-(+)-alpha-methoxy-alpha-(trifluoromethyl)-phenylacetyl chloride (MTPA), has been developed on GC and GC/MS. Additional analysis by Capillary Electrophoresis has increased the laboratories accuracy to identify the unequal distribution of methamphetamine isomer products. The analytical results and manufacturing trends will be discussed and reviewed.

Issues Facing Forensic Science Graduate Programs

Fred Tulleners, UC Davis Forensic Science Graduate Program

This presentation will discuss some of the educational and administrative issues facing forensic science graduate

programs and how they may impact the graduate student and the crime labs. Some crime lab managers have unrealistic expectations from a graduate program and expect the MS graduate to be fully qualified in a specified area. This concept is unrealistic and it overlooks a key function of a university graduate program. The recent meeting at the American Academy of Forensic Sciences all too well illustrated that the crime labs have abrogated their research effort, since the majority of the presenters were from academia either as professors or as research students.

During this presentation we discuss the following issues that affect a graduate program in the following areas:

- Primary Focus of a research based university
- Forensic Science Graduate Group concept
- MS Forensic Science focus
- M.S program funding – state vs. self supporting
- Graduate student funding
- Student Income issues, Teaching Assistant, Research Assistant, Loans.

Research funding opportunities/issues for for. sci. program

MS Degree program – research or coursework based:

Typical MS degree program

Time issues

Research creep

University theoretical classes vs. trade craft class

Duties of the crime lab in regard to training their staff

Interns duties in lab

Benefit of a MS Degree

Promotion, position, teaching future requirements

An Interesting Zip Gun Case

Mike Appel, Department of Justice Fresno Laboratory

This case involves a suspect in possession of a suspicious device when stopped by police officers. Subsequently, the agency submitted a "concrete nail gun" to the Laboratory. This item of evidence was later determined not to be a nail gun, but rather a functioning firearm. Function testing of the homemade device was performed to determine if it would fire, as requested by the agency. Examination of the firearm demonstrated that it would fire .22 caliber rimfire cartridges.

Characterization of Multilayered Glitter Particles

Robert Blackledge, El Cajon, CA

Glitter can be important trace evidence. Glitter is not all alike! It shows great variety. The more ways a Questioned glitter particle may be characterized the smaller the subclass of evidence it will fall into and therefore the greater its potential value as associative evidence. Most glitter particles have multiple layers. Glitter is cut into small individual particles from rolls of multilayer film. Although there may be one or more metalized (aluminum) layers, most of the layers will consist of polymers. Not only are the number of layers an important characteristic, also are the composition and thickness of the individual layers. The factory machines that cut the film into individual glitter particles do not make nice clean cuts. Therefore it is not usually possible to simply stand an individual glitter particle on end and under a microscope count and measure the individual layers. Some of the layers may be quite thin. Obtaining an infrared spectrum of layers that are very

thin may not be possible with an ordinary FT-IR microscope system. This presentation will show how making thin cross sections and using as the infrared source a beamline coming off the synchrotron at the Advanced Light Source, Lawrence Berkeley National Laboratory allowed us to both measure the thickness and obtain the infrared spectrum in transmission of individual layers in multilayered glitter particles.

The Effect of Hematocrit Concentration on Forensic Blood Alcohol Analysis

Jessica Savopolos, Department of Justice Fresno Laboratory

Defense attorneys have been questioning the validity of forensic blood alcohol analysis based on an individual's hematocrit concentration. The purpose of this work was to determine how much, if any, hematocrit concentration values affect forensic blood alcohol measurements using the heated headspace gas chromatography technique with an n-propanol internal standard. Samples were generated from bovine blood to give samples with hematocrit values ranging from 0 to 84 percent. Statistical analysis of the average blood alcohol concentration and the sample hematocrit showed no statistically significant correlation between the blood alcohol level and the sample's hematocrit value. Plasma, whole blood, and red blood cell fractions from human donors were evaluated to confirm the results from the bovine blood experiment were applicable to the evaluation of human samples. These results showed no statistically significant difference between the measured blood alcohol levels for plasma, whole blood, or concentrated red blood cell fractions. The partitioning of ethanol and n-propanol in bovine blood was evaluated by adding the alcohol to the blood sample prior to separation of the plasma and red blood cell fractions. Both ethanol and n-propanol favor the plasma fraction to a similar extent. This supports that hypothesis that the similarity in their partitioning behavior removes any effect of hematocrit on the measured blood alcohol concentration with heated headspace with an internal standard.

Statistical Evaluation of Torn Duct Tape End Matching

Ka Lok Chan, Fred Tulleners, John Thorton You-Lo Hsieh, UC Davis Forensic Science Graduate Program

Duct tapes are often submitted to crime laboratories as evidence associated with abductions, homicides, or construction of explosive devices. As a result, trace evidence chemists are often asked to analyze and compare commercial duct tapes that may establish a possible evidentiary link between different a suspect and a victim, or a suspect and a particular crime or between different crimes. Duct tape end matches, which is the re-assembly of two or more separated fragments, have significant evidentiary value and are considered to be the strongest association in forensic comparative examination. Even though it is a fairly routine examination, there is neither statistical data nor objective criteria to support what constitutes an end match. Hence, this study is designed to examine duct tape end matches in pursuance of developing some objective criteria and arriving at a relevant statistical basis for the comparative examination of duct tape tears.

The Construction of Mobile Reference Database of Domestic Mammalian Hair

Elsbeth Murata, California State University, Fresno

With over 162.3 million domestic animals currently living with us in the United States, the hairs of dogs, cats, horses, cattle, sheep, and hogs have found their way onto the crime scene (1). Therefore, the ability to distinguish the hair of humans from the hairs of domesticated mammals is paramount to any forensic hair examination. However, the morphological characteristics of these hairs are highly variable, both along the length of a single hair shaft and between different types of hairs found covering the body. We have created an online database of the hairs of domestic animals that captures a wide range of this variability in order to assist trace evidence examiners with the identification of both human and non-human hairs.

