



The **CACNews**

News of the California Association of Criminalists • Fourth Quarter 2010

The President's Desk

Crime Laboratory Review Task Force and a Plan for the Future

The California Crime Laboratory Review Task Force was created by the passage of AB1079 in 2007. Several editions of "The President's Desk" have focused on the creation of and the work of this task force: 4th Quarter 2007, 1st Quarter 2008, and 3rd Quarter 2008. The task force was empowered to review the delivery of crime laboratory services in California and to make recommendations in four areas: organization and management of crime laboratory services, staff and training, funding, and performance standards and equipment. Jennifer Mihalovich was the CAC's representative on the task force. Additional CAC members were on the task force, including Barry Fisher, Dean Gialamas, Greg Matheson, and Jeff Rodzen. I thank all of them for their work on this important task force and I encourage all CAC members to show their gratitude as well. I would also like to thank the additional CAC members who attended meetings and provided needed input.

In November of 2009, the task force issued a detailed report entitled "An Examination of Forensic Science in California," a copy of which can be found on the CAC website in the "Current Policy Issues" section under the "Community" tab (http://www.cacnews.org/policies/current_policy_issues.shtml). Although not specifically requested by AB1079, the task force debated the need for a statewide oversight or advisory body for crime laboratories in California and recommended that the task force meet for an additional year to study this issue.

While the task force was meeting, the National Research Council published their report entitled "Strengthening Forensic Science in the United States: A Path Forward." This report made several criticisms of forensic science and made a number of recommendations. The White House and Congress have taken steps in an attempt to address many of the concerns shared by the National Research Council.

Because the efforts on the federal level appeared to be picking up speed, the California Association of Criminalists and the California Association of Crime Laboratory Directors each submitted position statements urging the task force to postpone their work investigating the need for and functions of a statewide oversight body in forensic science to better assess the impact that these federal efforts might have on oversight in California. The task force voted 6-3 at their June 3, 2010 meeting to postpone their work until next year. The CAC and CACLD issued a joint paper, expanding our position statements and providing a unified point of view that many of the proposed functions of this oversight body are already being addressed. Additional detail on this joint paper can be found in this issue of the *CACNews*; the full paper as well as CAC's position statement can be found on the "Current Policy Issues" section of the CAC website.

One area that some members of the task force felt could be better addressed was the interaction between forensic scientists in California crime laboratories and other stakeholders. Although many of our members work in public crime labs, our membership also includes scientists at private laboratories, educators at universities and colleges, and students preparing for a career in forensic science. We do not exclude nonmembers from attending our seminars and have had numerous presentations from other forensic science stakeholders including judges, prosecutors, defense attorneys, defense advocates, academics, and members of law enforcement. I want to encourage stakeholders to continue to attend and give presentations at our meetings. With the varied backgrounds of our members and the contacts we have made through our seminars, I believe it will not be difficult to make a greater effort to improve our interaction with other stakeholders.

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Adam Dutra
CAC President

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FOURTH QUARTER 2010



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The *CACNews*, ISSN 1525-3090, is published quarterly (January, April, July, and October) by the California Association of Criminalists (CAC).

The CAC is a private foundation dedicated to the furtherance of forensic science in both the public and private sectors.

Please direct editorial correspondence and requests for reprints to the editorial secretary.

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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



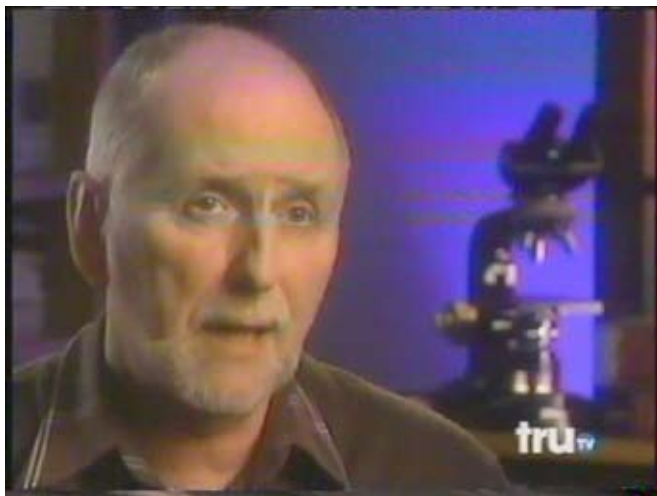
On the cover...

A break from the usual trace evidence: Microscopic seashell debris from the Scottish Highlands. Sample courtesy Ed Jones, photo by J Houde.

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CACBits



CAC member Brian Wraxall explains the DNA comparison of crime scene blood samples with those of a murder victim on truTV's Forensic Files. The episode, entitled "Fashion Police (The Jeremie Ryan Overstreet Case)," originally aired in March, 2009.

- Share your opinions about topics being discussed by CAC members on our Blog
- Update your mailing address, employer, and other info
- Upgrade your CAC membership
- Non-Members can apply for CAC membership

This system allows members to keep the CAC informed of their current contact information. This is important so our membership can be sure they are receiving both our email and postal communications. The Membership Secretary now uses this system to send out email blasts to all members. Therefore, it is essential that we have your current email address, and also that your email program/company/server does not block emails from "CAC@memberlodge.org" Please add this email address to your "white-list" (or your Safe Senders List) to be sure you receive our emails.

So, if you haven't checked out our new Member Services Site, please login soon and update your contact info so we can be sure you stay informed of all the latest CAC news and events!

CAC Webmaster

Check Out members.cacnews.org

If you haven't been to the CAC website lately, you may not have noticed that we have created an area of the website that is dedicated to making your administrative interactions with CAC easy, accurate, and up-to-date. We call it the CAC Member Services site and you can access it from our main website or at: members.cacnews.org.



Here are some of the things you can do at our Member Services Website:

- Register for seminars, study group meetings, and other CAC sponsored events
- Pay your annual CAC dues
- Look-up a fellow CAC member in the members-only directory

Draft Ethics Code—What do you think?

We have created a discussion forum in the Members-Only section of the CAC Website. The ad hoc committee that was formed to write a draft of a National Code of Ethics is eager for your opinions, thoughts, and suggestions. Please click on the link below, read the document, and post your comments on the forum. Your comments will only be visible to other CAC members.

When you visit this site, we ask that you "subscribe" to the topic. If you do this, the system will send you an email containing each comment that is posted on this forum. The hope is that this will encourage discussion and more comments from our members. To subscribe, just visit the forum by clicking the link below and then click "Subscribe to Topic" in the right-hand portion of the screen, above the post.

Peter Barnett, the chair of the committee that produced the draft, will be reading and compiling your comments. So please take the time to read and post your thoughts. This is something that may affect us all.

Soil Forensics in November

Scheduled for November 2 – 4, at the Long Beach Convention Center, the *Criminal and Environmental Soil Forensics Conference* promises numerous presentations of interest to trace evidence examiners. Visit <https://www.acsmeetings.org>, or contact marianne.stam@doj.ca.gov for more information. The program will include 2½ days of speakers with sessions covering contributions of forensic soil and forensic geoscience to intelligence work, public safety and the environment.

The Editor's Desk

Effects of the Higher Profile Position of Forensic Science

When I started my career as a forensic scientist in 1978, my arrival meant the LAPD had 23 criminalists on staff. However, with the resignation of two criminalists within 2 weeks, the number dropped to 21 and stayed there for almost two years due to the passing of Proposition 13 and the fear that all California municipalities would soon be bankrupt and lay off all its scientists. (Sound familiar?)

As a side note, I will provide a little history for all of you who are not aware of Proposition 13. In 1978 California voters passed Proposition 13, also called the Jarvis Initiative. It is thanks to this extremely well crafted proposition that we enjoy protections against politicians using property taxes to fund anything and everything while making it difficult for any of us to own a home. Prior to the passing of Proposition 13, residents had no control over increasing property taxes. In the mid 1970's, county and municipal governments were increasing property taxes annually, many times by double-digit percentages. Planning a household budget was impossible because you never knew how high your property taxes would be coming years. Prop 13 fixed the base property tax of a residence at a percentage of its value and limited the percent it could be increased each year. Once passed, it reduced existing property tax revenues by as much as 60%. Since a large percentage of county and municipal funding came from property taxes, it was assumed the measure would result in massive layoffs throughout the state.

During my career, I have seen our profession go from a point where very few people knew what we did to most everyone knowing what we do, and in some instances, thinking they know how to do it better.

I started with the LAPD on the day after Prop 13 was passed and immediately the city ordered all departments to plan on a 10% cut back in staff. I thought my career was going to end before it had a chance to begin. But thanks to the two resignations, I was safe. Does any of this sound familiar in today's economic climate? Now back to the point of this story.

In 32 years, the professional staff of the LAPD Criminalistics Laboratory has grown from 21 to over 120. Of course, this is to be expected, right? As a rule, everything grows. The population of the city of LA is significantly greater than it was in 1978. The number of sworn officers has also grown. It only

makes sense that the number of crime lab professional staff will also grow. But wait, the number of professional staff in the crime lab has grown by 5 times. The population of LA hasn't grown 5 times, the size of the LAPD has not grown by 5 times and the crime rate in Los Angeles has actually dropped to its lowest point in almost 50 years.

The number of people employed as forensic scientists in LA, and the rest of the country, has grown disproportionately to the people we serve, the organizations for which we work, and the number of crimes committed, because we have been successful. Despite the criticism we have experienced, our growth supports that what we do is important to the criminal justice system, and it is important because we do it well.

During my career, I have seen our profession go from a point where very few people knew what we did to most everyone knowing what we do, and in some instances, thinking they know how to do it better. There are trade offs to most everything and the rise of our profession is no exception. It used to be that we worked in relative anonymity and were rarely seriously challenged in court, but resources were always short. Today our work is well known, our successes are many, and so are our critics. But, our access to resources has never been better. Though it may not seem so under today's fiscal difficulties, we are still reaping the benefits of our significantly expanded role in the justice system. I firmly believe that if we were still filling the niche we filled in the late 1970's laboratories across the country would be closed and criminalists laid off to allow for the retention of police officers and their equipment. Our successes, quality work, invaluable service and, of course, media attention are savings jobs in these difficult times.

One of the issues that has recently arisen due to our higher profile is the activity of the California Forensic Science Task Force. Though the Task Force's primary assignment was completed in December 2009 with the release of the Task Force Report, we agreed to voluntarily continue the Task Force to investigate the concept of a state level advisory or oversight body. In June, due to a motion by the CACLD and the CAC, the Task Force

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Greg Matheson
CAC Editorial Secretary

The President's Desk cont'd

I encourage CAC members to share concerns that stakeholders have expressed to them, so that they can be addressed proactively. If you are a stakeholder and you feel that we could be doing more to meet your concerns, please let us know. Because most of our work is applied to criminal cases and because we would like to increase the channels of communication, I am seeking volunteers to act as liaisons between the CAC and the California District Attorney Association and the California Public Defenders Association. If you have any other ideas that you feel would help improve our interactions with our stakeholders, please let me know. As always, your comments are appreciated.



The Editor's Desk cont'd

voted to temporarily suspend further work on the advisory/oversight body discussion.

Sadly, the result of the vote created more media attention than the release of the Task Force Report itself. The members of the Task Force who voted against the suspension of the process generated the media attention. Reading the accounts written in the articles and opinion/editorial pieces disturbed me due to the misrepresentation of the discussions that occurred prior to the vote. The people representing the CACLD and the CAC, along with other laboratory directors representing different organizations on the Task Force, were described as being fearful of oversight and therefore must have something to hide. The vote was described as our attempt to hide our operations from scrutiny. This could not be further from the truth.

I will not go into a direct rebuttal of what has been publicly pronounced by those opposing the vote, or describe why we voted the way we did. But rather, I direct your attention to the well-crafted response prepared by the CAC and the CACLD included in this *CACNews*. The response clearly delineates the reasons for voting to suspend further activity until a future time. In the long run, we want to make sure that if a state level body is created, it is not just another bureaucratic nightmare that provides no added value and is duplicative of the many controls and review processes in which we currently participate and the result of federal activities (described in the article in this issue provided by Jennifer Mihalovich).

As hokey as it may sound, enjoy the excitement of doing good work and having a positive impact on our society. Focus on the value we provide, listen to our critiques for ways we can improve, but don't let it negatively impact your love for the profession.



What is the Wavelength of the D Line for Refractive Index Determinations?

When the refractive index of glass and polymers is determined, the wavelength at which the determination is made must be specified. Unless some other wavelength is specified, it is assumed that the wavelength is the yellow 589.3 nm line of sodium, denoted by n_D . Those of us who do trace evidence examinations have had that hammered into us from the outset. Typically we will even have a narrow bandpass interference filter to deliver light of that wavelength, or a sodium vapor lamp. If dispersion is to be considered, the other two classical wavelengths are the blue hydrogen line at 486.13 nm, denoted by n_F , and the red hydrogen line at 656.28 nm, denoted by n_C .

How dare anyone change all of this without asking our permission? However, it has happened, at least in Europe. DIN—the Deutsches Institut für Normung*—the agency responsible for the promulgation of standards in Germany, and consequently for much of Europe—has changed the wavelengths at which refractive indices are determined and dispersion staining colors are observed.

The new wavelength requirements are:

Wavelength	Symbol	Spectral Line
479.99 nm	n_F	Blue Cd line
546.07 nm	n_d (sic)	Green Hg line
643.85 nm	n_C	Red Cd line

Note that the new d line, according to DIN, is with a small case d, and this may serve to distinguish between the European and American designations. The new d line, the European one, isn't even yellow, as is the American D line. It is green.

Refractive indices may, of course, still be determined with our conventional American designations – we need not discard our costly C, D, and F interference filters. However, some confusion may occur if data from Europe were compared with domestic data. In that instance, the values for refractive indices will be different, particularly the v (nu) value for dispersion.

John Thornton
Napa Sheriff's Department

Meagan Gallagher
California Dept of Justice – Central Valley Lab

*Deutsches Institut für Normung e.V. – in English, the German Institute for Standardization. This is the German national organization for standardization, equivalent to our NIST, and is Germany's ISO member body. Currently there are about 30,000 DIN standards, covering nearly every field of technology.

Turning to the Jury

Throughout my career as a criminalist I had been excused from jury service by one or both attorneys, presumably because they decided someone in my profession wouldn't be objective or perhaps be unsympathetic to their arguments. All that changed this past June when I found myself on a district court panel, hearing a multi-count misdemeanor case. It's quite interesting, seeing the expert testimony delivered TO you rather than BY you for a change. I think the experience would be quite valuable for anyone making his or her living as an expert witness. One thing that stood out for me was when a prosecution witness was asked a question on direct examination, she turned towards the jury and gave her answer, just as we're taught to do. It's natural to want to direct your answer to the attorney who asked the question, but we're taught that the jury is the one who decides our credibility and therefore we should include them in our response.

But that's not quite how it came off, at least not for this witness. I immediately felt that it looked contrived. Not that the person was lying, just that it looked like she'd been coached to "remember to turn to the jury." She didn't help her cause when she was asked questions by the opposing counsel, either. She sat rigidly in her chair and only looked at the attorney. Hmmm, looks like she was told to turn to us by the prosecutor. It was just a feeling that I got, and I immediately thought "I hope I didn't come off that way when I was testifying!"

Now that I've seen this technique from the other side of the jury box, I can only offer this simple advice: Make it look natural! Certainly, simple answers would look ridiculous if the witness paused and turned toward the jury to say "...yes." However, long answers should appear thoughtful, perhaps the witness could acknowledge the attorney and look at the jury to include them in the response. No doubt there is an element of nervousness at play as well. That's why we as frequent court participants should strive to overcome our nervousness. After all, if we are perceived as being less than forthright on the stand, we've wasted our time in the lab!

John Houde

Beard Hair Research

This may be of interest to those who do microscopic hair comparison.

Abstract: We have investigated the expression of 52 of the 54 keratins in beard hair medulla. We found that not only 12 hair keratins but, unexpectedly, also 12 epithelial keratins are potentially expressed in medulla cells. The latter comprise keratins also present in outer- and inner-root sheaths and in the companion layer. Keratins K5, K14, K17, K25, K27, K28, and K75 define a "pre-medulla," composed of cells apposed to the upper dermal papilla. Besides K6, K16, K7, K19, and K80, all pre-medullary epithelial keratins continue to be expressed in the medulla proper, along with the 12 hair keratins. Besides this unique feature of cellular keratin co-expression, the keratin pattern itself is highly variable in individual medulla cells. Remarkably, both epithelial and hair keratins behave highly promiscuously with regard to heterodimer- and IF formation, which also includes keratin chain interactions in IF bundles. We also identified cortex cells within the medullary column. These exhibit all the properties of genuine cortex cells, including a particular type of keratin heterogeneity of their compact IF bundles. In both keratin expression profile and keratin number, medulla cells are distinct from all other cells of the hair follicle or from any other epithelium.

Abstract reprinted by permission from Macmillan Publishers Ltd: *Journal of Investigative Dermatology* (2010) 130, 55–73; published online 9 July 2009.

Bob Blackledge

Biofuels as Accelerants

The article abstract at the below link may be of interest to criminalists involved in fire debris cases.

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

Excerpt:

In general, the term biofuel is associated with only a few select chemical compounds, especially ethanol (used exclusively as a gasoline replacement in spark-ignition engines) and very large methyl esters in biodiesel (used as a diesel fuel replacement in diesel engines). The biofuels are oxygenated fuels, which distinguishes them from hydrocarbons in conventional petroleum-based fuels.