The database contains digital images of 3 areas on each of 6 types of domestic mammal (back, belly, and tip of tail) and 3 areas on each human specimen (head, pubic, and axillary hair), so a valid comparison can be made and differences can be illustrated. Three images of each hair were taken: proximal, subshield, and shield to accommodate the inherent variation present on each specimen. The analysis of these digital images includes a number of microscopic characteristics of the hair, including shaft diameter, medullary index, cuticle designations, medullary configuration, cortex configuration, and pigment aggregation among others. Also included are macroscopic characteristics such as shaft length, color, and banding patterns. Using these characteristics collectively, the difference between human hair and domestic mammal hair can be determined.

With 4,982 crimes being committed per 100,000 residents in the United States (2), the ability to identify and differentiate forensic hair evidence may be the difference between successfully prosecuting a case and letting a perpetrator go free. Currently the database includes 50 domesticated mammals with more being continually added. This database will be available via the Internet making it highly accessible and adaptable to the needs of the trace evidence community. With further growth this database will become a truly valuable resource to the forensic science community.

Mechanistic Details for DNA Binding to Silica

Samantha Tosch, Los Angeles Police Department

Previous work that validated the M48 Biorobot for the extraction of forensic unknowns demonstrated that cell digests containing DNA quantities of 4 ng or less were extracted less effectively than samples that possessed more DNA. Clues to the nature and efficiency of DNA-silica binding interactions described in the literature suggested that improvements in DNA recovery resulting from enhanced binding of DNA to the silica beads might be achieved by decreasing the pH, increasing the temperature, or adding additional chaotrope, during the binding phase. When the binding conditions were altered, DNA yields did not always increase as expected. When other reasons were sought to account for the observed decreases in DNA yield, quantifiable amounts of DNA were detected in the final water wash solution and remaining on the beads following elution. DNA losses at each of these steps were reduced by altering the final wash solution and the solution in which the DNA was eluted.

Forensic Investigation of the Shooting Deaths of Four Oakland Police Officers on March 21st 2009

Mark Bennett, Oakland Police Department

A routine traffic stop by two Oakland Police Officers resulted in the worst incident of officer fatalities in the history of the Oakland Police Department. Two motorcycle Officers and two Entry Team (SWAT) Officers were fatally wounded by parolee Lovelle Mixon in a single day. After initially shooting two motorcycle Officers, Mixon hid in an apartment across from the scene. Oakland Police made entry into the apartment resulting in a gun battle that resulted in the deaths of two members of the Entry Team and Mixon. Scene investigation of the apartment, examination of clothing and equipment and shooting incident reconstruction using laser trajectory analysis shed light on the sequence of events that took place inside the building.

Comparison of GRC from Lead Bullet Cores with GRC from Bullet Jacketing

Nancy D. McCombs, Department of Justice Fresno Laboratory

With the current increase in cost and demand for ammunition, often lower quality products are the only option available for purchase, and may begin to be more frequently encountered in casework. As the jacketing material on much of this ammunition is significantly thinner than what is more traditionally observed, it readily separates from the bullet core. Examination of various types of ammunition, as well as comparison of general rifling characteristics observed on bullet cores with those observed on jacketing material are evaluated.

Sex, Lies, and Blood Alcohol Levels

Stanley Dorrance, Forensic Science Services

This presentation will be a review of actual DUI cases that he has encountered wherein the blood alcohol results fall outside the normally expected levels. He will also be presenting examples of cases with documented preliminary alcohol screening tests, EPAS tests and blood alcohol test results are scientifically incompatible.

FEPAC - Its Implication for the Universities and the Forensic Science Community

Fred Tulleners, UC Davis Forensic Science Graduate Program

In 2003 National Institute of Justice Technical Working Group for Education and Training in Forensic Science (TW-GED) developed curriculum guidelines for undergraduate and graduate education in the United States. The document "Education and Training in Forensic Sciences: A Guide for Forensic Science Laboratories", proposed a series of educational standards for the forensic scientist. In 2002, this document led to the American Academy of Forensic Sciences (AAFS) established an adhoc Forensic Science Educations Program Committee. In 2004, the committee was changed to the "Forensic Science Education Programs Accreditation Commission or FEPAC as it currently known. The FEPAC process has developed a series of standards that address all aspects of a forensic science education. At the undergraduate level they involve standards for the technical curriculum, core forensic science curriculum and such issues as research or a capstone

project. At the graduate level they specify the entry level requirements degree and grade point requirements in addition to the core forensic science topics. FEPAC has the concept that research is still a key component. This paper will discuss the current accreditation standards, the self evaluation process, site inspection by two evaluators, and the final approval or denial by the FEPAC commission.

With the advent of a \$250,000 NIJ research grant to the AAFS, the impact of FEPAC accreditation can further benefit the educational institutions in that this grant will bestow about \$230,000 for student research in grants up to \$5,000 per successful applicant. FEPAC accreditation can also indicate to the hiring authority, that the applicant has successfully completed a certain number of minimum standards appropriate to the forensic science community.

As of January 2010, there are 16 accredited FEPAC BS degree programs and 13 accredited FEPAC graduate programs.

The Criminalistics Lab as a Testing Facility

Dr. Peter R. De Forest, Greg Matheson, Faye Springer

In this presentation we will assert that forensic science laboratory systems are widely viewed as little more than specialized testing facilities by members of the general public, and that this view of the forensic science function is common among lawyers, criminal justice professionals, and even some laboratory scientists. Further, we will argue that this conceptualization is naïve and that this naïveté is at the root of many of the problems, real or perceived, that face the criminalistics profession and serve to severely limit its potential contributions to the investigation and adjudication of criminal cases.