Bob Blackledge

Engineer's Conversion Table

(Hat tip, Bob Blackledge)

Ratio of an igloo's circumference to its diameter = Eskimo Pi
2000 pounds of Chinese soup = Won ton
1 millionth of a mouthwash = 1 microscope
Time between slipping on a peel and smacking the pavement = 1 bananosecond
5. Weight an evangelist carries with God = 1 billigram
Time it takes to sail 220 yards at 1 nautical mile per hour = Knotfurlong
16.5 feet in the Twilight Zone = 1 Rod Serling
Half of a large intestine = 1 semicolon
1,000,000 aches = 1 megahurtz

Basic unit of laryngitis = 1 hoarsepower
Shortest distance between two jokes = A straight line
453.6 graham crackers = 1 pound cake
1 million-million microphones = 1 megaphone
2 million bicycles = 2 megacycles
365.25 days = 1 unicycle
2000 mockingbirds = 2 kilomockingbirds
52 cards = 1 decacards
1 kilogram of falling figs = 1 FigNewton
1000 milliliters of wet socks = 1 literhosen
1 millionth of a fish = 1 microfiche
1 trillion pins = 1 terrapin
10 rations = 1 decoration
100 rations = 1 C-ration

CAC Representative to the Standards, Policies and Procedures Interagency Working Group

SPPIWG REPORT

The Subcommittee on Forensic Science (SoFS) was established by action of the National Science and Technology Council (NSTC) Committee on Science (COS) on July 7, 2009. SoFS is assigned the task of assessing the practical challenges of implementing those recommendations and advise the White House on how best to achieve the goals outlined in the NRC report titled *Strengthening Forensic Science in the United States: A Path Forward*. The purpose of the SoFS is to advise and assist the COS, NSTC, and other coordination bodies of the Executive Office of the President on policies, procedures and plans related to forensic science in the national security, criminal justice, and medical examiner/coroner systems at the local, state and federal levels. The Subcommittee shall terminate no later than September 31, 2011. Members of SoFS consist of representatives from the following agencies: Department of Commerce, Department of Defense, Department of Energy, Department of Homeland Security, Department of the Interior, Department of Justice, Department of Labor, Department of the Treasury, Environmental Protection Agency, Intelligence Community, National Institutes of Health, National Science Foundation, Smithsonian Institution, and the United States Postal Service. Additionally, the following organizations in the Executive Office of the President are represented on the Subcommittee: Domestic Policy Council, Office of Management and Budget, Office of Science and Technology Policy, National Security Council, and the White House Counsel. Additional information can be found at www.forensicscience.gov.

To accomplish the task, the SoFS sought input from the Forensic Science communities. Therefore, the SoFS formed the following Interagency Working Groups (IWG): Education, Ethics & Terminology, Accreditation & Certification, Outreach & Communication, Research, Development, Testing & Evaluation, and Standards, Practices & Protocols. The goal of SoFS was to have representatives from state and local practitioners and stakeholders, however the initial makeup of the IWGs was from federal agencies as SoFS had to be consistent with the Federal Advisory Committee Act. To solicit local input while adhering to federal rules, the SoFS solicited local volunteers, which would be endorsed by an elected official.

SoFS requested nominations from various professional organizations to fill these positions on the IWGs in Febru-

ary 2010. Mary Hong, then President, nominated Jennifer Mihalovich as one of the California Association of Criminalists representatives for consideration for membership on an IWG. SoFS approved the nomination and Jennifer Mihalovich submitted to SoFS a formal application. In June of this year, Ms. Mihalovich was selected by the SoFS to serve on the Standards, Practices, and Protocol Interagency Working Group (SPPIWG). Once selected, she required an elected official to authorize her to serve as their representative on this group. Oakland Mayor, Ron Dellums, authorized her to represent him on this group in July.

In support of the Subcommittee's efforts, the SPPIWG will convene with the purpose of exchanging views, information, and advice relating to the management and implementation of Federal programs relating to forensic science that are established pursuant to statutes that share intergovernmental responsibilities or administration. To accomplish this the SPPIWG plans to:

- Identify Standards Development Organizations (SDOs).
- Inventory existing standards/best practices/guidelines/protocols, including those relating to identification, collection, preservation, analysis, evaluation, comparison, interpretation, terminology, and reporting.
- Recommend processes for conducting a gap analysis, improving existing standards and protocols, and developing new standards and protocols where needed.

The SPPIWG shall, as appropriate, outreach to and obtain input from forensic science and criminal justice organizations, state, local, and private practitioners, and other stakeholders.

The SPPIWG is scheduled to meet every month to exchange views, information, and advice relating to the tasks assigned to the group by the SoFS. The first meeting in which the state and local members were in attendance was held on August 9th and 10th in Denver. The main topic of discussion centered on the use of the Scientific Working Groups as a resource for preparation of standards for use by forensic scientists. Additional topics related to standards, practices and procedures are to be vetted over the next twelve months.

I sincerely thank the CAC for the nomination to the Interagency Working Group. I will represent the best interest of the CAC during my interactions on the Standards, Practices, and Procedures group. Should any CAC member have topics they wish to raise to this group, please do not hesitate to forward them on to me. I will be up-dating the membership of the SPPIWG actions at each membership meeting and in the *CACNews*.

Jennifer Mihalovich

The main topic of discussion centered on the use of the Scientific Working Groups as a resource for preparation of standards for use by forensic scientists. Additional topics related to standards, practices and procedures are to be vetted over the next twelve months.

The Nadjik Pheromone

by Michael Kenneth Hemp

REVIEW BY BOB BLACKLEDGE

The Nadjik Pheromone is a work of fiction that CAC-News readers should find interesting. However, before I begin the review I'll relate the story of how this book and its author came to my attention. The experience for me contains an object lesson I wish I had learned eons ago. Perhaps it may be of benefit to younger CAC members.

For over forty years I've been a member of the American Chemical Society (ACS). I regularly receive ACS mailings and was aware that this past May they were holding a national meeting in San Francisco. Although I would not be able to attend, I nevertheless scanned the advance program for any presentations that might be of interest. A session titled "True Stories of Success from Chemical Entrepreneurs" and sponsored by the ACS Division of Small Chemical Businesses and cosponsored by the Division of Professional Relations caught my eye. Most of the talks looked like they would be boring, but "Truth, a "novel" concept: The Nadjik Pheromone is the future of biochemical breath analysis lie detection", Michael K. Hemp, certainly piqued my interest. I navigated the site and found and read the abstract. Although there were clues such as "novel" in parenthesis (used as a pun - novel meaning quite original and novel meaning a work of fiction), I didn't catch them. I thought this was a report of original research and I copied the abstract and e-mailed it to several friends. Was my face red when one of them politely replied that they thought it was a work of fiction and that was confirmed by my Google search!

I sent an e-mail to several higher-ups in the ACS saying that I felt the title of the presentation and also the abstract were misleading. Well, it was like stirring an ant hill with a stick. There were several e-mails back and forth between ACS officials (I was cc'd). The bottom line was that although they all agreed there was no intent to mislead, they could see that from the wording it wasn't obvious that the presentation was about a work of fiction.

The week after the meeting I received an e-mail from Michael Hemp. Although the subject line read "My thanks for your comments", I was afraid that this was sarcasm and that I had made a mortal enemy. I opened it with some trepidation. After the salutation it began: "I want to thank you for your comments on representations of "The Nadjik Pheromone" for the ACS San Francisco conference. They could have been handled more clearly, though no subterfuge was intended. The effect, though, was a marvelously harmless and perfect level of controversy I want to thank you for. It made it possible for ACS to be aware there was such a thing on the presenter's schedule." In closing he offered to send me a free copy of his book (he did).

His e-mail started a very satisfying correspondence between us. In my retirement and reflecting back on my life, I wonder how things might have been different if instead I had reacted to criticism in a positive way. Who knows? Perhaps the old boy/old girl clique that reviews forensic science grant proposals to the National Institute of Justice might even have approved one of mine!

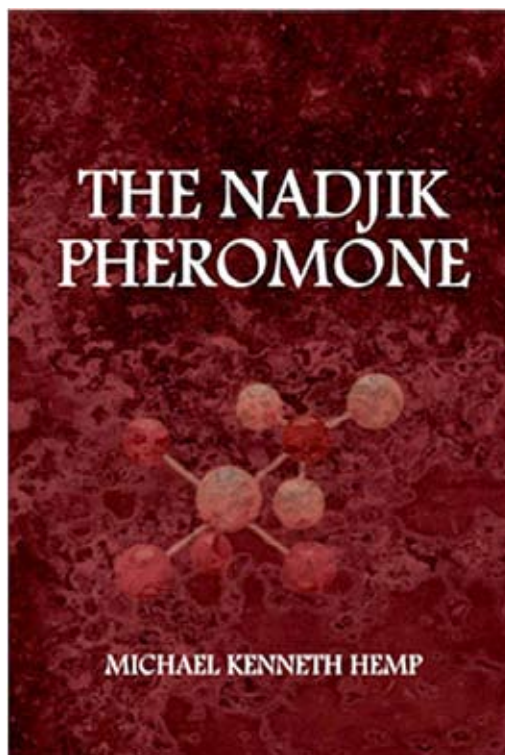
Before I launch into the book review, one more thing about Michael Hemp. He has a great sense of humor. When a

copy of his book arrived by mail it included a rather unusual bookmark, a roughly 12" length of twine. You guessed it; the twine was made from hemp!

The book takes place in the very near future. In many ways it is like many of the books by Michael Crichton (The Andromeda Strain, Jurassic Park, etc.). That is, it involves science that is either right on the cutting edge or very likely to be possible in the very near future. Also like Crichton, the characters are interesting and three dimensional, the plot though intricate is believable, and there are also very interesting subplots. The central character is a war correspondent for a major world wide news agency. He covered the war in Bosnia and is greatly upset by the genocide that took place. Unlike with the Nazis and World War II, there is virtually no documentation of these crimes. Will those at the highest level and most responsible get away with murder? Oh if only there was an absolutely reliable machine that could detect when someone is lying! Well, the hero meets some new friends that work in Silicon Valley, and based on their research in related areas they strongly feel the development of such a machine is possible with today's technology. They set off to do just that. Of course, there are many (not just the Bosnian war criminals) that would not welcome such a machine, so you can see where the plot is heading.

The book is not without its flaws (typos and the ending could have been handled better), but for a first book it's a fine effort and it really left me with lots to think about. The book was a 2009 Fiction Finalist in the Indie Book Awards and The NATIONAL BEST BOOKS 2009 Awards Finalist.

Michael Hemp will be giving a reprise of his ACS presentation at the fall 2010 CAC Seminar in Oakland, and will be available to sign copies of his book. I plan to be there.



347 pages, Hardback \$26.96, ISBN-10: 0-941425-03-7, Published June 2008

The Experience Fallacy

Quoth the Raven, "In my experience," Nevermore!



We recently had the pleasure of attending the NIJ conference on Pattern and Impression Evidence in Clearwater, FL, where we heard a wide variety of speakers, and an even wider variety of opinions expressed about the forensic disciplines encompassing dermal ridge prints, shoeprints, and toolmark/firearm evidence. Given the grand total of 2½ restaurants located within walking distance of the conference venue, we can only report that both the spirits and the spirited conversation were sufficient to elevate the menus during most of the week. On the last night we were desperate enough to spring for a cab and had a truly memorable meal with friends.

A clear dichotomy of opinions emerged on the first day of the week-long conference. One refrain, emanating predominantly from practitioners set on perpetuating the status quo, proffered examiner experience as a reliable and sufficient basis for a conclusion. The competing viewpoint, championed strongly by forensic commentators, and echoed by a minority of academically-oriented forensic practitioners, countered with the concept of evidence-based practice; the idea that conclusions emerging from examinations and analyses must be supported by data, preferably peer-reviewed published studies. One of those commentators, Professor Jennifer Mnookin of UCLA law school, has captured this sentiment in the question, "What is the warrant for the claim being made?" While she is certainly not the first to suggest this concept, Mnookin is currently one of the most articulate and vociferous proponents for data-driven conclusions. However, lest the reader

dismiss this idea as some new-fangled construct of forensic science critics, we point to Chapter 1, *The General Assumptions and Rationale of Forensic Identification* by John I. Thornton and Joseph L. Peterson in *Science in the Law: Forensic Science Issues* (Faigman et al., 2002)

"Many witnesses have learned to invoke experience as a means of circumventing the responsibility of supporting an opinion with hard facts. For the witness, it eases cross-examination. But it also removes the scientific basis for the opinion.

Testimony of this sort distances the witness from science and the scientific method. And if the science is removed from the witness, then that witness has no legitimate role to play in the courtroom and no business being there. *If there is no science there can be no forensic science.* [emphasis in the original]

Experience is neither a liability nor an enemy of the truth; it is a valuable commodity, but it should not be used as a mask to deflect legitimate scientific scrutiny, the sort of scrutiny that customarily is leveled at scientific evidence of all sorts. To do so is professionally bankrupt and devoid of scientific legitimacy and the courts would do well to disallow testimony of this sort. Experience ought to be used to enable the expert to remember the when and the how, why, who, and what. Experience should not make the expert less responsible, but rather more responsible for justifying an opinion with defensible scientific facts."

While vigorous debate currently exists as to whether a sufficient warrant currently exists for the more general, foundational, claims made by those disciplines around which the conference was organized, we limit our comments here to the ubiquitous "based on my experience ..." claim used widely to justify opinion testimony across all forensic disciplines.

Surely you have encountered these kinds of questions in court or discussions with investigators or attorneys:

- How often have you seen "this" at a crime scene?
- How often do you encounter this quantitative level of heroin?
- In how many of the sex crimes that you investigate is saliva detected?
- How often do you find sperm in underwear?
- Do you expect that the assailant will have lots of blood on him/her from a crime of this nature? (The answer usually starts with, "Based on my experience with these types of crimes...")

Surely we can properly and accurately recall our professional activities, and, if so, offer them as a partial basis of our expertise, can't we?

Well, frankly, no, we can't.



Gustave Dore

- *Don't you find always find blood on objects used to a bludgeon a person?*

I'm sure you can add many more interesting and creative examples to this list.

Is our experience in the practice of our profession a proper foundation for such opinions or testimony? While experience may, on occasion temper the interpretation of data, or suggest further tests that might be conducted, it should never, itself, provide the basis for a conclusion.

When we invoke our experience to promulgate an opinion, particularly in court, we, and consequently our audience, infuse that opinion with the same weight as our analytical results. Attorneys, of course, are all on board with this as long as it benefits their argument. And juries surely want to hear us expound on critical aspects of their case from a position of scientific expertise. But several reasons exist as to why reliance on experience is seductive and insidious. While carefully avoiding the absolutist trap of "never," we feel confident in counseling that at least most of the time we should avoid offering experience-based opinions *because they rely on our memory* of our past analytical results and experiences.

What's wrong with this? We are professionals, we pay detailed attention to our work, and we follow strict protocols and procedures. Surely we can properly and accurately recall our professional activities, and, if so, offer them as a partial basis of our expertise, can't we?

Well, frankly, no, we can't.

Most of us believe that we store information in our brain largely unchanged from our first encounter with it until we retrieve it later for some use, and that it is impervious to any outside influence. In fact, however, research has amply demonstrated (see, generally, Loftus 2003, Wells 2002, Wells 2003) that, as human beings, our memories are notoriously suspect, and deceive us at almost every turn. Consider:

- Our memories are not fixed, and our memories can be scrambled.

Psychological research has demonstrated that memories are encoded in different parts of our brain, and access to those memories is not a matter of simple will-power. We will not have access to every detail of a memory for an event (such as the working of a crime scene), and different parts of the memory may be activated by different stimuli (e.g. color, scent, emotion). In addition, both the sequence and relative associations of memories may be scrambled; we may not correctly recollect the order of events or whether a particular memory goes with event A or event B. In this way we may combine bits of memories from different experiences into a memory that we believe is of a single event. We cannot operate with the belief that we are remembering something clearly, for the memory may not be accurate or authentic.

- We pick up memories from different sources.

Our memory of the event itself may be combined with bits of our memory acquired from other sources; the perception of others, other events happening at the same, or even different times, and extraneous cues can all influence our apparent recollection of an event. Post-observation information is often incorporated into a recollection of an event, supplementing or altering it. This is dubbed the *misinformation effect*.

- Memories can be induced from non-existent incidents.

We hope that this effect does not occur, even rarely, amongst experts. But it is a well established phenomenon that, with the right stimulus and motivation, false memories can be planted into everyday memories of normal individuals. We only mention this to make analysts aware of the possibility that they should be wary when another analyst says, "Don't you remember that?" If you don't remember it, or if no independent evidence exists, be very, very careful of being persuaded of something suggested by another expert, or, worse yet, an attorney.

In brief, then, just like physical evidence, memories can be contaminated, lost, or destroyed. And if we cannot rely on our memories to accurately bring forth the benefit of our experience to any topic, then we are failing in our duties as scientists to offer warranted information to the remainder of the criminal justice system, which relies on our integrity to provide scientific, evidence-based analyses and conclusions.

Other persuasive arguments also exist that should convince us to abandon the practice of offering our "experiences" as the basis of an opinion or comment:

- We don't keep track of (document) our experience. No one writes down everything that they encounter. How many serologists have documented the number of sexual assault cases that are sperm positive, ACP positive, and p30 positive? Probably a few, but not most. How many have kept track of the number of times a knife that didn't have blood on it was submitted in a stabbing case, even though it was apparently the weapon used? How many of those knives had the assailant's blood on them from knife-slip? These are typical of the questions that we encounter, and many analysts will answer them with confidence, relying on memory, and without adequate documentation.

- Not being members of the Borg collective, each of us possesses only our own experience. How do we know whether our experience is typical or atypical? Or what proportion of the collective experience it represents? We rarely compare our experiences with those of our colleagues in any rigorous way. If we do, it's called a publication, which can serve as a legitimate basis for our claim. But if my 'experience' differs from yours, who's right? Do we integrate our experiences, subtract them from each other, arm wrestle? Other than joining the hive, no adequate means exists to resolve the lack of 'collective experience'. Some may claim that this is the very meaning of, "in MY experience," but rarely does that caveat result in moderation when the speaker offers the opinion, nor does it provide any reasonable means of tempering reception by the lay listener, usually the trier of fact.

- When we rely on our analysis of the physical evidence submitted to us as a sole or prominent basis for our experience, by definition we don't know the ground truth of the event. We are asked, or we offer, what our experience tells us because we, or the person asking, believe that such experience can bring clarity or resolution to an issue in dispute. What good would it do to keep track of blood negative knives if we don't know

whether it was indeed the weapon used? The knife in front of us was found on the suspect, it is blood negative; in your experience, is it unusual for a knife used in a stabbing to NOT have blood from the victim on it? The question is asked to deflect or minimize the inference that a blood negative knife equates to an innocent suspect, but when we don't know the ground truth of past matters, we can't use our experience based on previous appearances or assumption to count in favor of a proposition or against it.

- Any proposition supported only by experience is un rebuttable; no counterclaim is possible except someone else's experience. Of course, if some literature of controlled study exists, then the contrary stance dictated by 'experience' is more difficult to maintain. But we have even heard experts claim in the face of such data, "Well, I've never seen that!" Harrumph! Of course, the most extreme example of this fallacy is the fingerprint examiner's claim that he or she has never before seen two matching prints that didn't originate from the same source.

- Further, if no possibility exists of testing the validity of someone's experience, then it cannot claim to be scientific, or based on science. Here is the truly devastating blow to this practice; if we claim the mantle of science, we must adhere to the rigors of the discipline, and such rigor requires reproducibility, demonstrated validity, and explicit limitations. Our 'experience' satisfies none of these requirements, and so must be discarded from our armamentarium of practices that produce conclusions.

So, does our experience lack any redeeming scientific value? Quite the contrary; our experience is essential to deciding what evidence might be relevant and therefore collected and tested, to determine what cautions might be observed during the testing, and to suggest further testing on either the same or other items of evidence. In short, experience (and data!) is useful in providing high quality forensic science support to a case; but it is anathema to deciding what the results MEAN once the analyses have been concluded. We use our EXPERIENCE to guide us in properly performing the most specific and discriminating tests on the most relevant evidence, and we use DATA to decipher the meaning of the results, form conclusions, and put limits on those conclusions (quantitate the uncertainty).

Quoth the analyst "in my experience" nevermore!

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Sidebar—Regina v. Peter Weller

The British courts recently published a decision, *Regina v. Peter Weller*¹, which seems to support this notion of experience alone being an appropriate foundation for an opinion. Without dwelling on the case details, the issue related to a determination of what physiological substance accounted for the DNA profile of the victim detected under the fingernails of the suspect. The answer was, in large part, determinative of whether the contact was innocent or illicit. Those interested in the details may find the entire decision on our web site at <http://www.forensicdna.com/~Media/Weller_decision.pdf>

The Court stated, in part;

... it is unrealistic to examine a field of science of this kind only by reference to published sources.

... each of our long experience of dealing with expert witnesses in different fields is that experts often rely of *necessity* on unpublished papers and on their own experience and experiments. [emphasis added]

Later, it says,

But the real problem was that Dr. Bader was a scholar not a person who had experience of this form of science.

We want to make clear that the Court made reference to both experience *and* experiments performed by crime laboratory analysts; this is in distinction to the practice of relying solely on undocumented casework experience for an opinion, about which we have written in the main body of this piece.

Nonetheless, this Court makes the critical mistake of redefining science, rather than accepting any of the more standard definitions proffered by the field itself. First, it is not at all clear that crime laboratory workers must of *necessity* rely on unpublished papers and their experience. This reliance stems from courts asking questions to which they need answers, and laboratory workers willing to oblige them with answers that are not born of the long scientific tradition of observation, documentation, research, publication, peer-review, and replication. A more prudent response from science should be, I don't know the answer to that question; we must either do some research (open to review and critical evaluation), or courts must accept that, at the present time, science cannot provide a reliable answer to that particular question. For an experienced crime laboratory worker to accede to the request for an answer to these types of inquiries is to respond more as a craftsman, abandoning, or at least compromising, the scientific foundations of their work. We need to back-peddle from the idea that bald experience is an acceptable substitute for experimental data.

Second, the charge that the expert had no experience of "...this form of science" should trouble all practitioners. *This form of science* clearly refers to the idea that forensic science is different from other kinds of science, and should get a pass on rigour. The Court not only suggests, but demands, that our experience (continually defined as unpublished experiments, experience with the type of evidence examined, and reliance on the work of other examiners) not only supplements, but in this case

1 Neutral Citation Number: [2010] EWCA Crim 1085

trumps, rigorous detailed experimentation of the subject matter. The Court clearly states that:

It is inevitable that in most criminal cases there will be no forensic laboratory study that replicates the circumstances in a particular case.

but seems untroubled by the consequences of this inevitability, believing that the experience of the examiner adequately compensates for the lack of real data. The Court also fails to appreciate that, although by definition the exact circumstances of any particular crime cannot be duplicated in the laboratory, an accumulation of experimental data under similar circumstances can provide an objective foundation from which to form a conclusion. In large part what the experimental data provides is LIMITS to the conclusion. Determining the level of uncertainty immediately returns the conclusion, or even the opinion, to the scientific realm.

Assume that you go to the doctor, and after listening to your complaints and performing a thorough examination, postulates that you have prostate/breast cancer (choose the example that resonates). The physician will then test the hypothesis by requesting analyses that may confirm or refute it. When the physician receives the results of the tests, he will choose the next steps in the healing process based on what the test reveals. In this regard, he has at least two choices: he may reflect on his personal experience (the last three of my patients who exhibited these symptoms coupled with these test results were wrongly diagnosed with cancer), or he may consult collective studies, using controlled variables and a statistically significant number of patients, that demonstrate the value (false positive and false negative rates) of the tests. He is clearly on more solid ground by relying on experimental data, than on his memory and limited exposure to patients with this set of symptoms and test results. Even if he has kept meticulous records of his patients' results over his entire career, he is in a better position to judge the true condition of his patient based on the data collected from controlled experiments rather than merely relying on his own, for that data will surely provide a more reliable estimate of the patient's true situation. You may argue that, in the absence of data, the physician must

still make a diagnosis, even if no other data exists than his own experience. But we are under no such stricture; we can, and should, indicate that we have no reliable data on which to base an opinion, and the courts must proceed without benefit of scientific input. In fact, the courts receive a more accurate representation of the true weight of the evidence absent the false patina of science.

We are especially troubled by the closing remarks of the Court:

...but we do hope that the courts will not be troubled in future by attempts to rely on published work by people who have no practical experience in the field and therefore cannot contradict or bring any useful evidence to bear on issues that are not always contained in scientific journals. There are plenty of really experienced experts who are available and it is to those that the courts look for assistance in cases of this kind.

We believe that the courts should be more troubled by "really experienced experts" (what counts as *really* experienced?) than by attempts to rely on actual data. The *experience* of every single crime lab analyst is that the sun circles the earth on a daily basis; only a rigorous and detailed analysis of the movement of celestial bodies reveals the fallacy of that notion. Presumably, all lab analysts are indeed convinced of the fallacy of the proposition, and believe, in spite of their *experience*, that the earth circles the sun. If the courts insist on eliciting unsupported opinions from scientists for the purpose of simply providing more information (accurate or not) to the trier of fact on which to base a verdict, then the scientists themselves must be the ones to resist that pressure. We must become more adept at saying, "I don't know," and also convincing the courts that this is actually the more appropriate answer. To some extent we must resist diluting the impact of supported scientific conclusions with opinions based merely on expertise and experience. This will ultimately strengthen our profession and increase our ability to assist the court by providing accurate, reliable information to the criminal justice system.



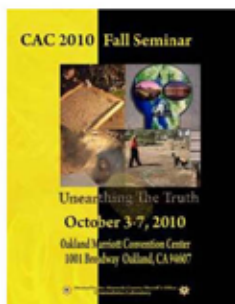
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The Chemistry of the Luminol Reaction— Where to From Here?

John I. Thornton, D.Crim., and Ralph S. Maloney, B.S.

Introduction

Due to the proven carcinogenicity of benzidine and the suspicion of mutagenicity or worse on the part of a number of its structural congeners, there is a distinct need for alternative presumptive chemical tests for blood. Although the classical luminol reaction has definite drawbacks as a presumptive chemical test for blood in routine applications, luminol is *not* mutagenic by the Ames test, and would deserve to be viewed with renewed interest by the forensic community if the specificity could be enhanced. The test as it is generally conducted is sensitive, but not particularly specific. The present work is intended to review the chemistry of the luminol reaction, the ultimate aim being to increase the specificity of the reaction by an adjustment of test parameters. Virtually all of the work that has been conducted on the luminol test up to this time has been directed toward making the reaction more *sensitive*; the chemistry of the reaction has not been subjected to any particular scrutiny to ascertain if it could be made more *specific*. The chemistry of luminol was last reviewed in the forensic literature in 1939, at a time when the nature of the reaction was poorly understood; the present work as an attempt to tidy up the chemistry so that promising avenues of further inquiry may be identified.

History of the Luminol Reaction in Forensic Practice

When luminol (I) was first synthesized, it was known by its chemical name of 3-aminophthalhydrazide rather than by its trivial name. (Purists may be more comfortable in calling it 5-amino-2,3-dihydrophthalazine-1,4-dione). It was first synthesized in 1902 by Schmitz [1]. It was not until 1928, however, that Albrecht first drew attention to the chemiluminescent properties and carried out fundamental spectral measurements [2]. This work was then confirmed in 1936 by Gleu and Pfannstiel [3], who discovered that crystalline hemin produced an especially intense reaction. This observation concerning hemin was almost simultaneously discovered by Tamamushi [4] in 1937.

In 1929, Harvey determined that the chemiluminescence of 3-aminophthalhydrazide is a result of anodic oxidation, or, alternatively, the result of molecular oxygen activated by metals [5]. In 1934, Huntress et al. published [6] a much more economical synthesis, and named the compound "luminol."

In the forensic domain, luminol was first proposed as a presumptive test for blood by Specht in 1937 [7], apparently at the suggestion of Gleu and Pfannstiel, whose interests were more aligned with the pure chemistry of the compound. In 1939, two San Francisco Bay physicians, Proescher and Moody,

published a rather definitive study entitled *Detection of Blood by Chemiluminescence* [8]. This is virtually the only detailed treatise on the subject from a forensic standpoint, although at that time the mechanism of the reaction was poorly understood. The first epoch in the forensic utilization of luminol ended about the time of Proescher and Moody. For a number of years thereafter, forensic consideration of hematin catalyzed luminol oxidation principally centered around differing perceptions of the specificity of the reaction [9-11]. Although numerous articles were published in other disciplines describing the chemiluminescence of organic hydrazides. (In other disciplines, luminol came to be a fairly prosaic way of monitoring oxidation reactions of a wide variety of sorts.) In 1966, Weber [12] described a more sensitive luminol reagent, in which the concentrations of luminol and of hydrogen peroxide, found to be inhibitory, were decreased. Then in 1973, Zweidinger [13] published a somewhat cursory discussion of the utility of luminol for the location and presumptive testing of bloodstains, the principal thrust of the article dealing with photography of the reaction.

Terminology

The chemistry of the luminol reaction can be a bit tricky, and variables in the reaction may give rise to considerable complexity in the reaction. This complexity is compounded to some extent by the confusion in nomenclature and general imprecision in terminology that occurs in the literature. As a consequence of this, an attempt will be made, to the extent possible, to standardize terminology against the International Union of Pure and Applied Chemistry *Compendium of Analytical Nomenclature* [14].

Chemistry of Luminol

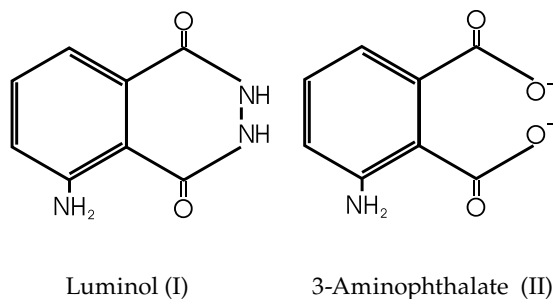
Chemiluminescence is the emission of light in excess of blackbody emission during a chemical reaction; like fluorescence, it occurs when, an electron moves from an excited to the ground state. Unlike fluorescence, it does not require excitation by radiant energy. It does require, however, a chemical reaction which will supply energy of at least 40-70 kcal/mole [15]. Many chemical reactions are capable of supplying that much energy, and indeed there must be a large number of chemiluminescent reactions; the development of instrumental means to detect as few as 10^3 photons $\text{cm}^{-3} \text{sec}^{-1}$ [16-17] has permitted studies of these weak reactions.

But only a few reactions are known where the chemiluminescence is truly brilliant. Among these is the reaction involving luminol. Albrecht [2] concluded that oxidation of luminol in alkaline solution gave 3-aminophthalate dianion (II) and nitrogen.

Since after the chemiluminescence had ceased only luminol could be isolated from the reaction mixture, Albrecht concluded that luminol itself was the light emitting species.

Ed. note: First published in the CACNews in September, 1985, this article seems to be enjoying a renaissance of late. We've noticed an uptick in requests for reprints so we thought we'd save librarians some trouble.

This assumption was challenged by White and co-workers [18-20], who established, during the period 1961 to 1964, that the 3-aminophthalate dianion is the light emitting species.



The work that has been done on the luminol reaction since 1964 has refined somewhat the assumptions that have been made concerning the mechanism of the reaction, but hasn't totally elucidated the precise mechanism. This is primarily the result of an inability to identify certain of the intermediate species which are being formed and altered too rapidly to permit isolation. The Albrecht mechanism [2], and that of Shevlin and Neufeld [21], both of which are outlined in the sourcebook, *Forensic Serology, Immunology, and Biochemistry* [22], are almost certainly flawed.

Certain generalities may be advanced concerning the reaction mechanism, however:

- 1.) In aprotic solvents, such as dimethylsulfoxide, dimethylformamide, or hexamethylphosphoric acid triamide, only a base and oxygen are required [23]. Aprotic solvents are consequently unsuitable for forensic work.
- 2) In protic solvents, e.g., base, the requirements of the reaction are the base, an oxidizing agent, a catalyst, and either oxygen or a peroxy compound [23].
- 3) (Hemin) catalyzes the oxidation of luminol independent of the concentration of the base [24].
- 4) Luminol acts as a typical two electron donor in peroxidase catalyzed reactions. Chemiluminescence is initiated by a one-electron oxidation of luminol, followed by a rapid addition of superoxide. It is then necessary to add a second electron to the peroxy radical in order to prepare it for the final light emitting step [25].
- 5) Oxygen is required stoichiometrically [26].
- 6) As per electron paramagnetic resonance, free radicals are involved [27].

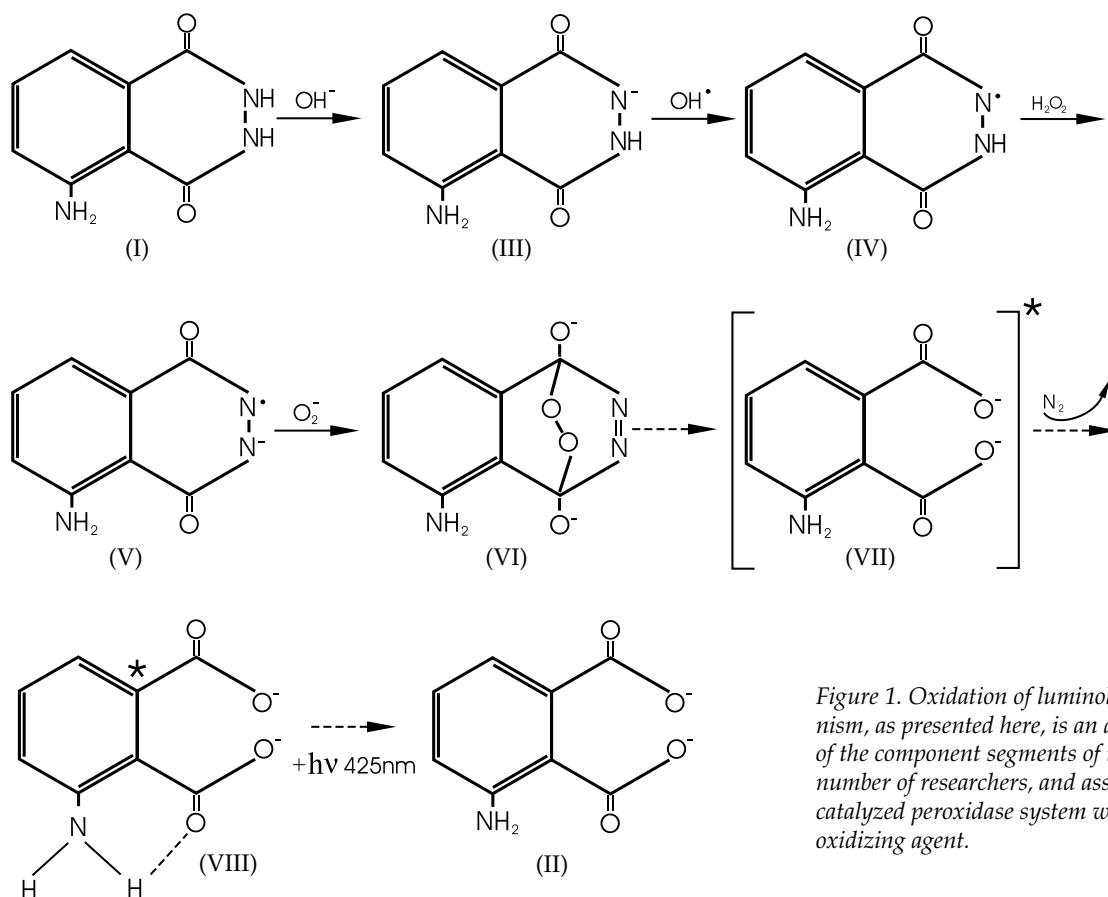
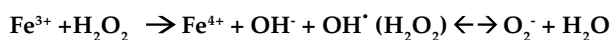


Figure 1. Oxidation of luminol. This mechanism, as presented here, is an amalgamation of the component segments of the work of a number of researchers, and assumes a hematin catalyzed peroxidase system with H_2O_2 as the oxidizing agent.



Luminol, cont'd

7) Super-oxide is involved in the reaction [28], since superoxide dismutase inhibits the reaction at neutral and acidic pH in aqueous solutions.

8) Nitrogen is produced stoichiometrically [26].

9) The 3-aminophthalate dianion species is the end product [29].

10) The effects of both luminol and hydrogen peroxide concentration on the luminescence rate show normal Michaelis-Menten kinetics [27].

By the pathway outlined in Figure 1, luminol (I) is oxidized by a hydroxy anion generated from the reduction of an oxidant, in this case H_2O_2 , to the luminol monoanion (III), which is then immediately converted to the luminol radical (IV) by a hydroxy radical present from the previous reduction of the hydrogen peroxide. This luminol radical is then attacked by another hydroxy anion to further oxidize the luminol radical to the luminol radical anion (V). This radical anion is then attacked by a superoxide radical to form a transannular peroxide, luminol endoperoxide (VI). Then, by as yet an unknown pathway, this endoperoxide is converted to an electronically excited dianion (VII) with the subsequent loss of nitrogen. Upon the return of the excited dianion to the ground state (II), a photon with a wavelength of approximately 425 nm is emitted. The pH optimum for the *light emitting* reaction is 10.4 to 10.8 [30], a fact that has profound implications for the luminol test as a presumptive test for blood.

Catalysis of the Reaction by Blood

One severe constraint on the luminol test is that one cannot optimize the light emitting reaction without compromising the reactions that cause blood to react. When one turns to what it is in blood that causes the luminol reaction to kick over, and for that matter, other catalytic reactions as well, one runs afoul of the terminology. The classical statement is that catalytic tests for blood depend on its "peroxidase activity." The suffix "-ase" ordinarily suggests a protein enzyme, but in this context it does not. Heme compounds, i.e., ferri- and ferroporphyrins, may *mediate* oxidation of organic compounds, including peroxide.