We are fully aware that there are many formidable impediments to be overcome in bringing about positive change with respect to the recognition of the negative consequences of the existing situation and in taking the steps necessary to remedy it eventually. Some ideas for dealing with some of these will be put forward and discussed.

This contribution will take the form of an oral presentation laying out and detailing the major thesis. This will be followed by a panel discussion and a question and answer session to discuss the implications of the problems described and to review possible remedies.

There are still some open positions on CAC committees, including the Financial Review, Endowment, Alcohol Review, and Nomination Committees. Check out the different committees and their duties, then email CAC President Adam Dutra and tell him you'd like to serve on a committee!

www.cacnews.org

Truth Machine

The Contentious History of DNA Fingerprinting

Michael Lynch • Simon A. Cole • Ruth McNally • Kathleen Jordan

REVIEW BY NORAH RUDIN

Truth Machine, the Contentious History of DNA Fingerprinting, traces the evolution of forensic DNA analysis from its inception through the first several years of the new Millennium. This is not the first attempt at documenting the birth of the most recent tool in the forensic arsenal, however it is the most comprehensive, informed and thoughtful. The volume is much more than just a chronological history of events. All four authors are social scientists who ardently follow forensic science, and one (Ruth McNally) also contributed technical knowledge based on a bachelor's degree in genetics. The historical events are analyzed in great detail, and placed in a cultural and social context. The treatment is extremely academic, which confers both advantages and disadvantages. While the subject matter is treated exhaustively and quite neutrally, the text can become turgid at times in the quest for completeness.

Forensic scientists reading this volume should be warned that the experience feels a bit like what I imagine a native or tribal population feels like when the anthropological researchers descend. It is not always comfortable to be the analytical subject rather than the analyst. Nevertheless, the experience is both illuminating and humbling. Laboratory scientists tend, by nature, to develop tunnel vision. We interact more easily with our test tubes and computers, forgetting that, ultimately, everything that we do exists in the greater sociological, cultural, and yes, political context.

The authors tackle difficult subjects such as statistics and database searches, as well as softer issues such as the perception of scientific evidence by the judicial system and its players. Given that none of the four writers has a hard science background, the information is remarkably accurate. Nitpickers will certainly find nits to pick. But I would suspect that few of us would do as well with completely foreign subject matter.

The structure of the book is divided into ten chapters and five "interludes," each of which expands on an important, usually technical, point. The main subject matter is dense and the interludes provide the reader with a "brain break" of at least a different, if not less complex, subject. The chapters concentrate more on the social scientific and historical aspects of forensic DNA, while the interludes will feel more familiar to the physical scientist. The main audience for the book would appear to be social scientists as the language of that discipline is used freely and without definition or explanation. While some of the terminology may annoy forensic scientists, be advised that it is the standard language in

which social scientists talk amongst themselves; in effect we are getting a dose of the medicine that we, more often than not, dole out.

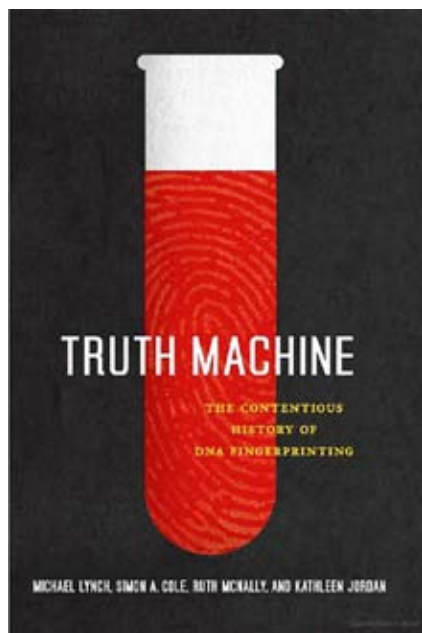
A main theme mentioned very early in the first chapter, and to which the authors return to elaborate in the last chapter, is that of an "inversion of credibility." This refers to the rapid shift from dermatoglyphic fingerprints to DNA typing as the gold standard of forensic identification. The authors discuss the reasons for this and its effect on both the forensic community and judicial system. In fact, although the focus of this book is DNA, frequent comparisons are made to fingerprinting and it is a major secondary topic of the volume. Other topics the authors tackle range from the admissibility of scientific evidence to the nature of controversy.

The contribution this book makes is to place forensic DNA typing, and to some extent fingerprinting, as well, into a cultural context. We don't work in a vacuum, and it behooves us to understand a bit about how science tends to progress, including attitudes about it and toward it. For example, understanding the discordance between the prevailing scientific culture and the judicial culture in a particular jurisdiction can help us understand the reasons underlying particular admissibility decisions, and can explain the reasons for some of the miscommunications with which we are all familiar. To some extent, the authors act as translator between the lay and scientific communities.

I would offer the same admonishment to forensic scientists reading this book as I do to my attorney clients: your job is not to become a social scientist; rather it is to become familiar with the big picture, to understand the questions to be asked and the limitations to the answers. Although sure to become an authoritative text in the social studies of science, the forensic scientist is unlikely to read this book cover to cover. Rather it might serve, as hard science texts do for attorneys, as a reference volume.

Finally, some of you might, as I did, bristle at the very title of the book, referencing "DNA fingerprinting." Why should I read a book written by social scientist who can't even get the name right? My query of one of the authors produced the information that the title was chosen quite carefully and deliberately. You will have to read the book to find the reason.

While some of the terminology may annoy forensic scientists, be advised that it is the standard language in which social scientists talk amongst themselves; in effect we are getting a dose of the medicine that we, more often than not, dole out.