The iron in heme may exist in either the Fe^{2+} ferrous, the Fe^{3+} ferric, or the Fe^{4+} transition state. Fe^{2+} is the state in ferroporphyrin (heme) or as the state existing in oxyhemoglobin. Fe^{2+} can be easily oxidized to Fe^{3+} which is the form of iron in methemoglobin. A fundamental feature of the luminol reaction is that heme can catalyze the reduction of peroxy compounds while at the same time catalyzing the oxidation of luminol. Oxyhemoglobin can be oxidized so that the iron is in the Fe^{3+} state. Upon the addition of an oxidant such as hydrogen peroxide, sodium persulfate or sodium perborate, ferriprotoporphyrin (hematin) is further oxidized to the Fe^{4+} transition state, while at the same time reducing the oxidant. The addition of oxygen to ferriprotoporphyrin should convert the iron to the Fe^{5+} transition state; however, an extra electron is supplied from somewhere in the hemoglobin molecule, probably from the ligand attached to position 5 of the heme molecule [31] so that the highest transition attained is the Fe^{4+} state. Chemiluminescence is initiated by a one electron oxidation of reduced luminol, followed by a rapid addition of a superoxide molecule; it is then necessary to add a second elec-

tron to the peroxy radical in order to prepare it for the final, light emitting step. At the same time that luminol is being oxidized, the Fe^{4+} ferriprotoporphyrin is being reduced, allowing the heme molecule to again participate in the reaction as a catalyst.

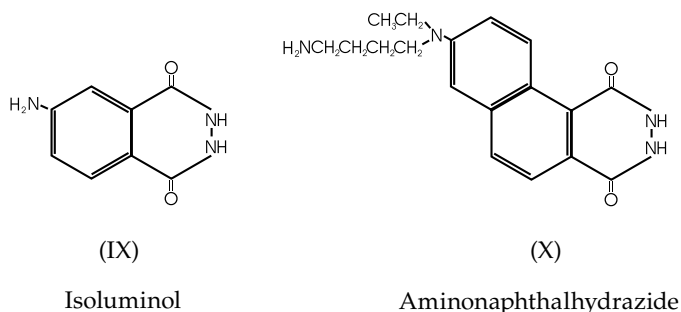
Three other possibilities exist whereby blood can oxidize luminol, two of which are likely to be insignificant. There may be a very small amount of xanthine oxidase present which upon oxidation of iron will generate superoxide which in turn can oxidize luminol, and there may be a very small amount of peroxidase (the "true" protein peroxidase enzyme) which will oxidize the luminol. The third possibility is catalase, which is present in significant quantities in red cells.

The pH optimum of catalase is approximately 7.0, and the optimum for the heme-mediated "peroxidase activity" is approximately pH 4.5. And herein lies the tragedy; the pH optimum for catalase and peroxidase is very far away from the pH optimum of the luminol reaction. If an acidic pH is necessary for the peroxidase mechanism to proceed at optimum efficiency and an alkaline pH for the oxidation of luminol, favoring the luminol will give us chemiluminescence but at the expense of the peroxidase reaction. And when we really get down to it, it isn't the luminol reaction that we are fundamentally interested in, but the peroxidase reaction; the chemiluminescence is only a tool by which we can visualize the peroxidase (and catalase) reactions.

Candidate Modifications of the Luminol Test

The carbonyl form of luminol is required for the production of chemiluminescence, and at pH 8 only 25% of the luminol is in the carbonyl form. Therefore, if the pH were to be reduced to take advantage of the known catalytic mechanisms in blood, there will be a drastic diminution of the amount of light produced due to the reduction of luminol in the carbonyl form necessary for electron excitation. One way out of this would be to substitute another, more efficient compound for luminol; if a more efficient compound were available, we could afford to give up some of the quantum yield from the chemiluminescence reaction in order to gain on the peroxidase or catalase reaction which is teleologically of more interest.

Chemiluminescent compounds of greater efficiency than luminol have in fact been described. Isoluminol (IX) has only about 10% of the efficiency of luminol, but alkylation of the amino group leads to significant increases in chemiluminescence capability. Similar substitution on luminol, on the other hand, leads to severe steric hindrance which decreases



its efficiency. 7-(N-ethyl-N-aminobutyl)aminonaphthalene-1,2-dicarboxylic acid hydrazide (X) is 420% more efficient than luminol [32], which should permit the reaction to be run at pH 8 with approximately the same chemiluminescent yield as luminol. This material is unfortunately not available, even from the workers having originally synthesized it [33]. The synthesis is published [34], but it is a real bitch, and the present authors are not widely known for their acumen in organic synthesis.

Another approach would be to ignore the chemiluminescence of the aminophthalate, and to concentrate on the fluorescence. Luminol is not fluorescent in alkaline medium, while aminophthalates are. Since fluorescence is a more efficient process than is chemiluminescence, oxidized luminol may be more efficiently located by means of ultraviolet fluorescence of the oxidized aminophthalate than by a strict reliance on chemiluminescence. In the author's laboratory, effort is being concentrated in this direction; the principal problem with this approach is that fluorescence following autochemiluminescence, *i.e.*, oxidation of luminol by traces in the reaction mixture of Cu^{++} , Co^{++} , or other transition metal, would be even more of a problem with respect to specificity than it is with the luminol test as it classically run. Solvent parameters would have to be carefully selected.

A combination of fluorescence and the use of a more efficient aminophthalhydrazide or aminonaphthylhydrazide would seem to be a conspicuously applicable approach to the conservation of the peroxidase reaction at lower pH. This would also have the advantage of not adversely affecting the proteins in a dried bloodstain in order that other genetic markers may later be identified.

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AB-1079 and the California Crime Laboratory System: Statewide Forensic Science Oversight

*Point of View from
California Association of Criminalists
California Association of Crime Laboratory Directors*

Adam Dutra, CAC President (San Diego Police Department Crime Laboratory)
Steven Hayes, CACLD President (Alameda County Sheriff's Office Crime Laboratory)

Executive Summary

Since completing its original mandate and issuing its recommendations in November 2009, the California Crime Laboratory Review Task Force has been studying the merits of a statewide forensic oversight entity. At the June 2010 Task Force meeting, the California Association of Crime Laboratory Directors (CACLD) representative, with support of the California Association of Criminalists (CAC), introduced a motion to suspend this discussion until 2011, since the federal government is actively investigating the creation of a similar entity at a national level. The motion passed by a 6-3 vote.

After this meeting, defense advocates on the Task Force have made public statements that the crime laboratory representatives "disbanded" the Task Force and are essentially fearful of a statewide regulatory agency. We discuss herein that our opposition is not based in fear, but on the fact that sufficient oversight of forensic science already exists.

We discuss ways in which forensic science in California is already regulated. We discuss this from the perspectives of overall laboratory management, as well as required, documented commitments to quality, monitoring and testing of analysts' work. Herein we also present the existing mechanisms for handling complaints of misconduct, both at the laboratory level and for individual analysts.

The National Academy of Sciences (NAS) issued a report, "Strengthening Forensic Science in the United States: A Path Forward," in February 2009, which was critical of forensic science across the United States. This report prompted responses from virtually all of the professional organizations that accredit crime laboratories, certify individuals in forensic disciplines, and enforce codes of ethics against individual analysts. These responses are reviewed in the following pages.

Implementing a vast majority of the recommendations made by the NAS report and the California Crime Laboratory Review Task Force's report requires a dependable and longterm commitment of significant funding. At a time when state and local budgets are strained to the maximum, the creation of a new state bureaucracy that would need its own operating budget would be fiscally irresponsible, especially when the laboratories themselves currently cannot obtain the additional funding necessary to implement many of the recommendations and needed improvements.

The Task Force's 2009 report identified several key areas for laboratory improvement. We provide documentation herein indicating the active efforts and support of the CAC and CACLD to address or incorporate those areas.

Lastly, we present a plan for going forward. We propose extending invitations to participate in our semiannual meetings to other stakeholders in forensic science. While this open invitation has always existed, it is time to proactively renew the invitation. We are genuinely interested in hearing their factual concerns and issues for improvement in the forensic sciences, as everyone involved in the criminal justice system wants the best and most reliable crime laboratory system possible.

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1. Introduction

The California Association of Criminalists (CAC) and the California Association of Crime Laboratory Directors (CACLD) have been providing guidance to California crime laboratories for more than 40 years. They have always promoted the highest professional and ethical standards, an open exchange of information with the criminal justice community, and advised state legislators in the development of policies and legislation affecting forensic science. Several of our organizations' members were privileged to serve on the California Crime Laboratory Review Task Force (Task Force). The Task Force's report that was issued in November of 2009 resulted from the efforts and commitment of crime laboratory personnel, as well as district attorneys, representatives from the criminal defense community, academicians, law enforcement personnel, and others. This report genuinely reflected the state of forensic science in California and pointed out the need for significantly increasing resources for California crime laboratories.

While both the CAC and the CACLD have expressed appreciation for the thoughtful approach and efforts of the Task Force members in the completion of their mandated goal as defined by Penal Code 11062, both organizations expressed

Prepared by Jeff Rodzen, Adam Dutra, and Steven Hayes
July 28, 2010

concern with the Task Force's efforts to extend itself beyond its mandated function by continuing to convene in an effort to examine and define the functions of a statewide forensic oversight committee. Defining the role of such an oversight committee was never mandated by the legislation which established the Task Force. Additionally, the Task Force's efforts toward these ends have since been superseded by various efforts at the federal level.

The CAC and CACLD issued individual position statements concerning statewide oversight of crime laboratories, which were distributed to the Task Force members prior to the June 2010 meeting. Both statements recommended that the Task Force temporarily suspend its investigation into whether a new state-level regulatory or advisory body is needed and what the structure and function of such a body would be. CACLD Task Force representative Bob Jarzen made a motion to suspend future Task Force meetings and to request authorization from the state legislature to reconvene the Task Force in 2011 to allow time to evaluate progress currently underway at the federal level regarding forensic science oversight. California Public Defenders Association representative Jennifer Friedman offered an amendment to the motion to have an August 2010 meeting prior to suspending the Task Force. This amendment was defeated by a vote of 5-4. The unamended motion to suspend was then voted on and passed 6-3.

It must be made clear that the vote to suspend was *not* a vote to disband the Task Force, despite the defense advocates' public statements to the contrary. Suspension of the California Crime Laboratory Review Task Force has resulted in inaccurate criticisms from a minority of Task Force members who have published, or contributed to, opinion pieces in the press mischaracterizing the motion which was put forth by the CACLD as a "disbanding" of the Task Force. These misleading public statements characterized crime laboratory directors as wanting to completely regulate themselves with no oversight whatsoever, while omitting important facts about the extensive oversight which already exists for the crime laboratories in California.

Oversight and advisory bodies such as the American Society of Crime Laboratory Directors / Laboratory Accreditation Board (ASCLD-LAB), Forensic Quality Services International, the California Department of Public Health Forensic Alcohol Analysis Regulatory Program, and the Quality Assurance Standards for Forensic DNA Testing Laboratories, as mandated by the federal government for laboratories utilizing CODIS, all play significant roles in the manner in which crime laboratories of California operate. These programs hold crime laboratories accountable through external proficiency testing, education and training requirements, quality assurance programs, audits and inspection processes, and ongoing compliance monitoring requirements that help to ensure that the quality of work is of the highest order. In addition, the very nature of the criminal justice system provides its own informal, yet powerful, oversight of crime laboratories' performance through the discovery process, review of crime laboratory work by defense experts, and court "gate-keeper" decisions (e.g. *Daubert* and *Frye*).

Even with these existing oversights, CAC and CACLD have worked diligently to advance the profession of forensic science through various means such as the development of a certification program, which ultimately was adopted by the American Board of Criminalistics for testing and certifying criminalists in various forensic disciplines. CAC and CACLD

members are also active on various national and international scientific and technical working groups (SWGs and TWGs) which publish well-recognized and peer reviewed documents on best scientific practices and standards for forensic science practitioners.

Each of these mechanisms for oversight of forensic science activities plays a key role in the quality of crime laboratories in the state of California. Our state has a unique forensic delivery system which relies upon independent city, county, and state crime laboratories. There are also many forensic units operating within various police agencies and sheriff's offices which perform limited forensic services such as crime scene documentation, latent print processing, and latent print comparisons. Though operationally independent, these forensic laboratories and technical units all share the common goals of high quality scientific work and adherence to professional and ethical standards.

All public full-service crime laboratories (and several private crime laboratories) in California are accredited by nationally accepted accreditation bodies. However, as noted above, smaller unaccredited "forensic units" exist within various law enforcement agencies. Analysts in these units typically perform limited forensic services such as latent print examinations and some firearms examinations, and they testify to their results in court. It is our opinion that these analysts should be held to the same professional and ethical standards as those working in accredited labs. In this regard, the American Society of Crime Laboratory Directors has already begun a concerted effort to identify these entities nationwide and to encourage them to pursue accreditation. ASCLD is currently conducting a requisite survey at the request of ASCLD/LAB and the Consortium of Forensic Science Organizations.

Through the leadership of organizations such as the CAC and CACLD, California crime laboratories are among the very best in the nation. Studies such as those completed by the California Crime Laboratory Review Task Force have been supportive by pointing out the need for additional resources for California crime laboratories to make them even better in terms of delivery of service, providing adequate staffing and equipment, and enhancing educational opportunities for forensic practitioners. This paper is intended to discuss the ramifications of the Task Force study, address concerns of stakeholders who may feel that a strong statewide forensic oversight committee is necessary for California crime laboratories, and look at future models as to how California crime laboratories can be best supported and funded to efficiently deliver the highest quality forensic services.

2. Oversight

The general mandate of the California Crime Laboratory Review Task Force (Task Force) is to "make recommendations as to how best to configure, fund, and improve the delivery of state and local crime laboratory services in the future." One of the Task Force discussion items related to this mandate focused on the establishment of an oversight commission or advisory type body. This question of forensic services oversight has been a contentious issue within the Task Force with those in the defense community advocating aggressively for the creation of a State level regulatory body, while those representing California crime laboratories believe that creation of such an entity is unnecessary. We discuss herein that the creation of such an entity at this point in time is not needed and would be an unjustified use of scarce public dollars.

While defense advocates have routinely claimed their “vision” of a state body is not “regulatory,” their intended mission of such a body clearly indicates otherwise. The Task Force report stated that some suggested functions of a state body include: *improving allocation of resources and reduce inefficiency; standardizing terminology and improving communication of forensic science findings; evaluating the education and training needs of forensic scientists and coordinating delivery of continuing education programs; and investigations of serious negligence and misconduct.*¹ While these are the intentions stated in the formal report, the defense community has also advocated for mandatory laboratory accreditation (which, in practice, already exists), mandatory certification of forensic analysts that work in public crime laboratories, and standardization of best practices. As defined previously, these roles are clearly not “advisory” in nature, but are strongly “regulatory.” It should be noted here that advocates from the defense community simultaneously seek to exempt themselves and private forensic practitioners from these same requirements.²

Much of the crime laboratories’ experience with state-level regulation has come from the regulation of forensic alcohol testing. The general concern of forensic science practitioners is summarized on page 85 of the Task Force’s 2009 report:

“Other members of the Task Force had strong reservations about the idea [of a statewide oversight/regulatory body], questioning both the need for and the desirability of such a statewide body, particularly if it were empowered to micromanage local crime laboratory operations. The California Department of Public Health’s regulation of public forensic alcohol testing was cited as an example to be avoided. Some believe that the Department of Public Health exercised its regulatory authority in an obtuse and arbitrary manner, forcing laboratories to comply with rules in a manner that was cumbersome, inefficient, and discouraged innovation.”

Applying the Department of Public Health model of oversight to other forensic disciplines would place excessively burdensome requirements on laboratories already operating under multiple layers of guidelines, standards, and requirements.

In making the determination as to whether a forensic oversight commission is necessary, the core questions that the Task Force and public members have wrestled with, and have still not produced answers to, are “*what are the problems we are trying to fix?*” and “*what are the improvements we are trying to achieve?*” Many Task Force meetings were spent trying to get oversight advocates to answer these questions. While many issues were addressed in the Task Force’s 2009 report, the vast majority stem simply from insufficient funding by the laboratories’ parent agencies. It remains unclear how a new state body, especially one that costs money to operate, will alleviate this problem. Instead, the proponents of an oversight com-

mission have steered it towards “oversight” of best practices, accreditation, certification and surveillance of laboratory personnel and management; away from the original mandate of the Task Force. The creation of a state level regulatory body is truly a solution in search of a problem.

A review of other states’ approaches to advisory / oversight bodies was conducted by the Task Force and is presented in summary in the 2009 report. The New York and Virginia models can be characterized as strongly regulatory, while others such as Illinois and Minnesota are largely advisory. Virginia operates one state laboratory system, making management much easier than California’s diverse mix of state, county, and city laboratories. The New York commission is regulatory in that it also accredits laboratories, although it essentially rubber-stamps existing accreditations, such as those administered by the American Society of Crime Laboratory Directors / Laboratory Accreditation Board (ASCLD/LAB). It also reviews and approves new laboratory techniques and conducts investigations of misconduct. The Texas commission is another state level body that was originally intended to be regulatory. However, the authorizing legislation was so poorly written that it essentially left the commission powerless and unfunded, although it is slowly evolving into a proactive body under a new chairman.

A common complaint about various state level bodies that was observed by the Task Force is the issue of politicization. In several states, the open, public meetings of these various bodies quickly degenerated from a proactive entity to a collection of advocates with a larger forum to express their opinions. We are concerned that the same thing would occur in California, distracting an oversight body from achieving its tasks.

Before considering the value or need for an oversight committee or advisory body in California, the unique nature of the delivery of forensic science services in California and the many factors already in place to ensure a quality product, need to be taken into consideration. California is unique in the way forensic science services are delivered in that there are roughly 30 crime laboratories under various unrelated government jurisdictions across the state. Because of this lack of central control, the Task Force must

approach the discussion of the value or need for a California oversight commission or advisory type body from the perspective that existing commissions and/or advisory type bodies in other states are not directly applicable to the delivery of forensic science services in California.

Regardless of the merits of the variety of state level bodies in existence, substantial effort is being made at the federal level to implement many of the suggestions put forth in the National Academy of Sciences (NAS) report, “Strengthening Forensic Science in the United States.” Current drafts of federal legislation propose some degree of federal oversight of accreditation, certification, research, standards and best practices. Existing efforts by the President’s Office of Science and Technology Programs (OSTP) Subcommittee on Forensic Science have already created five Interagency Working Groups (IWGs) to also address these issues at the federal level. It should be noted that the IWGs and much of the current legislative efforts at the federal level did not exist when the Task Force began its work over two years ago. Creation of a new entity in California to address issues raised in the NAS report would likely either duplicate, or perhaps be in conflict with, current federal efforts.