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OFFICE OF THE REGIONAL DIRECTOR NORTH

On March 4th, 2010, the U.C. Davis Forensic Science Program hosted a CAC luncheon and study group meetings. CA Deputy Attorney General Michael Chamberlain (CA Dept. of Justice) and Senior Wildlife Forensic Specialist Jeff Rodzen (CA Dept. of Fish and Game) presented "The Future of Forensic Science in California: The 2009 and 2010 Reports of the California Crime Laboratory Review Task Force." This presentation focused on the findings and recommendations of this task force. There were approximately 72 attendees. Several study groups met before or after the luncheon. These meetings are described below.

Quality Assurance

The Quality Assurance study group had 13 attendees and discussed ISO-accreditation topics, including recent audits, proficiency testing, and ISO 17025 standards 5.10.2 and 5.10.3.

Toxicology

The first meeting of the newly-formed Toxicology study group covered various topics, including screening and confirmatory techniques and post-mortem vs. human performance toxicology. There were 15 individuals in attendance.

Alcohol/QA

The joint meeting of the afternoon Alcohol and QA study groups discussed the ASCLD/LAB Breath

Alcohol Calibration Program, presented by Laurel Farrell of ASCLD/LAB. In addition, method validation and interpretation as related to forensic alcohol testing as well as Title 17 updates were discussed. There were 16 attendees.

Drugs

The Drug study group was given a detailed presentation on marijuana by BNE Special Agent Jackie Long, complete with microscopes and experiments! There were 20 attendees.

DNA

The DNA study group discussed a variety of topics — nucleospins (Michelle Halsing, DOJ Richmond), sexual assault examinations (Dr. Green, U.C. Davis Medical Ctr.), feline forensics (Dr. Lyons, U.C. Davis), and CA databank processing and interesting samples (Melody Duke and Stacey Zimmerman, DOJ Richmond). There were 47 individuals in attendance.

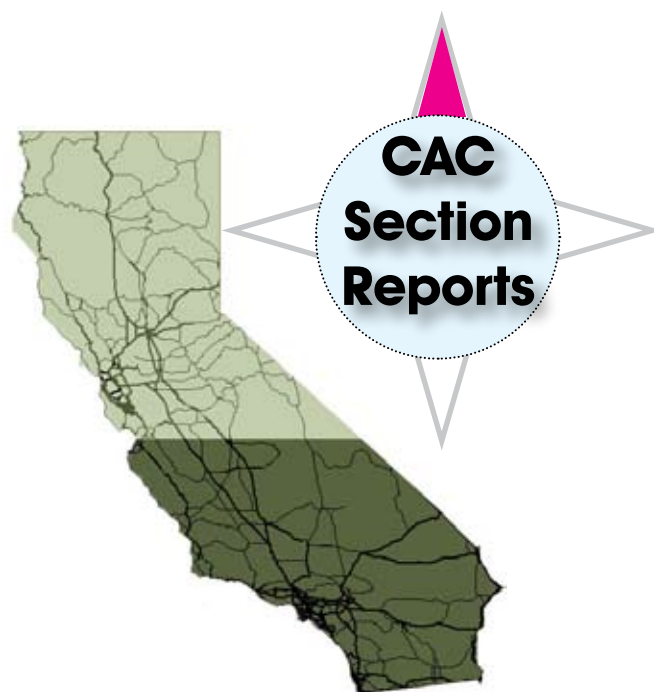
Firearms

The Firearms study group met separately on March 25th, 2010, also at U.C. Davis. Forty individuals were in attendance. There were several presentations ranging from field updates to case reports to research studies. A more detailed report of this one-day meeting has been submitted to the *CACNews*.

Arson & Trace

The Arson and Trace study groups did not meet during this period.

Finally, Brittany Crane of the Alcohol, Tobacco, and Firearms Laboratory (Walnut Creek) will co-chair the trace study group with Chip Pollock (Sacramento County Crime Lab).



OFFICE OF THE REGIONAL DIRECTOR SOUTH

- DOJ Riverside hosted the last study group meeting at the Corona Police Department on March 23, 2010
- Speaker was CA Deputy Attorney General Michael Chamberlain who spoke on *Melendez-Diaz* and CA Crime Lab Review Task Force Report
- Meeting was well attended; Approximately 80+ people attended
- Study groups that met: QA, DNA, CSI, Drugs & Tox (joint meeting)
- Next study group meeting will probably be scheduled for sometime in June
- Jamie Daughetee will be the new DNA study group chair—I believe she may be looking for a co-chair so if you're interested, please let me know.
- Drugs study group chair is vacant, please let me know if interested

F.I.R.M.S.—

Report on the Fourth Network Conference*

Bob Blackledge

FIRMS stands for Forensic Isotope Ratio Mass Spectrometry. Although stable isotope ratio mass spectrometry has been used in other scientific areas since the 1930s, its use in forensic science is comparatively recent. The FIRMS organization was established in 2002 (website:forensic-isotopes.org/index.html). Its first use in a criminal trial was in 2002 in the UK in a case involving the comparison of ecstasy tablets (1).

Isotope ratio mass spectrometry (IRMS) results on evidence examinations have yet to be introduced in a criminal trial in the USA. The FBI had anticipated that its first use might be in the trial of the Unabomber, Ted Kaczynski, but that ended when he pled (I insist that this is the proper past tense of the verb, to plea, not the discordant *pleaded*) guilty. Next, the FBI thought they would introduce IRMS results in the trial of the suspect in the anthrax letters case, Dr. Bruce E. Ivins, but he committed suicide just a few days before they were going to arrest him.

This was my first FIRMS conference and I came away very encouraged by the general attitude and cautious approach of attendees to its use in forensic science. Starting with welcoming remarks by the FBI Lab Director, D. Christian Hassell, continuing with a plenary talk by James Ehleringer (perhaps the foremost authority in the USA on IRMS) (2,3), and generally followed throughout the ensuing presentations and posters the attendees were in agreement that the potential of IRMS in addressing questions in forensic science not be oversold and that all Daubert requirements be assiduously followed. I found this in marked contrast to the employment of IRMS by laboratories certified by the World Anti-Doping Agency (WADA) for testing athletes' urine samples for banned substances (4-8).

Many of the abstracts, papers, posters and PowerPoint presentations from past FIRMS conferences may be accessed at their website. Although not as yet available, it is anticipated that this will also be true for the Fourth FIRMS Network Conference. What follows will be my very personal, opinionated, and selective condensation of those presentations and posters I found most interesting.

From my study of the analytical results in the Floyd Landis case (I gave an oral presentation on this), I was familiar with one type of IRMS instrumentation where typically a GC or an HPLC is interfaced (after the eluant was combusted to CO₂ and water and the water vapor removed) to a special type of mass spectrometer. What I didn't know was if you had multiple collectors you could use laser ablation high resolution multi collector inductively coupled plasma mass spectrometry



(HR-MC-ICPMS) and you could do IRMS on heavy elements all the way up to uranium. There were many papers and posters on this, including some that looked at the provenancing of soil samples. Hmmm—I wonder, could this be used to distinguish (provenance) talc particles in the “shimmer” used in cosmetics?

IRMS may be employed to examine the stable isotope ratios of bulk samples (example, ¹³C/¹²C, ¹⁵N/¹⁴N, ²H/¹H, and ¹⁸O/¹⁶O isotope ratios in hair samples), or it may be employed to determine compound-specific stable isotope ratios (example, ¹³C/¹²C isotope ratios of certain metabolites of testosterone from urine samples). Have an unidentified body and DNA, fingerprints and dental work have not provided answers? IRMS of hair, teeth, and bone may well provide investigative leads. A truly awesome example may be found in an article by Dennis Page in the June/July 2007 issue of *Forensic Magazine* (9). Also in the bulk sample category were several papers on the provenance determination of hair samples, drinking water, honey, one on wine and champagne, one on plant materials, American beef, alligator bioapatite, migratory birds, Australian papers, pests, soils, duct tapes, PVC tape backings, and milk.

To me, the most fascinating bulk sample example was a poster, “CO₂ in Breath as a Short-Term Record of Geographic Movement” (10). With human respiration you breathe air in and expel CO₂. The stable isotope ratios of the expelled CO₂ will be related to the stable isotope ratios in the water you drink. Let's say you told your wife that you had to go to Sacramento on business for a few days but you actually took your “hottie” secretary to Cancun. Assuming you drank the local water (even if it was bottled water from that locale), when you returned to California for the next few days the CO₂ you expelled in your breath would have stable isotope ratios characteristic of the water in Cancun. Shame on you, you Bad Boy!

There were many presentations and posters on the provenance of various types of explosives. No doubt these have great investigative value. In fact the value of FIRMS in providing investigative leads even if not actually used as evidence in court was a repeating theme. Of course it can also be used for the provenance of marijuana, heroin, oxycontin tablets, etc.

My prize for the most fascinating presentation was, “Identification of Fake Archeological Artifacts using Stable Isotope Methods: Authenticity Examination of the Inscript-



*April 11-14, 2010, Washington, D.C.



tion on the Ossuary Attributed to James, Brother of Jesus Case Study" (11). An ossuary is a container for the burial of human bones. Pictured below is the ossuary in question and the close-up of the inscription (in Aramaic) that translates to "James, son of Joseph, brother of Jesus." (photos from Wikipedia: en.wikipedia.org/wiki/James_Ossuary) The authenticity of the chalky limestone ossuary itself was not in question. It had been dated to the first century, but had the inscription been added more recently? The ossuary bore a thin patina (similar to desert varnish on rocks). Had the inscription in the limestone been made at roughly the same time as the ossuary, the patina within the inscription crevices would be chemically and isotopically the same as the patina on the surface. Bottom line—it most likely is a fake.

Although not a presentation or poster given at FIRMS 2010, the following journal reference would no doubt have been a welcome addition. "Amino acid $\delta^{13}\text{C}$ analysis of hair proteins and bone collagen using liquid chromatography/isotope ratio mass spectrometry: paleodietary implications from intra-individual comparisons", Maanasa Raghavan, James S. O. McCullagh, Niels Lynnerup, and Robert E. M. Hedges,

Rapid Communications In Mass Spectrometry, 2010, 24, 541-548

If anyone would like a file containing the abstracts of all the presentations and posters presented at FIRMS 2010, just send me an email at bigpurple@cox.net

(1) www.forensic-isotopes.rdg.ac.uk/newslett/issue2.pdf (accessed on April 30, 2010)

(2) ecophys.biology.utah.edu/ and www.isoforensics.com/isoforensics/home.html (both accessed on April 30, 2010)

(3) Forensic Science Applications of Stable Isotope Ratio Analysis, James R. Ehleringer, Thure E. Cerling, and Jason B. West, Chapter 15 in *FORENSIC ANALYSIS ON THE CUTTING EDGE: New Methods for Trace Evidence Analysis*, Robert D. Blackledge, Editor, 2007, Wiley Interscience.

(4) "The Floyd Landis Sports Doping Case: As seen through the eyes of a "mythical" ASCLD-Lab Inspector", Bob Blackledge, *CACNews*, 4th Quarter 2007, 11-20.

(5) "Bad Science: The instrumental data in the Floyd Landis case", Robert D. Blackledge, *Clinica Chimica Acta*, 406 (1-2), 11 Aug. 2009, 8-13.

(6) "The Science of Doping", D.A. Berry, *Nature*, 2008, 454, 692-693.

(7) "Floyd Landis: an unsafe conviction regardless of the quality of the data", Nicolass Klass M. Faber, *Clinica Chimica Acta*, 411 (1-2), 04 Jan. 2010, 117-118.