¹ Task Force report at pages 77-81

²One example of this is the Innocence Project’s proposed legislation for oversight of forensic science (see <http://www.cacnews.org/policies/OFSISLegislativeOutline.pdf>), which states in Title V, Paragraph five, “Nothing in this Act will preclude a non-certified practitioner from testifying to the relative strengths or weaknesses of a given forensic assay, device, technique, or technology, either in general or as applied to the specific case”

3. Funding

3.1. Funding of an Oversight Entity

In order to properly execute its role of statewide oversight, a commission or body would require a full time staff and appropriate budget. This was observed in nearly all the interviews that Task Force members conducted with commissioners in other states. The New York commission has an annual budget of \$500K - \$1M and a staff of 12, and covers only 20 labs. The Texas commission has only one full time employee and a meager budget of \$200K. Considering that the state of California has, by far, the largest number of forensic laboratories, it may easily require a staff of 20 and a budget of \$1.5M, if the New York regulatory model is to be considered.

Where would this money come from? The State has faced chronic deficits from several years and this trend is likely going to continue for several more. Likewise, the economic downturn has hit county and city budgets hard, and many of their crime laboratories have faced budget and staffing reductions. Thus, local agencies will be unable to contribute funds to a state-level body.

3.2. Statewide Laboratory Improvements Cost Money

The Task Force's 2009 report identified many issues hindering the delivery of timely forensic science services in California. It identified, in detail, issues with the following areas and the complicating factors in remedying them: *recruitment and retention, improving education, individual certification, workload, staffing, facilities, lab accreditation, and funding*. Their many findings and recommendations are discussed in detail in the 2009 report and will not be repeated here.

Essentially the main root cause of California's laboratory system problems (real or perceived) is lack of funding by the parent agency: *"All the California crime laboratories surveyed reported they lack predictable and stable funding. Further, there is clear, overwhelming evidence that this lack of stable funding prevents laboratories from planning for future growth or technological advancement...California crime laboratories are under-resourced in many respects. All laboratory needs identified in the surveys...stem from the root problem of inadequate funding."*³

It remains unclear how the creation of a new state regulatory body, which would cost money to operate, will result in better funding for the laboratories. Aside from redistributing federal and/or state funds that laboratories already receive, no ideas to find new resources have been proffered by those advocating for the creation of an oversight body. Given the wide mix of funding sources, such as the various federal, state, county and city funds, it is unclear how a new state level body could possibly dictate the allocation of resources to laboratories not funded and controlled by the State.

4. Investigations of misconduct and ethics violations within California

Recent incidents of employee misconduct at the San Francisco Police Department (SFPD) and CA Department of Justice (DOJ) Ripon labs have become the rallying cry for a new state regulatory body by the defense advocacy community. Seeking to justify an oversight commission by exploiting isolated allegations of misconduct by two forensic science professionals is disingenuous and overshadows the high level of skill and dedication of California's forensic science commu-

nity. While their arguments in favor of additional state regulation may be appealing to the lay person, a new regulatory or oversight body cannot prevent occasional misconduct.

It is a sad fact of human nature that a few unethical individuals find their way into every profession. We often hear of the crooked cop, unethical doctor, dishonest attorney, intoxicated airline pilot, and so on. All of these professions have a few things in common: oversight and regulation, both by professional organizations and government entities. Human nature cannot simply be regulated out of existence, despite claims to the contrary.

Allegations of misconduct can be reported many different ways. It is standard practice for a laboratory's parent agency to conduct its own internal affairs investigations of reported employee misconduct. It is in the agency's best interest to investigate reports and either vindicate or punish the individual appropriately, since any appearance of "institutional corruption" for a public agency can result in years of serious problems and public relations issues for its upper management.

The main accrediting bodies, the American Society of Crime Laboratory Directors / Laboratory Accreditation Board (ASCLD/LAB) and Forensic Quality Services International (FQS-I) also investigate complaints of negligence or misconduct that affect the integrity of a laboratory's forensic results or noncompliance with accreditation standards, and do so diligently. ASCLD/LAB and FQS-I are themselves accredited by another entity and failing to investigate allegations of misconduct in one of their accredited laboratories jeopardizes their own legitimacy. Maintaining accreditation is a major incentive for laboratories to properly handle employee misconduct or analytical errors.

While some may argue that California does not have mandatory accreditation, in practicality it does mandate it. In order for the forensic biology unit of any crime laboratory to search a DNA profile in the CODIS database, it must be accredited. This is stated specifically in sections 295-300 of the CA Penal Code. Additionally, crime laboratories must be accredited in order to be eligible for most federally funded, forensic-related grant programs.

Laboratories receiving federal funds via the National Institute of Justice (NIJ) need to have an external clearinghouse for investigations of misconduct per the Coverdell Program reporting requirements. Within the state, the CA Emergency Management Agency (CAL-EMA) has been designated as this entity and is approved and endorsed by the NIJ. If a laboratory does not specify a designated outside agency or entity for investigating misconduct, it cannot receive federal funds under the Coverdell Program.

An individual analyst can also be censured by the CAC for violating its code of ethics, which effectively eliminates him/her as an expert witness. The CAC has censured unethical analysts in the past. The American Board of Criminalistics (ABC), which administers national certification examinations, can also revoke an individual's certification if it finds that person violated its code of ethics. Several other professional groups with codes of ethics include ASCLD, American Academy of Forensic Science (AAFS), International Association for Identification (IAI), Association of Firearm and Toolmark Examiners (AFTE), American Board of Forensic Toxicol-

³ Task Force report at page 48

ogy (ABFT), Society of Forensic Toxicologists (SOFT), and the California Association of Toxicologists (CAT).

Analysts also take required proficiency tests either annually or semiannually, depending on their discipline. Results of proficiency tests, successful or not, are required to be reported to the accrediting body in order to maintain the laboratory's accreditation. A failed proficiency test warrants a review by the accrediting body's proficiency review committee and creation of a documented corrective action plan, which is also subject to review during accreditation inspections. Failure to comply will jeopardize a laboratory's accreditation status.

Results of these investigations and actions, whether they apply to a laboratory or an individual, are also discoverable documents, as are an individual analyst's proficiency test results. The results of these investigations can be used by the laboratory's controlling agency during a disciplinary hearing. An analyst could be censured by one of several professional organizations, which would severely compromise his/her usefulness as an expert witness.

The creation of a new state regulatory body for investigating misconduct would merely be bureaucratic duplication of existing mechanisms described above. Furthermore, and especially in California, nearly all analysts belong to one of several different unions. An independent regulatory body would, in all likelihood, not be able to terminate an analyst. This would need to be performed by the analyst's employing agency.

5. Forensic Science Community Responses to the NAS Report

A common argument for new state regulations stems from the National Academy of Sciences (NAS) report.^{4,5} This report does not state that forensic science is "bad science," but rather states that several areas of forensic science need additional research. It also recommends mandatory accreditation of laboratories, individual certification, and the promulgation of standards and best practices. These points are well taken by the forensic science practitioners, but the major impediment is a lack of funding at the state and national levels.

The responses of various professional forensic organizations have been largely supportive of the recommendations put forth in the NAS report. However, the creation of yet another regulatory federal entity was discouraged by most forensic professional organizations. This was largely out of concerns for micromanagement, lack of responsiveness to local judicial culture, and concerns that a federal body composed of appointees could make drastic changes of direction with each change in administration. This occurs in virtually all federal agencies.

In a letter dated 28 August 2009, the CACLD expressed its views relating to the NAS findings.⁶ *"It is the genuine desire of our members and their laboratories that CACLD play an active role in developing and implementing the policies that will be considered in the years to come for the continuous improvement and development of quality and integrity in our profession."* Many of the CACLD's arguments supporting California laboratories. support for the NAS recommendations are phrased in respect to the ISO/IEC 17025 standards, which together with ASCLD/LAB's supplemental requirements, govern how an accredited laboratory operates a quality system. The ISO standards are very rigorous and comprise over 400 separate criteria for laboratory management and address many of the issues raised in the NAS report. These include continuous improvement of the laboratory management system and technical procedures, robust quality assurance, adherence to "customer" requests

and customer service, monitoring of analyst court testimony, and being free from undue influences. CACLD also strongly believes that academic preparation of new analysts, and continuing education for existing ones, is important and critical to maintaining a high level of competency and professionalism in the field.

The CAC issued a response to the NAS report as well, dated 15 Aug 2009.⁷ One of the largest contributions CAC has made to the profession at the national level was the creation, development and validation of certification examinations, which are now administered through the American Board of Criminalistics. These exams are very rigorous and require thorough knowledge of general criminalistics and a practitioner's area of expertise. Participants must also abide by a Code of Ethics to remain certified and to remain members of the CAC. The CAC's Code of Ethics is one of the strongest professional codes of ethics in the profession and sciences and has been used as a model by many other organizations. Additionally, the CAC recognized the need for working standards many years ago. It formed the first DNA advisory committee in 1989, whose standards eventually became the foundation for national guidelines in use today. Furthermore, many national working groups and advisory committees are staffed in part by CAC members. Lastly, the CAC thanks the NAS for identifying these national issues and welcomes any assistance it can provide in identifying sources of funding to help advance the field.

The American Society of Crime Laboratory Directors (ASCLD) in its December 2008 Position Statement⁸ to the NAS prior to the issuance of their report strongly stated that the first and foremost priority of its members must be ethics and objectivity in forensic science: *"Laboratory managers must strive to ensure that forensic science examinations are conducted in accordance with sound scientific principles and within the framework of the statutory requirements to which forensic professionals are responsible."*

After the release of the NAS report, ASCLD issued a letter to Senator Leahy, Chair of the Senate Judiciary committee, dated 17 March 2009.⁹ ASCLD stated that it supports mandatory accreditation for all crime laboratories. It recommends that Congress provide substantial and consistent funding for all forensic science disciplines, not just DNA, to produce timely, accurate, and meaningful results. Congress should also provide funding to crime laboratories and education institutions for improved validation research studies of these other methods. ASCLD remains opposed to the creation of a new national oversight entity, stating that new funding should be directed to the existing laboratory systems and their wide range of science, education, and policy collaborators.

The American Society of Crime Laboratory Directors /

⁴ The National Academy of Sciences is one of the National Academies. The research arm of the National Academies is the National Research Council (NRC). The report is referred to as the NAS Report and the NRC report. For the purpose of this document, it will be referred to as the NAS report.

⁵ The National Academies Press, www.nap.edu

⁶ The CACLD response to the NAS report can be found on their website at <http://www.caclld.net/Files/News%20of%20Interest/nrc%20caclld%20reply.pdf>

⁷ The CAC response to the NAS report can be found on their website at http://www.cacnews.org/policies/NAS_Response.pdf

Laboratory Accreditation Board (ASCLD/LAB), the world's largest forensic science accrediting body, issued a separate statement regarding the NAS report. This document related the NAS suggestions to the current ISO-17025 and supplemental standards for accreditation. While all public laboratories in California are accredited, this is not true on a national level. In that regard, ASCLD/LAB recommends mandatory accreditation. Its document also discusses certification of individual analysts, again from the perspective of the ISO standards. These standards, in ASCLD/LAB's opinion, satisfy nearly all the requirements of individual certification: *"It is easily argued that an evaluation of education, training, competency testing, proficiency testing and casework is much more rigorous than relying on the results of a single written test."* Documentation clearly showing successful completion of these items for each working analyst must be produced during an external assessment that is part of the accreditation process. ASCLD/LAB will most likely be mandating professional responsibility and ethics training for analysts, and laboratories will need to document successful completion for each analyst. Inclusion of

ASCLD/LAB's own code of ethics (ASCLD/LAB Guiding Principles of Professional Responsibility for Crime Laboratories and Forensic Scientists) in each laboratory's quality management document is also very likely in the near future.

The International Association for Identification (IAI) issued a response to the NAS report on 18 March 2009. This organization represents several thousand analysts in fifteen different forensic disciplines. It demonstrates that many forensic techniques are not new methods developed for the convenience of law enforcement, but in fact date back over 100 years in some instances and are based on solid principles of science. The IAI is generally supportive of efforts to improve funding for the further study of various forensics methods and supportive of a national guiding or advisory body to help enhance and promote the science. The IAI currently has in place a Code of Professional Conduct and Code of Ethics for its members and persons certified by the IAI in one of the forensic disciplines. The IAI also has an enforcement mechanism which provides due process and penalties, if appropriate, and would therefore support any measure to establish a national code of ethics for forensic practitioners.

The American Board of Forensic Toxicology (ABFT) issued a press release on 23 Feb 2009 addressing concerns raised in the NAS report. The ABFT has already developed and implemented the standards identified in the NAS report in the field of forensic toxicology. The ABFT administers an individual certification program with over 300 certified members. Regarding accreditation, the ABFT has been accrediting forensic toxicology labs since 1996. The main obstacle to advancement of the forensic toxicology field has been a lack of funding. The future research and validation of toxicological methods and education, training and certification of toxicologists requires a commitment of new resources.

The Society of Forensic Toxicologists (SOFT) likewise issued a response to the NAS report dated 23 Feb 2009. SOFT supports many of the NAS report's recommendations. It sponsors toxicological research via competitive awards to graduate and

postgraduate students. It also provides continuing education to toxicologists through workshops and presentations. SOFT assisted in drafting the original toxicology laboratory guidelines, which are the bases for the current American Board of Forensic Toxicology (ABFT) accreditation program. Additionally, it supports the establishment of uniform requirements for certification of individual toxicologists.

At the state level, the California Association of Toxicologists (CAT) does provide enforcement of professional ethics and standards. Members must be professionally competent and have good moral character and integrity. If it is reported to the CAT that one of its members is acting unethically, it can, upon review, terminate that person's membership. The CAT did not write a response to the NAS report.

It is obvious that forensic science organizations are well aware of the concerns raised in the NAS report. They are generally supportive of the recommendations and are eager to collaborate with a new guiding advisory body to implement meaningful changes. However, the results will depend largely on the availability of new funding to develop and implement changes in management and analytical techniques. It is in the best interest of both sides of our adversarial justice system to help forensic science acquire the much needed funding to make improvements and move forward.

6. CAC and CACLD's Response to Suggested Functions of a Statewide Forensic Science Oversight Body as Described in the Crime Laboratory Review Task Force Report

The California Crime Laboratory Review Task Force (Task Force) was established in 2007 as a result of the passage of AB1079. The functions of the Task Force as outlined in AB1079 were to review and make recommendations in four key areas: organization and management of crime laboratory services, staff and training, funding, and performance standards and equipment.¹⁰ Representatives of the California Association of Criminalists (CAC), the California Association of Crime Laboratory Directors (CACLD) and various stakeholders in forensic science were selected for the Task Force. After nearly two years of gathering data and meeting, they issued a thorough report of their findings and recommendations in November 2009 entitled "An Examination of Forensic Science in California" (Task Force report).¹¹ This report detailed the Task Force's examination of these four areas, but also covered a fifth area, neither requested by the legislature nor expressed in the Mission Statement of the Task Force: statewide forensic science oversight.¹²

Concurrent with the meeting of the Task Force, the National Academy of Sciences (NAS) established a committee to conduct their own review of forensic science in response to the Science, State, Justice, Commerce and Related Agencies Appropriations Act of 2006. The NAS published their report "Strengthening Forensic Science in the United States: A Path Forward" in February 2009.¹³ In the report, they recommended that "Congress should establish and appropriate funds for an independent federal entity, the National Institute of Forensic Science (NIFS)" to oversee forensic science on a national level. The report made additional recommendations in the areas of standardizing terminology and reporting; increasing the amount and quality of research; establishing best practices and standards; establishing routine quality control, assurance and improvement, including mandating laboratory accreditation and analyst certification; establishing a national

⁸ see <http://www.asclcd.org/files/releases/ASCLD%20Position%20Statements%202008.pdf>

⁹ see <http://www.asclcd.org/files/releases/090317%20ASCLD%20Letter%20to%20Congress%20FINAL.pdf>

code of ethics; improving education and training; improving the quality of the medico-legal death investigation system; improving interoperability of AFIS databases; and preparing forensic scientists and crime scene investigators for their roles in managing and analyzing evidence from events that affect homeland security.

In response to the NAS report, the Senate Judiciary Committee issued a Preliminary Outline of Draft Forensic Reform Legislation (Draft Legislation) for comment by the forensic community, dated 5 May 2010.¹⁴ This legislation would create a national Forensic Science Commission (FSC) to enact recommendations of the NAS report in five main areas: Accreditation, Certification, Research, Standards/Best Practices, and Oversight and Coordination.

The Draft Legislation outline specifies that members of the FSC would be appointed by the President, but President Obama already has acted in absence of a legislative mandate. On 7 June 2009, the White House established the Subcommittee on Forensic Science (SoFS) within the Office of Science and Technology Policy, National Science and Technology Council, Committee on Science “to assess the practical challenges of implementing recommendations in the 2009 [NAS] report...and to advise the White House on how best to achieve the goals outlined in that report.”¹⁵ The SoFS has Interagency Working Groups (IWGs) that focus on five areas: Education, Ethics, and Terminology; Accreditation and Certification; Outreach and Communications; Research, Development, Testing, and Evaluation; and Standards, Practices, and Protocols. Several CAC and CACLD members have received appointments to these IWGs.

Although the SoFS has recently selected members for the IWGs and the Senate Judiciary Committee has released their Draft Legislation outline, little movement at the federal level had begun when the Task Force members chose in late 2009 to meet for up to an additional year to “review and evaluate the various oversight models used by other states, as well as solicit further input from lab directors, controlling agencies, stakeholders and relevant professional organizations” and recommended that “California should establish a statewide body to consider issues related to forensic science.”¹⁶ Both the Draft Legislation and the documents available from the SoFS imply that some sort of federal oversight of forensic science is likely in the near future. Largely in response to the prospect of federal oversight and concerns that any state oversight body would not be sufficiently funded, the CAC and the CACLD each submitted position statements recommending that further work by the Task Force toward statewide forensic science oversight be suspended.¹⁷ On 3 June 2010, the Task Force voted to discontinue their work until 2011 in order to assess progress made at the federal level and determine how that progress would affect a potential statewide forensic oversight commission.

Chapter six of the Task Force’s report, “Statewide Forensic Science Oversight” listed a number of possible functions that a statewide oversight body could have. Additional suggestions of the role of an oversight body were made during discussions of the Task Force. Although only a few of these areas shared wide support from the Task Force, the CAC and CACLD believe that it is worthwhile to address each of the proposed functions of a statewide forensic oversight body and indicate why we believe that all of these fit into one of three categories:

- Areas that will be addressed by the pending federal Draft Legislation and/or the SoFS and its IWGs. . Areas that cannot be or would not effectively be achieved by a statewide oversight body.
- Areas that are already addressed or can be addressed by accreditation and certification programs, the CAC, the CACLD, and/or other existing groups in the absence of a statewide oversight body.