(8) "Anti-doping researchers should conform to certain statistical standards from forensic science", Klass Faber and Marjan Sjerps, *Science and Justice*, 49 (3), Sept. 2009, 214-215.

(9) "Four Years To Day One: A Saga of Science and Inquest", Douglas Page, *Forensic Magazine*, June/July 2007.

(10) "CO₂ in Breath as a Short-term Record of Geographic Movement", S.P. O'Grady, C. Remien, L. Enright, L. Valenzuela, L.A. Chesson, D.W. Podlesak, T.E. Cerling, and J.R. Ehleringer, poster, Fourth FIRMS Network Conference, April 11-14, 2010, Washington, D.C.

(11) "Identification of Fake Archeological Artifacts Using Stable Isotope Methods: Authenticity Examination of the Inscription on the Ossuary Attributed to James, Brother of Jesus, Case Study", Avner Ayalon, Miryam Bar-Matthews, and Yuval Goren, oral presentation, Fourth FIRMS Network Conference, April 11-14, 2010, Washington, D.C.

The Dirty Evidence: Soil and Geoscientific Contributions to Intelligence Gathering & Environmental & Public Safety

November 2 – 4, 2010

The 3rd International Conference on Criminal and Environmental Soil Forensics is only 6 months away in beautiful Long Beach, California! Conference information will be available at: <https://www.acsmeetings.org/>

Registration will open on July 1, 2010. Come join us for a Murder, Mystery, and Microscopes session with crime authors and book signings, and catch up with your international colleagues as you have fun in the sun!

For more information, contact Marianne Stam at: marianne.stam@doj.ca.gov

How low can you go? Should you just say no?

Since we began meeting “halfway in between” in San Mateo a few years ago, the food scene seems to have picked up. Taking a break from our usual “office” at Astaria, we had a couple of wonderful meals at Capellini’s over the winter. For this meeting, we decide to try a new location, Aquapazza. We are encouragingly greeted by a *maitre d’* sporting an authentic Italian accent, who seats us in a very pleasant corner adjoining a sunny open air patio. We regretfully decline the wine list (gotta work), but make our choices from the tempting menu. Our *insalata caprese* arrives and well, moving on from the dining report ...

An occupational hazard associated with doing review work is that by the time a case has filtered this far through the system, we are usually looking at data that are complicated, complex, and confusing. Gone are the days when we were trying to educate law enforcement to think about collecting DNA evidence; now they collect and submit EVERYTHING. Relevant or not, visible or not, it all gets submitted to the lab, where an analyst must then make difficult triage decisions about what to test. Are there some benchmark criteria that can help us with this decision, or do we just blindly test everything that comes through the laboratory door, hoping to sort it all out on the other end? The laboratory does not exist today that is not back-logged and overworked. The question that we begin with today is whether some lower limit exists below which DNA evidence simply should not be analyzed. As the reader will see, it is not quite where we end up, but we hope you will enjoy the journey.

Forensic DNA technology has, over the last two decades, advanced at lightning speed. The question we pose today is, has the technology been pushed past our ability to reliably interpret the results? Does a boundary exist at which we should “just say no,” or should everything and anything be typed, leaving the difficult work for the unfortunate analyst (and ultimately the trier of fact) stuck with interpreting ambiguous results? If a decision threshold should be established, at what point in the process should this occur? Inevitably, our question generates more questions. Time to attempt to answer some of them.

We, of course, start with the collection of biological evidence. Not surprisingly, we immediately agree that the first decision threshold to overcome is the relevance of the item and any potential finding. For example, finding spermatozoa in the vaginal cavity of an 8 year old is inherently relevant since no innocent explanation exists. Another example is a knife found sticking out of the chest of a dead body; the item is highly relevant as it was likely wielded by the perpetrator. To take this example a bit further, the blood on the business end of the knife is completely irrelevant from the perspective of analyzing it for DNA—it is obvious whose blood will be found on the blade. However, if analyzing the handle for the DNA could tell us who wielded the blade, that would highly relevant. That is, if it could tell us. The relevance of the handle is somewhat reduced because it potentially contains the

entire history of people who have touched it, and does not tell us which, if any, of those potentially multiple contributors was the actual stabber. However, other elements of the crime event, such as who had access to the knife previous to the murder, can dynamically alter the relevance.

Assuming the item is apparently relevant, the next decision threshold we encounter is collection of the biological material. But wait, we first have to visualize it—or do we? Traditionally, only detectable biological substances were collected for further testing. Even if a physiological substance is not directly visible to the naked eye, an arsenal of tests can be employed to detect a fluid or stain. Visual enhancements, such as an alternate light source or a microscope, as well as chemical or immunological tests, can help us find and identify biological deposits that are not apparent to the naked eye.

In recent years, however, it has become popular to collect “touch DNA” from areas of objects or items that are thought to have come in contact with a person. Touch DNA can be divided into roughly two categories: DNA left by the owner or habitual wearer of an item or garment, and DNA left by more fleeting recent contact, perhaps in connection with a crime event. Either way, the relevance of any such DNA is inherently reduced because a physiological origin cannot be identified. Recall that one of the original advantages of DNA over fingerprints was that the substances containing it, usually blood, semen, or saliva, tended to be left as a result of violent or intimate activity. This advantage is lost with contact DNA, which is deposited as easily and as innocently as fingerprints. This is as good a time as any to clarify that we really have no idea what vehicle transports “touch” DNA. The carrier is often discussed as skin cells; however, this has never been proven experimentally. In fact, it seems unlikely from first principles, given that the cells in the top layer of epidermis, the stratum corneum, have lost their nuclei. It seems more believable to us that DNA left by skin surface contact derives from either saliva or tears accumulated on the hands, or perhaps from cells extruded from hair follicles housing sebaceous or eccrine glands. Nevertheless, this theory also remains both unproved and untested, just one that seems to make more sense.

An additional disadvantage to analyzing contact DNA is that samples frequently result in low-level complex profiles that are difficult to interpret. Additional challenges are encountered when attempting to provide a fair statistical weight to any potential inclusion(s). More often than not, a well-meaning swab of a gun results in the dreaded “inconclusive” as analysts simply throw their hands up in despair at providing a supportable interpretation. While any forensic sample, even a detectable stain, always carries the risk of producing



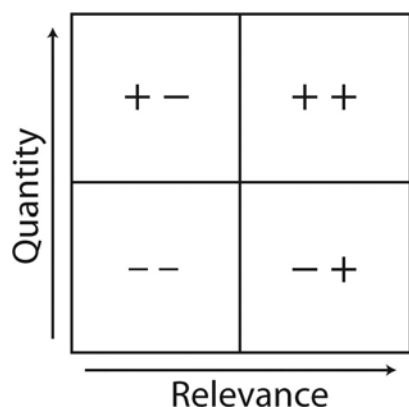


Figure 1a

a difficult or ambiguous profile, the likelihood of obtaining results compromised by low template DNA or multiple contributors increases dramatically when swabbing blindly for some undetectable, unidentifiable DNA-containing material.

So we must ask ourselves, given the increased probability of problems resulting from contact DNA samples, including interpretational challenges, and the decrease in obligate association to a specific incident in time, is it even worth collecting and analyzing such samples? This is starting to feel a bit like a mobius loop, until we finally realize that relevance and quantity must be considered as simultaneous rather than sequential variables. At this point, the butcher paper covering the table cloth gets put to good use, replacing our usual vehicle of a napkin. Several iterations of scribbles later, we come up with our first approximation of this relationship, the 2 x 2 matrix pictured in the sidebar (Figure 1a).

Once constructed, we realize that this matrix has very practical implications. Let's take a moment to explore the various nominal combinations. At the bottom left corner (- -) we find evidence that is of low quantity and inherently not very relevant. For example, swabbing clothing for touch DNA when neither the wearer nor the killer are in dispute will add no useful information to the case. It is a complete waste of resources to analyze dozens of such samples (and yes one of us had that case). Diagonally opposite (++) is evidence that is of both highly relevant and present in a high quantity. An example is sperm in the vaginal cavity of the aforementioned 8 year old. Another less obvious example of a highly relevant and also abundant sample might be a circular blood stain amongst a blood stain pattern on a prone body. This type of sample is anticipated to yield a good quality single-source profile, and can be inferred to have dropped from a source positioned vertically over the body, perhaps the perpetrator.

The two other quadrants are perhaps less obvious, and thus more interesting to consider. In the top left corner (+-) we find samples that are high in quantity but of potentially low relevance. For example, semen found on the interior fly of jockey shorts of a male accused of rape is not the first sample from which to seek probative information. Such a deposit could have no relevance at all to the crime event. However, if a vaginal swab is, for some reason, unavailable, it is not unreasonable to test the semen stain in hopes of finding a female component. While the quantity of the evidence will not change, the decision to attempt testing is more dependant on the instant circumstances than the double positive or double negative extremes.

The final example, found at the bottom right corner, is the situation in which the sample is of low quantity, but

potentially high relevance (-+). This is exactly the situation that initiated this discussion, often touch DNA on a weapon or other murder instrument, such as a ligature. Determining who touched guns, knives, ropes, etc., would seem to be highly relevant. However, the nature of the biological sample inherently reduces the relevance. The level of DNA is likely to be relatively low, and the possibility of multiple contributors relatively high. The time of deposition, and the order of contributors is impossible to establish. Another confounding factor is the method of deposition, as such small amounts of material can more easily be explained by secondary transfer than large amounts of material. Another common example is material found under fingernails. An enthusiastic debate usually occurs as to whether a foreign profile represents violent activity or could result from casual contact.

Of course we realize that all evidence falls along a continuum of both parameters that describe the axes of our graph. Our matrix should thus be intersecting clouds rather than quadrants with strict boundaries. (Figure 1b) Given the previous discussion, the most important work to be performed is a *gedankenexperiment* (thinking experiment, see Wikipedia) before beginning any testing of a sample. What are the possible outcomes of analysis and how could each be explained? If different explanations would result in the same outcome, or if divergent outcomes can result from the same explanation, then performing the analysis is a waste of resources. As an example, if several people all admit to handling a gun, and the question is who used it to kill the victim, DNA analysis is unlikely to provide a definitive answer to the question. Both the absence and presence of any of the handlers can be explained, and neither the time nor order of DNA deposition can be determined. Further, the profile is likely to be a mess, and dismissed as "inconclusive." Just because evidence can be analyzed and DNA detected doesn't mean that it should be. A few minutes spent thinking about possible results and whether they can reliably answer relevant questions will save considerable angst down the line.

Once the decision has been made to proceed with typing, and the DNA has been extracted and quantitated, we reach the decision threshold at which many DNA analysts start. If no or very little DNA is detected using a sensitive quantitation method, is it worth moving forward with typing? Assuming one is using a modern PCR-based quantitation method, little or no DNA detected presages production of a problematic profile, if one is detected at all. A true lack of signal (what we call a "flat-line") is not an interpretational problem, just a waste of resources. It is the partial low-level profiles, sometimes exhibiting signs of multiple contributors, that present interpretational challenges. Conceivably, a laboratory could develop a quantitation threshold based on validation data. But how many loci, or what statistical threshold, should be considered dispositive¹? And how is this tempered by lack of knowledge regarding the potential number of con-

¹ We deliberately use the legal term "dispositive" here. The definition of dispositive is: effecting the final outcome of a court case. And, ultimately, court is where we are headed. So the critical question, to which we have no good answer, is, how many loci, or what level of statistical strength, will the trier of fact require to cross the criminal legal threshold of reasonable doubt. Because the judge or jury is considering the DNA evidence along with any other evidence, physical or otherwise presented in the case, the question becomes, how convincing must the DNA evidence be to either support or overcome all the other evidence in the case. This is unknown, unknowable, and different for every case.