6.1. Improving the Allocation of Forensic Science Resources and Reducing Inefficiency¹⁸

The Task Force devoted the largest section of their chapter on statewide forensic science oversight to the topic of allocation of resources and reducing inefficiency. It noted that crime laboratory funding is limited, uneven, unpredictable, and unstable. Many California laboratories face furloughs, lost or frozen positions, obsolete instrumentation, and deferred facility maintenance. Several crime laboratories are in the same outdated facilities as when the Hertzberg-Polanco Crime Laboratories Construction Bond Act of 1999 failed at the ballot box a decade ago.¹⁹ The CAC and the CACLD welcome ideas for additional funding of crime laboratories and would like to ensure that their funding sources are predictable and stable; however, a statewide oversight body would not be able to create more predictable or stable funding of crime laboratories, nor would it effectively ensure that each laboratory gets the appropriate funding it needs.

The Task Force report indicated that a state-level advisory body could conduct or commission studies to determine the appropriate staffing and support levels for laboratories with a particular population and crime rate. A model for such studies already exists. The CAC annually publishes a survey of salaries and benefits of criminalists and related crime laboratory staff each year.²⁰ These salary surveys have been used to advocate for greater parity in pay by laboratory staff who receive lower compensation than those of surrounding laboratories. Although studies on appropriate staffing and support levels for laboratories would be beneficial in that they would create benchmarks for funding of crime laboratories to be used by their parent government agencies, these studies would not by themselves increase the limited funds to laboratories, and these studies could easily be commissioned by the legislature and conducted in the absence of a statewide oversight body.

¹⁰ See Penal Code Section 11062(c)

¹¹ See http://ag.ca.gov/publications/crime_labs_report.pdf

¹² See http://ag.ca.gov/meetings/tf/pdf/Vision_Mission_Statement.pdf

¹³ The National Academies Press, www.nap.edu

¹⁴ A copy of the Draft Legislation is available on the CAC website at http://www.cacnews.org/policies/Draft_Outline_of_Forensic_Reform_Legislation_5-5-2010.pdf

¹⁵ See www.forensicscience.gov

¹⁶ Task Force report at page 91

¹⁷ The CAC position paper can be found on the CAC website at <http://www.cacnews.org/policies/CAC%20Position%20Statement%20on%20Oversight.pdf>

The Task Force report continued by stating that the advisory body could “educate the Legislature about the benefits of forensic science and [offer] guidance on funding priorities.” The presence of an advisory body to educate the Legislature would not have any real effect on the budgets of a majority of crime laboratories in California. Most funding for laboratories comes from their parent agency and from the federal government. A number of sources of state funding, such as the DNA Cold Hit Project, have expired or have been reduced. Many laboratories receive funds from the state as a result of Proposition 69, and disbursement of these funds is in accordance with formulae that are statutorily defined.²¹ Because amendments to this statute by the legislature must further the measure and be consistent with its purposes, it is unlikely that reallocation of these funds would be possible at the suggestion of an oversight body without the passage of a new initiative. Although the state has influence over the general funds of local governments, it is unlikely that the legislature would be willing to withhold taxes or other funds to local governments in exchange for increasing or reallocating greater money to crime laboratories. If they were to do so, it is likely that this action would result in numerous lawsuits from local governments. This limits the control that the state has over local crime laboratory budgets and the uneven funding of crime laboratories. It is unlikely that local government agencies would be willing to provide more equitable funding of crime laboratories by voluntarily giving up a portion of their funds to another agency that the advisory body feels is more deserving.

The federal government is able to encourage change because they have the ultimate form of encouragement: money in the form of federal grants and contracts. Two of the main National Institute of Justice (NIJ) grants available to California crime laboratories are through the Paul Coverdell Forensic Science Improvement Program (Coverdell Grants) and the Forensic DNA Backlog Reduction Program (DNA Grants). The California Emergency Management Agency (Cal-EMA) disburses money from the Coverdell Grants to each laboratory in proportion with the number of proficiency tested laboratory analysts. The CACLD decides the formula for disbursement of the DNA Grants using specified factors such as crime rates and population. A state grant, the DNA Cold Hit Project, was administered by the Office of Criminal Justice Planning.²² Administration and disbursement of state and federal grant money has occurred over the years in the absence of an oversight body and will continue in a manner that has been equitable.

The Task Force report suggested that a statewide oversight body could make recommendations on ways to reduce inefficiency by streamlining funding needs. These may include prioritization of certain laboratory functions or prioritization of funding for the construction of new laboratories. Because the oversight body will not have power to do more than make recommendations, the body will be ineffective in creating real change in this area.

6.2. Standardizing Terminology and Improving Communication of Findings²³

The Task Force report recommended “moving toward standardization of terminology and reporting of results.” These are common goals of both the CAC and the CACLD. The efforts of the various Scientific Working Groups (SWGs) in forensic science have generated standardization of terminology and reporting guidelines for many forensic science subdivisions. A number of documents exist that include defined lists of terminology and standards for reporting of crime laboratory results, such as those of the FBI Quality Assurance Standards for DNA Analysis, ASTM Committee E30 on Forensic Sciences, and the AFTE Training Manual. All public laboratories in California have been accredited by the American Society of Crime Laboratory Directors / Laboratory Accreditation Board (ASCLD/LAB) or by Forensic Quality Services International (FQSI). Because both ASCLD/LAB and FQSI have incorporated ISO Standard 17025 as part of their requirements, all public laboratories in California will meet stringent international reporting standards and will be using defined terms approved by ISO for their next reaccreditation, which must occur within the next five years.

The NAS report recommended the creation of a federal agency that would standardize terminology and reporting. The Task Force report indicated that they were unclear whether a federal agency would be created toward this goal. However, the Draft Legislation in the Senate would indeed create such a federal agency, with standards and reporting terminology as two of its key goals. The White House’s SoFS has two Interagency Working Groups covering these areas: the IWG for Education, Ethics and Terminology and the IWG for Standards, Practices and Protocols. The creation of a statewide oversight body to independently create standards and terminology would be duplicative and may conflict with existing standards and the upcoming standards that may result from the work of the federal government.

The Task Force expressed concern about inconsistency in laboratories. practices regarding disclosure of information to attorneys and suggested that a statewide advisory body might be useful to establish best practices. The CAC and CACLD will gladly assist the courts by increasing communication and providing our recommendations for best practices. However, these are legal requirements that are not specific to forensic scientists, and we believe that these will be decided by court rulings, not by professional organizations or a statewide forensic science commission.

Task Force members have suggested that a statewide advisory body could study ways to improve communication between laboratories and stakeholders. Poor communication with stakeholders can lead to inefficient and ineffective use of crime laboratory resources. The ISO 17025 standards to be met by crime laboratories have requirements for communication, including assessment of “customer” feedback and monitoring of testimony. Improving communication between forensic

¹⁸ Task Force report at pages 86-87

¹⁹ See <http://primary2000.sos.ca.gov/VoterGuide/pdf/15.pdf>

²⁰ CAC salary surveys for the past decade can be found at <http://www.cacnews.org/survey/survey.shtml>

²¹ See http://www.ag.ca.gov/bfs/pdf/sec_state_full_version_prop69.pdf, esp. sections IV and V

²² The Office of Criminal Justice Planning was abolished in 2003 and incorporated into the Office of Emergency Services (OES). This later became Cal-EMA. A report on the DNA Cold Hit Project can be found on the Cal-EMA website: [http://www.oes.ca.gov/WebPage/oeswebsite.nsf/PDF/Process%20Evaluation%20of%20the%20California%20DNA%20Cold%20Hit%20Program%20/\\$file/DNAfinrt.pdf](http://www.oes.ca.gov/WebPage/oeswebsite.nsf/PDF/Process%20Evaluation%20of%20the%20California%20DNA%20Cold%20Hit%20Program%20/$file/DNAfinrt.pdf)

²³ Task Force report at page 87

scientists and stakeholders is also a goal of the White House's Outreach and Communication IWG.

6.3. Evaluating the Education and Training Needs of Forensic Scientists²⁴

The Task Force report recommended establishing priorities for education, training and research and noted that "although California is fortunate to possess substantial educational and training resources, it is clear that the needs of forensic laboratories are not being fully met." California has several public and private universities that offer undergraduate and/or graduate degrees in forensic science. The Task Force report noted that the Forensic Sciences Education Program Accreditation Commission (FEPAC) offers accreditation of forensic programs at universities and colleges. The Task Force recommended all California colleges and universities with forensic science programs seek FEPAC accreditation. Faculty and Staff of most of these programs are members of the CAC and CACLD, and we are committed to ensuring the quality of forensic science education in California by encouraging them to seek and maintain accreditation from FEPAC. The federal IWG for Education, Ethics, and Terminology charter states that it will "identify formal degree programs and continuing education programs for forensic science examiners, prosecutors, defenders and judges" and "identify accreditation organizations for formal science degree programs." It is likely that the SoFS, in combination with organizations like FEPAC, will be able to effectively evaluate forensic science programs at California universities and set standards for curricula and faculty.

CAC and CACLD members in academia encourage students at these universities to become affiliate members of the CAC. Through their involvement with the CAC, they make contacts that often lead to internships. Internship programs are formalized in many laboratories in California, providing hands-on training to the interns and better preparing them to enter the workforce. This benefits the laboratories by creating a more experienced pool of applicants. The CAC and CACLD offer scholarships to students in forensic science programs at California universities. We will continue to support these university programs and their students.

Another major training resource for forensic scientists in the state is the California Criminalistics Institute (CCI) of the state's Bureau of Forensic Services. CCI offers training classes to forensic scientists and other stakeholders, but the funding for CCI has been reduced as the state deals with continuing budget shortfalls. Funds are available to some public laboratory employees from the California Commission on Peace Officer Standards and Training (POST) to attend certain classes on their course list. Unfortunately, some public laboratories do not have access to POST funds, and communication between POST and the forensic science community has been poor. As with CCI, POST funding has been cut by the state, and fewer training opportunities through POST exist for forensic scientists. With POST funding cut to law enforcement agencies, some forensic scientists have lost access to funds because their agency prioritizes sworn officers over civilian laboratory employees. The CAC and CACLD believe that the state should fully fund CCI and POST and that POST funding opportunities should be made more available to laboratory staff.

The CAC administers an endowment that typically

funds one or more CCI courses every year and also pays for training classes organized by its members. The CAC offers workshops at each semi-annual seminar, providing continuing education and training on new techniques. The CAC will continue to supplement the training offerings provided by the state. The CCI Users Advisory Board, in which the CAC and CACLD each have a role, allows input and feedback on their past, current and future offerings. Similarly, the CAC has committees that poll crime laboratory staff to determine what needs exist for training, to evaluate proposals for training, and to review the course offerings after completion to determine how effectively the needs are being met. As laboratory supervisors, CACLD members regularly evaluate and set priorities for training forensic scientists in California.

Several Task Force members suggested that a statewide advisory body could assess and make recommendations regarding the training of stakeholders. Although state crime laboratory employees receive priority for CCI courses, these are not limited to public laboratory employees. Private laboratory employees and other stakeholders, such as evidence technicians, detectives, and crime scene investigators are students in CCI classes. The CAC and CACLD have several members from private crime labs, some of whom primarily work for the defense. Most CAC meetings have presentations from prosecutors, defense criminalists, defense attorneys, and occasionally judges. While we have an opportunity to learn from them, they also benefit from the scientific papers we present. But more can be done to provide training to stakeholders. One previously expressed idea to improve outreach and education is the plan for CACLD to extend their meetings and allow for greater stakeholder interaction. The CAC and CACLD are committed to improving stakeholder training in the absence of a statewide oversight committee and will make a concerted effort to ensure that the stakeholders are invited to attend and present at our conferences and that members will feel free to attend and present at stakeholder conferences.

It has been proposed that a statewide body could establish a model training program for criminalists in the area of *Brady* and discovery compliance and to adopt best practices in this area. The CAC is in discussion with future seminar planners to express their desire to hold a workshop or panel discussion to address this issue. This topic can also be covered at CACLD conferences or one of the proposed CACLD stakeholder sessions. Both organizations intend to improve their communication with the prosecution and defense communities in an effort to develop better training and education on *Brady* and discovery issues.

6.4. Evaluating Priorities for Research²⁵

Although research is conducted at CCI and state crime laboratories, most local laboratories do not receive significant money from the state for research. As a practical matter, most crime laboratories must commit their limited resources to managing casework backlogs and expected turnaround times, and simply do not have the resources to devote to formal research. The CAC endowment does fund some research projects for forensic scientists and students. The endowment committee evaluates proposals for funding and prioritizes them, taking into account the perceived benefit the research will have on the field, the design of the research, and the cost. The amount of money for research in forensic science provided by the CAC is dwarfed by the funds from the NIJ and, to a lesser extent, the National Science Foundation. Because the

²⁴ Task Force report at page 88

federal government is the source of the largest share of funds, they have the power to prioritize research in the forensic sciences. In addition, both the federal Draft Legislation and the SoFS have research funding and prioritization as key components. Much of the research in forensic science is driven by evidence and attempts to develop more rapid, reliable, and reproducible casework analysis. Often research includes development of new methods in response to or in combination with research at commercial laboratories. Because the state has little influence on funding research, a statewide advisory committee will not have much influence in prioritizing research in the forensic sciences.

6.5. Establishing and Promoting Best Practices²⁶

Some Task Force members believe that a statewide oversight body could play a crucial role in establishing and promoting best practices. A number of SWGs have established best practices for their respective fields, and best practices are also encouraged through the standards set by the FBI Quality Assurance Standards for DNA Analysis, ASTM Committee E30 on Forensic Sciences, and the AFTE Training Manual. Accreditation by ASCLD/LAB and FQS-I requires adherence to established standards enforced through regular external inspections and required self-evaluation. In fact the Task Force report states, "Best practices for forensic disciplines...are elements of accreditation."²⁷ The federal Draft Legislation has an entire section devoted to the creation and promotion of best practices, and this is one of the goals of the IWG for Standards Practices and Protocols. Best practices should be consistent from state to state and a set of federal standards is more desirable than a collection of differing state standards. The promotion of best practices is a main function of the CAC and the CACLD, and we believe that efforts at the federal level, in combination with accreditation, existing standards, and the efforts of the SWGs will continue to establish and to promote best practices without the need for a statewide oversight commission.

6.6. Investigating Allegations of Serious Negligence and Misconduct²⁸

The Task Force report suggests that a statewide oversight body could "act as a clearinghouse for complaints and allegations of serious misconduct or negligence" and "could ensure that investigations are...conducted in a manner that satisfies federal grant requirements." As was previously stated, this clearinghouse function is performed by Cal-EMA and it has met the requirements for the administration of federal grants. In addition, many crime laboratory parent agencies have codes of ethics, standards of professional conduct or formalized disciplinary procedures that allow for investigation of negligence and misconduct. Lastly, the professional associations in forensic science have codes of ethics that also serve this function. More detailed discussion of this issue is described in Section 4 of this report.

6.7. Protecting the Independence of Laboratories²⁹

A number of Task Force members expressed their desire that the statewide oversight body provide a forum for laboratory employees to address issues concerning policies and/or procedures of the laboratory or parent agency that affect their ability to perform their job in an ethical and scientific manner, which are not being addressed by the laboratory and to provide a forum for issues that may arise between laboratories and their parent agencies. Crime laboratories should be independent of influence to obtain results beneficial to the law enforcement agencies or the DA's offices that are their parent agencies. The Task Force report notes that "accreditation requirements protect the „independence. of laboratories."³⁰ Most agencies have an independent investigative unit, such as Internal Affairs, that can serve as an outlet for complaints of undue influence. The CAC and CACLD support attempts to eliminate pressure and bias in the laboratory. The CAC Code of Ethics states, "The scientific mind is unbiased and refuses to be swayed by evidence or matters outside the specific materials under consideration. It is immune to suggestion, pressures, and coercions inconsistent with the evidence at hand, being interested only in ascertaining facts."³¹ The SoFS also will work to protect the independence of laboratories, stating in its charter that one of their main functions is "assuring that forensic laboratories have an appropriate degree of independence from prosecutors and law enforcement agencies."

6.8. Accreditation of Laboratories and Certification of Laboratory Analysts³²

California leads the way in both laboratory accreditation and the certification of criminalists. All public laboratories and some private laboratories in California are accredited by ASCLD/LAB or FQS-I. Part of this is required by law because access to CODIS requires accreditation and analysts performing DNA analysis must meet rigorous requirements for proficiency testing, education and training in order for the laboratory to be able to enter their DNA profiles into CODIS. The CAC established the first certification program in criminalistics and continues to promote certification by the American Board of Criminalistics. The Forensic Specialties Accreditation Board was created with assistance of NIJ to accredit certification bodies and ensures that the certification of forensic scientists meets national standards. The federal Draft Legislation has sections on accreditation and certification and makes both mandatory for laboratories and their staff to receive federal funds. But the Draft Legislation states "Generally, the FSC will delegate the determining of standards for accreditation to a qualified professional organization." and "Where a Subcommittee determines that one or more qualified professional certifying organizations exist for a particular discipline, the Subcommittees will generally delegate the determining of standards for certification to those organizations."

The IWG for Accreditation and Certification indicates that it will recommend processes to assist laboratories to become accredited and to assist forensic scientists to become certified. Although they mandate or encourage accreditation

²⁵ Task Force report at page 85

²⁶ Task Force report at page 85

²⁷ Task Force report at page 81

²⁸ Task Force report at page 88

²⁹ Task Force report at page 85

³⁰ Task Force report at page 81

³¹ The CAC Code of ethics can be found on their website at: <http://www.cacnews.org/membership/handbook.shtml>

³² Task Force report at page 88

and certification, neither the Draft Legislation nor the work of the SoFS suggest that substantial changes will be made to existing accreditation or certification standards. The Task Force report stated "Should the federal government adopt or enact new certification or accreditation requirements for crime laboratories, a California advisory body would be in the best position to advise state leaders on how to address such changes." The incorporation of ISO 17025 standards to ASCLD/LAB and FQS-I accreditation did not require a state advisory body, nor did the adoption of the FBI Quality Assurance Standards for DNA Analysis. Changes to certification testing and adoption of new disciplines have not required a state advisory body. The CAC and CACLD believe that if changes are made at the federal level affecting accreditation and certification, they will be incorporated into existing accreditation and certification bodies without the need for a state advisory body.

Some have suggested that the state create its own standards for accreditation and certification. The CAC and CACLD do not believe this will be effective, nor do we believe that it will be an improvement on existing standards.

The Task Force report suggested that "in the future, the state should consider making certification mandatory for government experts who testify in court." Although many criminalists in public and private laboratories in California are currently certified, the CAC and CACLD are concerned that this will create an unnecessary division between analysts from public and private laboratories. The federal Draft Legislation recommends changing the rules of evidence to only allow certified forensic scientists to testify in federal courts. Although the CAC and CACLD support certification of analysts, we do not believe that either would be a reasonable approach. This can create situations where an analyst may have their certification lapse due to a technicality or due to retirement and cannot present their work in court. We prefer providing incentive to analysts to attain and maintain their certification. Some laboratories provide a pay differential to certified employees, and we believe this will encourage a much larger portion of analysts to become certified.

6.9. Establish and Provide Enforcement of a California Code of Ethics for Criminalists

Although not present in the Task Force report, suggestions have been made for the need of a California Code of Ethics for Criminalists. The CAC and CACLD are committed to ensuring that all criminalists in California behave in an ethical manner, and the CAC code of ethics has been a standard for professional conduct in the forensic sciences for over fifty years. The code is thorough, but it also has detailed enforcement procedures.³³ Most other professional organizations have codes of ethics, many of which are modeled upon the CAC code of ethics. Certification bodies also have codes of ethics that must be followed. Providing incentives for certification and participation in professional organizations will bring most, if not all analysts under one or more of these codes of ethics. The federal Draft Legislation and the IWG for Education, Ethics and Terminology recommend the creation of a national code of ethics. The presence of a national code of ethics for criminalists would make the establishment of a state code of ethics unnecessary.

³³ The CAC Code of Ethics Enforcement Procedure can be found on the CAC website at: <http://www.cacnews.org/membership/handbook/shtml>

6.10. Conclusions

It is likely that many or all of the proposed functions of a statewide forensic oversight commission will be covered by the final product of the Senate or the White House. The SoFS charter states that "Unless renewed by the Committee on Science prior to its expiration, the Subcommittee shall terminate no later than September 31, 2011." The CAC and CACLD believe that waiting until 2011 will give the Task Force a better idea of the appropriate steps, if any, to take toward statewide forensic science oversight. In the interim, we are committed to improving our communication with stakeholders to ensure that we are aware of and can address issues that affect forensic science in California.

7. Future Plans to Improve Outreach and Education

CACLD and the CAC have a long history of successful education of its members and outreach to stakeholders. Both associations are in the process of evaluating and incorporating several new concepts into their semi-annual meetings which will serve to reach out to all forensic science stakeholders and provide educational opportunities.

The first proposal is to host a roundtable discussion with stakeholders at the CACLD meetings. This could consist of an afternoon session before the meeting where various stakeholders in forensic science could present and discuss their views and concerns with laboratory management staff.

The various stakeholders need to be notified of upcoming meetings of the CAC and CACLD with invitations to present forensic science related topics or express concerns about the state of forensic science in California. Examples of attorney associations that should be notified include the CA District Attorneys Association and the CA Public Defenders Association. Criminal investigators should also be invited, including those that are active in investigation of major crimes such as homicides, sexual assaults, and narcotics. Victim advocacy groups need to be invited as well.

Presentations given at the CAC's semiannual conferences in the past have included talks by many different people who are critics of forensic science, defense advocates, or individuals who just seek to encourage criminalists to think critically and skeptically when analyzing evidence. One well known critic of forensic science, William Thompson, has given two presentations at the CAC meetings (2005 and 2007). Gabe Overfield (The Innocence Project) and forensic scientists working primarily for the defense (including Ed Blake, Keith Inman, Norah Rudin, and Peter Barnett) have also sat on discussion panels or given presentations to the membership. While there is a documented history of the CAC inviting defense advocates to give presentations, perhaps a renewed outreach effort to these various groups is in order.

There is movement within various professional organizations such as ASCLD/LAB to bring the smaller, more specialized laboratories and forensic science entities into the mainstream. Examples of these include the ID and CSI units that operate within a law enforcement agency, medical examiners, labs, and others. Inviting their representatives to the CAC and CACLD meetings or holding joint meetings has been suggested by our membership.

Additional legal issues training for analysts could be promoted by the CAC and CACLD. The California Criminalistics Institute (CCI) could perhaps be guided in developing a course that would address the various legal issues faced by forensic practitioners, such as *Brady*, *Melendez-Diaz* and subse-

quent decisions, discovery issues, and further development of analysts into forensic science experts. This could be done via a CCI course or by workshops held at the CAC meetings and study groups.

There are indeed many ways that the CAC and CACLD can improve education of their members and outreach to stakeholders. We will make a concerted effort to reach out to the various stakeholder groups and extend the invitation to attend and present at our frequent meetings and conferences. We acknowledge the need to better understand their concerns and devise ways to more effectively address them. Communication between all the various stakeholders in the criminal justice system is the key to a fair, honest, and efficient system.



On June 24, 2010, the Santa Clara County Crime Laboratory hosted a CAC dinner and study group meetings. The dinner was held at Bella Mia restaurant in San Jose. Deputy District Attorney James Gibbons-Shapiro (Santa Clara County) and Supervising Criminalist John Bourke (Santa Clara County Crime Laboratory) presented “Jilted Lover + Real Estate Baron = Murder.” This was a presentation of a case involving the murder of a well known Silicon Valley developer and restaurateur by his former girlfriend. There were approximately 21 attendees. Three study groups met before the dinner. These meetings are described below.

The Quality Assurance study group had 15 attendees and discussed getting staff involved with the QA process Julie Renfro, DOJ Richmond), recent court rulings on uncertainty of measurement (Mark Ruefenacht), dealing with the recent press on crime laboratories, and working relationships with command staff, prosecutors, and the press (Marty Blake, SFPD).

Elissa Mayo, Quality Assurance Manager for the CA DOJ Bureau of Forensic Services, was the guest speaker for the Drug study group. She discussed “Quality Assurance solutions to the current rise in alleged misconduct of controlled substances analysts.” There were 18 attendees.

The DNA study group hosted a panel discussion on “the new SWGDAM Interpretation Guidelines and how it affects our laboratory.” Panel participants included: David Stockwell (Contra Costa Sheriff Forensic Services Division), Brian Harmon (CA DOJ Jan Bashinski DNA Laboratory), Lynne Burley (Santa Clara County DA’s Crime Laboratory), and Ellie Salmon (Forensic Analytical). There were 24 individuals in attendance.

The Firearms study group plans to meet July 29-30, 2010 at the Santa Clara County Crime Laboratory training facility. Presenters are currently being arranged for a one and one-half to two day training seminar focusing on solid technical presentations.

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

Meghan Mannion Gray
Regional Dir. North

- Next study group meeting
 - o San Diego PD to host – Coral Luce is coordinating
 - o Lunch topic – Amber Dubois and Chelsea King case
 - o Initially scheduled for end of July but speaker scheduling conflict so will probably now be scheduled for sometime in August
- Todd H. Davis (DEA Southwest Laboratory) is the new Drugs Study Group Chair for the south

Mey Tann
Regional Dir. South

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The Exterior and Wound Ballistic Aspects of Billy Dixon's Long Shot and the Battle of Adobe Walls

Lucien C. Haag*

Keywords: Adobe Walls, Billy Dixon, Quanah Parker, Isa-tai, Tohah-kah, Big Fifty Sharps, .50-90 Sharps, .50-100 Sharps, Sharps, exterior ballistics, wound ballistics, lagtime, paper patch bullets

Abstract

The Second Battle of Adobe Walls occurred in the Texas Panhandle over the dates of June 27-29, 1874. This nearly forgotten battle involved a small group of buffalo hunters and residents of several adobe buildings who were attacked on the morning of June 27, 1874 by a large force of Indians drawn from at least three warrior tribes: Comanche, Kiowa and Cheyenne. The Indians, lead by Quanah Parker, and inspired by the medicine man, Isa-tai were armed with bows, lances and relatively short-range firearms. Their armaments as well as their culture requiring them to approach the barricaded defenders of Adobe Walls to deliver effective fire and demonstrate great individual courage. Most of the defenders at Adobe Walls were buffalo hunters all armed with large caliber, long range rifles. Among the men at Adobe Walls was William "Billy" Dixon- a buffalo hunter who was an extremely accomplished long range marksman and who, on the third day of the battle, purportedly made an incredible long distance fatal shot with a "Big Fifty" Sharps rifle.

According to Dixon's biography, this shot was witnessed by participants on both sides of this battle and brought an end to the hostilities. In the years that followed the battle, the distance was variously reported as 800-yds, 1200-yds, 1400-yds and finally as 1538 yards-the current and popular value.

The author has been to the site on three occasions, taken measurements and with the help of sons Matt and Mike Haag, ultimately recreated this seemingly impossible feat of long-range marksmanship.

This effort included the purchase of a replica .50-100 Sharps, the assembly of .50-100 cartridges loaded with black powder and bullets of the types in use at the time of the battle, multiple Doppler radar trackings of these bullets at the U.S. Army Yuma Proving Grounds at Yuma, Arizona in 1992 and 1995, measurements of muzzle velocity, flight times and bullet penetration in tissue simulants at the reduced impact velocities associated with 1500+ yards of flight.

That the event at Adobe Walls occurred is not in serious dispute. But Billy Dixon's Long Shot raises some interesting ballistic questions. This paper will lay out the historical background and setting for this great battle and then describe the application of modern technology to this historic event.

The Background and Actors

The story of Billy Dixon's Long Shot occurred on a stage of immense proportions and awesome beauty that is almost impossible to appreciate let alone understand in today's world. I can only wish that every reader of this article could go there and spend some time just sitting and contemplating the events that occurred at this remote place. To fully appreciate it and gain some understanding of the motives and actions of the individuals involved, one should acquire and read references 2, 4, 6, 10 and 16. It was a place and time filled with frightful violence and inspiring courage on the parts of both red men and white men.

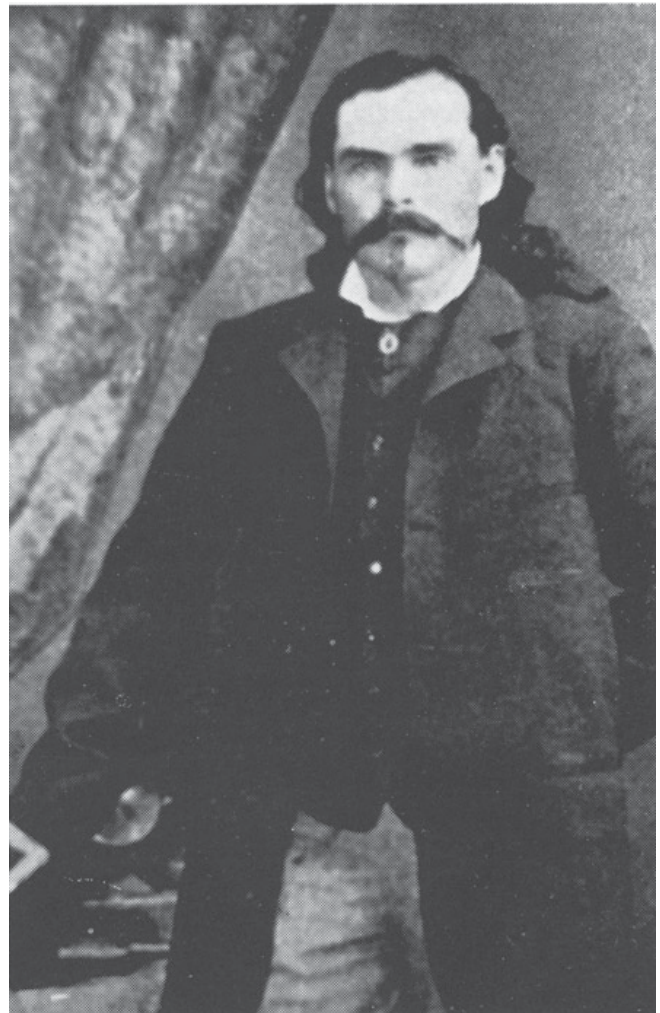


Figure 1. Billy Dixon

Originally published in the *AFTE Journal*, Vol. 40, No. 2 (Spring 2008), pp. 195-213. Reprinted here by author's permission.

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Billy Dixon's Long Shot, cont'd

As for Billy Dixon, [See Figure 1] he was many things in his life: a buffalo hide hunter, a farmer, woodchopper, teamster, fur trapper, scout and guide for the U.S. Army, store owner, cowboy, justice of the peace and postmaster. He was the quintessential American frontiersman- totally self-reliant, handsome, brave and proficient in the use of firearms. His life spanned some 63 years from his birth on September 25, 1850 in West Virginia to his death (due to pneumonia) on March 9, 1913. You will find his grave at Adobe Walls should you go there. He was orphaned at age 12 and went west after his sister died. His wife, Olive King Dixon- *"The prettiest gal in Hutchinson, Co. (Texas) and the only gal in Hutchinson County"* according to Billy, lived until 1954 and wrote his autobiography from notes he had dictated. [Ref. 4]

He was, by all accounts and witnesses a truly remarkable shot and a man of uncommon nerve and courage. To this day he remains the only civilian recipient of the Congressional Medal of Honor as a result of a subsequent battle and further feats of incredible marksmanship in the 3-day *Battle of Buffalo Wallow* in September of the same year. [You can view it and other artifacts from the *Battle of Adobe Walls* at the Panhandle Plains Museum in Amarillo, Texas]

Yet he lived to regret the passing of the frontier that he helped to tame. Billy Dixon helped usher the cowboy and cattle rancher, the farmer and shopkeeper onto the stage dominated for centuries prior by the buffalo and Indian- most notably the Comanches. He came to realize that he and his fellow hide hunters were significant contributors to the destruction of the buffalo herds on the Southern Plains in the early to mid-1870s. This destruction weakened the strength and resistance of the Plains Indians whose life cycle and life style was so intimately tied to the buffalo. In the years to follow he became sympathetic to their plight and thoroughly regretted the passing of wilderness and the free hunting life of the plains. In speaking of them, he said- *"No man is ever quite his former self after he has felt deeply the bigness, the silence and the mystery of that region. The heart swells with emotion at remembrance of the wild, free life along those old trails, and the knowledge that they have vanished forever brings a feeling of deep regret."*

"I fear that the conquest of savagery in the Southwest was due more often to love of adventure than to any wish that cities should arise in the desert, or that the highways of civilization should take the place of the trails of the Indian and the buffalo. In fact many of us believed and hoped that the wilderness would remain forever. Life there was to our liking."

When asked in his later years about his experiences on the frontier, he often detected an implication that the hardships of life on the plains must have been unbearable. His response was straightforward and simple- *"Gladly would I live it all over again. Such is my cast of mind and my hunger for the freedom of the big wide place. I would run the*

risks and endure all the hardships that were naturally ours just for the contentment and freedom to be found in such an outdoor life. I should be unspeakably happy once more to feast on buffalo meat and other wild game cooked on a campfire, to eat sour dough biscuits and drink black coffee from a quart tin cup."

Before we judge Billy Dixon and his fellow hunters too harshly one should consider that at the time they thought there was an inexhaustible supply of buffalo. The hide of the buffalo had been made a very lucrative cash crop as a result of newly developed methods in Europe and the East for tanning these hides. A skilled marksman with a large caliber, long-range rifle and a skinner could, and did make a considerable amount of money in a relatively short period of time. And while not a justification, it must also be said that the buffalo and Indian would have met their sad fate without Billy Dixon and the buffalo hunters. These men happened to hunt and kill an animal with great popular and symbolic appeal. As a result, they paid a price- they came to be portrayed as murderous ghouls in greasy, bloodstained pants, killing the noble buffalo for profit.

The Comanches and other Indians of the Southern Plains were people whose fate was largely determined by signs, omens and magic. With favorable signs and magic, they went into battle convinced that they were invincible. Among the Quahadi Comanches (lead by Quanah Parker) was a young medicine man named Isa-Tai. He rose to prominence in about 1873 with the help of supportive witnesses to his "medicine" which included the power to see the future, the power to immunize his followers against the white man's bullets and to produce miracles. In May of 1874 he orchestrated a "Sun Dance" that was attended by many of the later participants in the attack on Adobe Walls. Out of this gathering of the major tribes in the area came the realization that if their centuries old free hunting and raiding way of life was to continue, they would have to drive the whites out of their territory. After much discussion, it was decided that the place to start was the lonely outpost of Adobe Walls occupied by a small number of buffalo hunters, skinners and shopkeepers. Until the spring of 1874 there had only been occasional white hunters in the area. Now with most



Figure 2. Lone Wolf (Kiowa)



Figure 3. Stone Calf (Cheyenne)

of the buffalo in Kansas killed, the major buffalo hunting outfits had moved south and established Adobe Walls as their base of operations. The attack would come at dawn after the setting of the first full moon of June of that year, 1874.

The Indian forces were variously estimated to be from 200 to as much as 700 strong, composed of Kiowas (led by Lone Wolf), Cheyennes (led by Stone Calf) and Comanches (led by Quanah). [See Figure 2, 3 and 4] A small number of Arapahoes were also present largely as observers.

Quanah was an amazing historical figure in his own right. Born of a white captive mother (Cynthia Ann Parker) and the Comanche chief Peta Nocona, Quanah became the last great chief of the Comanches to submit to the white man's rule. Even so, he went on to serve the interests of his people admirably on the reservation in Oklahoma. References 6, 10 and 16 are a 'must read' for more about Quanah Parker.