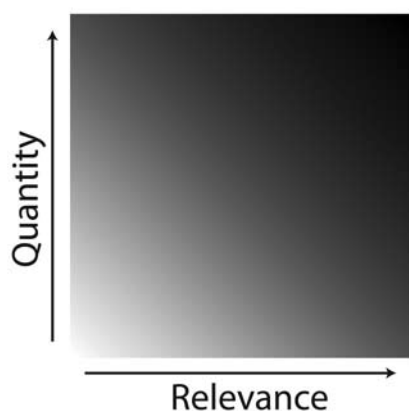


Figure 1b

tributors? Any quantitation threshold, like the current analytical thresholds employed by most labs, will necessarily be based on some personal or administrative comfort level. Even with extensive validation to determine the kinds of profiles likely to result from various amounts of DNA, no objective scientific criteria exist with which to determine an absolute point cut-off value. Even using likelihood ratios, which much more successfully advise us of the strength of ambiguous data, one must determine an LR at which the data is not useful. How far from 1 does an LR need to diverge for the data to be useful? 10? 100? 1000? In the end, humans, whether the analyst or a jury, still determine what level of evidentiary support convinces them of the potential source of a sample.

Another significant issue in typing low-level samples is the use of “enhancements.” Enhancements now encompass a wide arsenal of techniques, including extra PCR cycles, post-PCR clean-up, post-PCR concentration, increased injection volumes, and increased injection time. We do not classify pre-PCR optimization of the reaction itself as “enhancement” because these techniques tend to increase rather than decrease the chance of truthfully representing the alleles present in the sample. Such techniques include sample concentration, adding more template to the PCR reaction, or adding extra *Taq* enzyme or BSA to combat inhibition. The problem with post-PCR enhancements is that they tend to increase signal strength without increasing the useful information obtained in the profile. Essentially, this has the result of instilling a

false confidence in the reliability of a profile. Said another way, a high signal strength may misleadingly suggest that the input components of a sample are completely and accurately represented by the resulting profile. Pushing the limits of the system by using these various enhancements also increases the introduction of various kinds of artifacts, including “drop-in” alleles. Thus confusion about the true profile that represents the alleles present in the original sample can actually be increased. Add to this that only recently have many labs realized that each enhancement requires a separate validation to determine the appropriate interpretation criteria, and it is easy to understand how the value of simply increasing the signal strength of an already problematic profile becomes questionable.

One way to think about enhancements is whether they can assist us in choosing amongst various causes (C_n) of the result. (Figure 2) Let's say we begin with C_1 , C_2 , and C_3 , three guys who may have fired a gun. We find it difficult to choose which one cause or combination of causes best explains a complex low-level profile, so we decide to use a post-PCR enhancement to increase the signal strength. Perhaps C_1 and C_2 become less likely explanations for the profile, but C_4 , C_5 , and C_6 may be added as a result if additional peaks are detected. So what have we really gained? The signals that we originally observed may be stronger, but it is entirely likely that additional signals (that may or may not represent DNA present in the original sample) as well as artifacts have been introduced. We may actually have defeated our purpose by increasing the number of possible causes of the evidence profile. Where are the studies demonstrating that enhancements increase the information content of an analyzed sample rather than merely increasing signal strength? Too often we hear that, for example, increased injection time is used to increase the signal simply to surmount a policy-based RFU threshold that the lab has established (for the original injection time). Why not simply interpret the original information that is present, using a scientifically-based threshold such as a limit of detection (LOD) (Gilder, 2007)

So has this rather round-about discussion helped us at all to answer the original question, should there be a lower decision threshold below which evidence should not be analyzed, not be typed, or not be interpreted? We agree that while no simple answer exists, a consideration of the interpretational issues should be considered *before* analyzing the sample, and that multiple decision points should exist. The analysis may be aborted at any of these decision points. Further, some tools may be better than others both for making informed decisions and for interpreting the results. Especially when the results are complex and ambiguous, likelihood ratios seem the only reasonable statistical vehicle that can provide some reliable weighting of various hypotheses. Stay tuned for further discussion of the specifics of this approach.

Having finished our excellent cappuccinos, accompanied by an extra dessert, compliments of the chef, we collect the various substrates containing our scribbles and head out.

References:

- Gedankenexperiment: http://en.wikipedia.org/wiki/Thought_experiment
 Gilder, J.R., Doom, T.E., Inman, K., Krane, D.E., Run-specific limits of detection and quantitation for STR-Based DNA testing, *J. Forensic Sci*, 51(1), 2007.

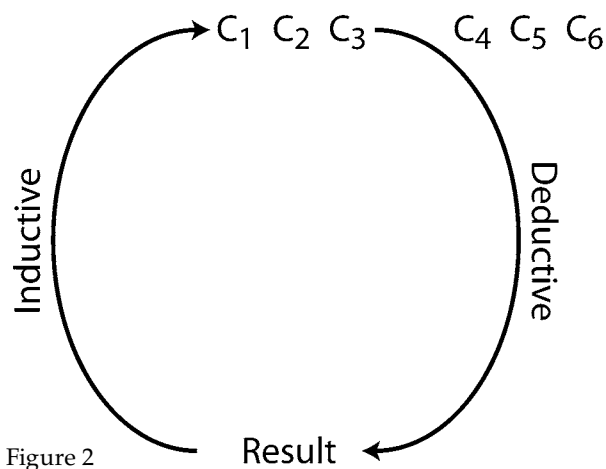


Figure 2

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