The Attack

The 95% full moon set at 3:30am on the morning of Saturday, June 27, 1874 as the largest war party ever assembled on the Southern Plains gathered near the Canadian River southeast of Adobe Walls. Sunrise would not be until 5:30 that morning with first twilight a half-hour earlier. Billy Dixon was up at first light looking out to the east towards the horses that were grazing along Adobe Creek. He described the attack as follows: *"I looked in the direction of the horses. They were in sight. Something else caught my eye. Just beyond the horses was a large body of objects advancing vaguely in the dusky dawn toward our stock and in the direction of Adobe Walls. Then I was thunder-struck. The black body of moving objects suddenly spread out like a fan, and from it when up one single, solid yell—a war-whoop that seemed to shake the very air of the early morning. I could see that hundreds of Indians were coming. There was never a more splendidly barbaric sight. In after years I was glad that I had seen it. Hundreds of warriors, the flower of fighting men of the southwest plains tribes, mounted upon their finest horses, armed with guns and lances, and carrying heavy shields of thick buffalo hide coming like the wind. Over all was splashed the rich colors of red, vermillion and ochre, on*

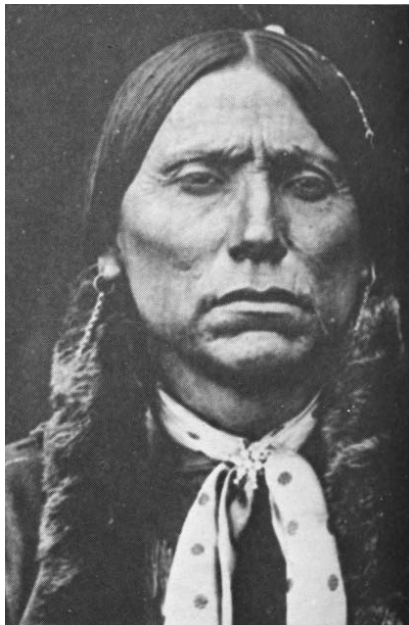


Figure 4. Quanah Parker (Comanche)

the bodies of the men, on the bodies of the running horses. Scalps dangled from bridles, gorgeous war bonnets fluttered their plumes, bright feathers dangled from tails and manes of the horses, and the bronzed, half-naked bodies of the riders glittered with ornaments of silver and brass. Behind this headlong charging host stretched the plains, on whose horizon the rising sun was lifting its morning fires. The warriors seemed to emerge from the glowing background."

At that moment, the "Walls" were occupied by 28 men and one woman, Hannah Olds, the wife of storekeeper William Olds. The occupants of Adobe Walls did not know it at the time, but the heavy body painting of the warriors was the result of Isa-tai's medicine. He had assured them that the white man's bullets would have no effect on them. The Indians swept in and quickly killed the two Shadler (aka Shiedler) brothers and their Newfoundland dog, all of whom were sleeping in their freight wagon adjacent to the structures. [See Figure 5]. Soon all of the 56 horses and 28 oxen were killed leaving the defenders without a mounted means of escape. A very young Bat Masterson (age 20 at the time) was also among the men there that June morning. Billy Tyler, a friend of Masterson's, was the only other direct casualty. He was killed by a bullet through his lungs when he exposed himself in the doorway of Myers and Leonard's store. He and the Shadler brothers are buried in a common grave at the north end of the Adobe Walls site. During the first half hour of the battle the Indians were so daring that they rode or ran up and struck the doors of the barricaded buildings with the butts of their rifles. But Isa-tai's medicine was not up to the power of the defenders' buffalo guns and many were soon killed or wounded including Quanah Parker who suffered a temporarily disabling shoulder wound by either a ricocheted bullet or a bullet that perforated a pile of buffalo hides. Toward the end of the 3-day siege Isa-tai's horse, fully painted for protection from bullets, was struck in the head and killed by a bullet fired from great distance. On the third day of the battle, a small group of about 15 Indians appeared on a bluff east of the "Walls." Bill Dixon was challenged by one or more of the defenders to have a go at them with the "Big Fifty" Sharps he had been using during the battle. He considered the range, made careful judgment of the departure angle necessary to place a bullet among the Indians and fired. To everyone's surprise (including Billy Dixon) one of the Indians toppled from his horse while the others dashed for cover. Shortly thereafter, several Indians appeared and collected the fallen warrior, a Comanche named Toh-hah-kah, and then disappeared from their observation point in the direction of the Canadian River. By this time it was clear to Quanah and his Kiowa and Cheyenne compatriots that Isa-tai's medicine was "bad" and that to continue this fight would ultimately get them all killed by the long range marksmen holed up in the adobe buildings at the "Walls." Billy Dixon later noted that, *"Our guns had longer ranges than theirs."* The Indians referred to these long-range buffalo guns as, *"The guns that shoot today and kill tomorrow."* Years later, Quanah Parker told the famous cattleman, Charles Goodnight, that *"They killed us in sight and out of sight."*

The last white casualty at Adobe Walls was William Olds who, while coming down a ladder to an observation port, dropped his loaded rifle which discharged upon striking the floor, killing him instantly in front of his horrified wife and all those present at the time. Among the Indian casualties was a black bugler who had apparently deserted from a U.S. cavalry unit and had joined the Indians. He was shot and killed by Harry Armitage with a .50 Sharps. There was one other amazing event that followed this battle. Billy Dixon's dog, Fanny, could not be found after the battle and he assumed she had been killed much like the Shadler's big Newfoundland. Dixon returned to the "Walls" in late summer or early fall at which time she appeared and presented him with 4 puppies obviously sired by the Shadler brothers' dog.

Billy Dixon's Long Shot, cont'd

The "Walls" were subsequently abandoned and later burned to the ground by Indians but the outlines of the buildings could still be seen from the air when this writer and his two sons, Matt and Mike, flew over the site and photographed it in the fall of 1995. [See Figure 6]

In late September of that year (1874) the Comanches- formerly *The Lords of the South Plains*, were forced to yield to the white man's will when they were trapped and surrounded by soldiers in Palo Duro Canyon. Only a few weeks before this Billy Dixon was involved in another incredible and seemingly one-sided battle when he and another scout for the Army, Amos Chapman along with 4 enlisted men were surprised by a group of about 125 Kiowa and Comanche Indians. Their horses shot out from under them and with one of the enlisted men (Private Smith) mortally wounded, they took refuge in a small depression on the treeless prairie made by buffalo- a buffalo wallow. Once again Billy Dixon's astounding marksmanship held off the attacking Indians for three days after which the surviving Indians collected their dead and departed. The author has also visited this very hard to find site near the Washita River in the Texas Panhandle where a lonely granite monument stands in present-day Hemphill County. It reads- "Here on September 12, 1874, two scouts and four soldiers defeated 125 Kiowa and Comanche Indians. Stand Silent! Heroes here have been who cleared the way for other men."

All of these men subsequently received the Congressional Medal of Honor. There is no other battle on record in which every participant was so honored.

Two granite monuments will also be found at Adobe Walls. One erected by the Panhandle Plains Historical Society on June 27, 1924 lists the defenders at Adobe Walls. The other was erected by a Native American group in 1941. It lists the names of some of the Indian dead and reads in part, "They Died for That Which Make (sic) Life Worth Living On the Plains which They Enjoyed for Generations."

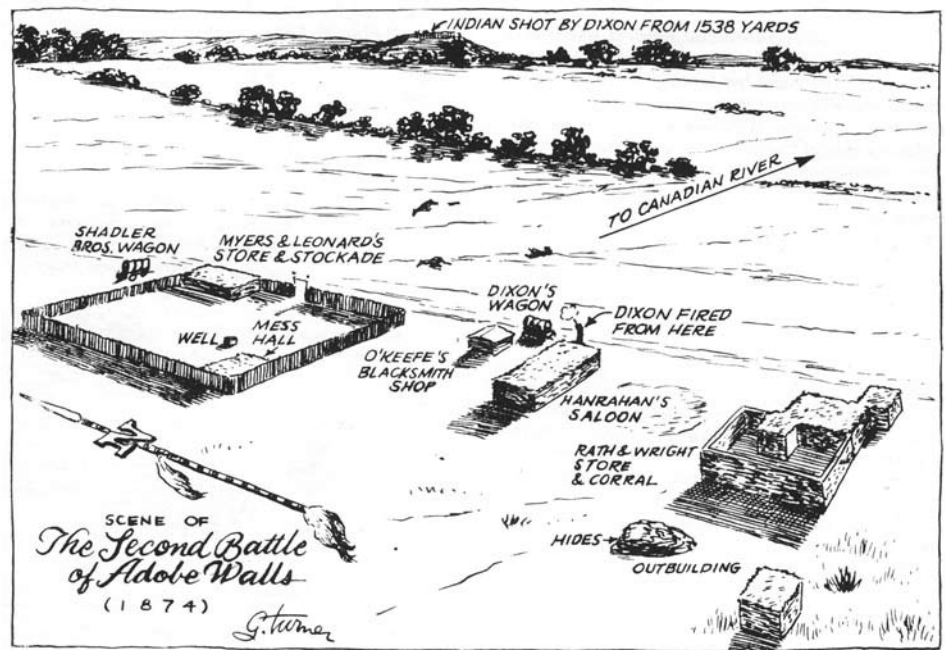
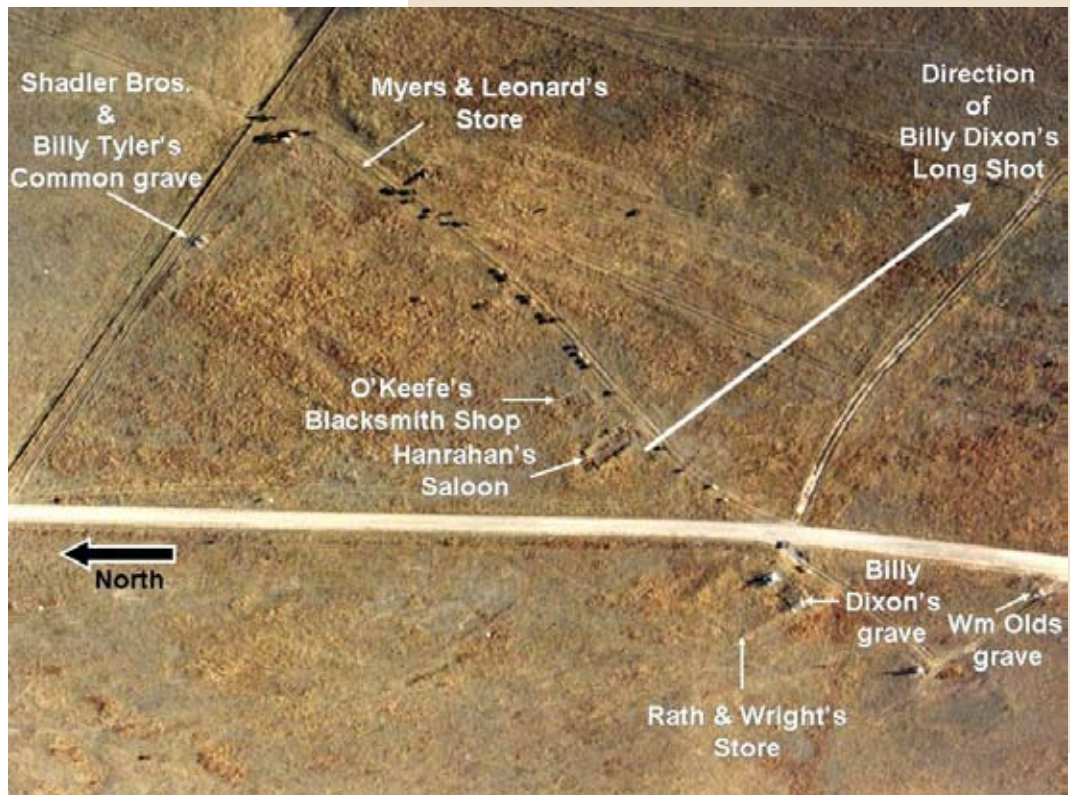


Figure 5. Diagram of the 1874 Adobe Walls Trading Post (from Panhandle Pilgrimage – Ref. 12)

Figure 6. 1995 Aerial Photograph by Author



In the fall of 1877 Billy Dixon met Quanah Parker. They relived the battle and became friends. Quanah told him of having his horse shot out from under him while 400 to 500 yards out from the "Walls" and of being wounded by a deflected or ricocheted bullet.

Isa-tai also survived the battle and the subsequent ridicule of his tribesmen and other Indian survivors of the Battle of Adobe Walls. He joined Quanah Parker on the reservation in Oklahoma, lived a full life and had a large family. A picture of him surrounded by his family can be found in Reference 2 (page 42-figure 24) and Reference 12 (page 90).

Interim Summary

Some readers may believe that this historical review has no place in this article or our Journal. If so, I truly feel sorry for you. These were all courageous men fighting for their lives and what they believed in. I'm not sure we have such men among us today and a reading of the few books on the subject can almost take you to that lonely spot in the Texas Panhandle where acts of daring and desperation were played out in June of 1874. I have been there three times now and hope to return again as it was a truly spiritual experience.

The Ballistics of Billy Dixon's Long Shot

Until very recent times Billy Dixon's long shot at Adobe Walls probably held the record for the longest shot made on an adversary. The distance has been repeatedly given as 1538 yards based on the 1927 edition of his biography although there is reason to believe it may have been more like 1200 to 1400 yards. Although Billy Dixon was able to identify the spot from where he fired the shot, the Indians had removed the unlucky victim from the battlefield so this location is decidedly uncertain consequently the 4-significant figure accuracy suggested by the 1538-yd value must be regarded with considerable skepticism. What is known and appears to be undisputed is that the victim was among a small group of 15 to 20 Indians positioned on a small mesa to the east/southeast of Adobe Walls. The author has been to this site and would estimate this mesa to be approximately 50 yards long by 40 yards wide. It can easily be ascended on horseback from a position of concealment toward the Canadian River. The mesa directly east of Adobe Walls is only 700 yards distance and cannot be easily summited on horseback if at all. The Adobe Walls site itself is well marked (once one finds it on a lonely dirt road to the east of the highway between Borger and Spearman, Texas.). My GPS puts it at about 101° 10'W by 35° 53'N and with a mean sea level elevation of 2680 ft. The central area of the bluff literally pointed out in a 1975 photograph on page 95 of Reference 12 is approximately 1500 yards from the area immediately in front of Billy Dixon's grave and 100 feet higher in elevation. Figure 7 is one of my photographs taken in November of 1995 where I am simulating Dixon's Long Shot with my .50-100 Sharps. The fatal bluff and hill can be seen in the distance.

Although the Yuma Proving Grounds (YPG) Doppler radar tracks allowed the 1538-yd velocity and time of flight to be determined for multiple shots with a number of representative types and weights of bullets, a more useful approach (that will often be followed in this article) is to frequently provide the reader with 1500-yard velocity values. As will be seen, there is not a great difference in velocity for such heavy, large caliber bullets at these two distances.

Several articles have appeared over the last 15 years in popular gun magazines recounting Billy Dixon's famous long shot during the Second Battle of Adobe Walls*, Texas on June 27, 1874. These articles have generally failed to adequately address the exterior and terminal ballistic aspects of this historic event. At least one of these articles even used a rifle of a different caliber (.45-70) in a claimed "recreation" of this 1538-yard shot. I should also point out that even the photograph in the definitive book, *Life of Billy Dixon*, written by his wife, shows the wrong bluff and butte upon which the Indians were located. I strongly suspect that whoever took the picture for the first revised edition printed in 1927, went to the site, looked around and couldn't believe it was the distant bluff and mesa shown in Figure 7. The bluff and mesa shown in the *Life of Billy Dixon* is only 700 or so yards distance but does look more like a location where one might have a fair chance of hitting a human-size target. I might also reiterate that one cannot ride a horse to the top of the mesa shown in the *Life of Billy Dixon* book [Ref. 4]. The probable location and view of the fatal hilltop from the "Walls" is shown on page 95 of the Robertson and Robertson book, *Panhandle Pilgrimage* [Ref. 12] and in Figure 7.

The actual rifle used by Billy Dixon was a Model 1874 Sharps chambered for the "Big 50" Sharps cartridge more commonly known as the 2-1/2 inch straight case, .50-100 Sharps.

This writer's first awareness of Billy Dixon's Long Shot came with a 1990 inquiry from Dr. John Thornton who wanted some suggestions on a reasonable ballistic coefficient for the long obsolete bullet loaded in .50-100 Sharps cartridges in the late 1800s. I have presently forgotten what information, if any, I was able to provide but the classic approach for estimating a G_1 ballistic coefficient is to first calculate the bullet's sectional density. In English units, this is simply the bullet's weight (in pounds) divided by the effective diameter (in inches) squared. A form factor (i) derived from a published diagram of bullet profiles developed by Bugless and Coxe and their accompanying table (published in Reference 7) is incorporated into the complete formula as shown below.

$$BC = w/id^2$$

I will return to this formula and its application to selected .50 Sharps bullets later in this article.

John Thornton's interests in this remarkable shot and his later article in the *Journal of Forensic Sciences* [Ref. 15] also stimulated my interest and resulted in my subsequent contacting the foremost manufacturer of replica Sharps rifles (the Shiloh Sharps Company of Big Timber, Montana). This led to a visit to the factory, the later purchase of a long-range .50-100 Sharps rifle with a 34-inch barrel and preparations for casting bullets that would be faithful replicas of the bullets of the era. These latter efforts involved a literature search and ultimately required the purchase of an original, factory-loaded cartridge from a cartridge collector, a trip to AFTE Technical Advisor Bill Woodin's laboratory to have the cartridge x-rayed followed by the manufacture of a custom bullet mould for a comparable paper patch bullet.

*The First Battle of Adobe Walls occurred in 1864 about a mile south of the 1874 Adobe Walls site. It also involved a large number of Indians and a group of soldiers led by Colonel Kit Carson. The Indians effectively won this battle with the surviving whites barely escaping with their lives.



Figure 7. A Simulated "Long Shot" at the 1500-yd. Hill and Butte to the East-Southeast of Adobe Walls (November 1995)

In 1992, Wolfgang (Wolf) Droege, the then president and founder of the Shiloh Sharps Company of Big Timber, Montana, came to the Yuma Proving Grounds with several loadings of paper patch bullets of 650 and 675-gr weights. These were fired and tracked out to 1500-yds and beyond.

Two of the literature references (*Cartridges of the World*, by Barnes and *Sharps Firearms*, by Sellers) listed a number of loadings for the "Big Fifty" Sharps cartridge. Sellers book provided two standard factory loads: a .50-100-425 and a .50-100-473PP load. The latter cartridge was loaded with a paper patch (PP) bullet of 473 grains weight and 100 grains of black powder. Barnes lists two factory loads on page 144 of his book along with muzzle velocity values. These are shown as the .50-110-335 at 1475f/s and the .50-90-473 at 1350f/s. Buffalo hunters on the western plains were free to load other bullet weights and could cast .50-caliber bullets weighing as much as 680 grains. Paper patch bullets were preferred by buffalo hunters because of their ease of loading in the field, their proven accuracy and their very lethal effect on large game.

At this point some readers are probably confused by the names of these cartridges. They all involve the same 2½-inch straight .50-caliber cartridge case. Figure 8 illustrates two of these cartridges (an original and one of the author's handloads) along with a .22LR cartridge serving as a scale. The middle number in the naming system of the day denoted the amount of black powder (in grains) contained in the cartridge. The third number represented the bullet weight in grains. A properly seated heavier bullet takes up more of the space available for the powder charge resulting in less room for the black powder. An alternate 425-gr. grooved and lubricated .50-caliber bullet available from Lyman (mould #515141) was purchased since these types of bullets were known to exist at the time of this incident. When cast with pure lead alloyed only with tin in a 20:1 ratio, the resultant bullet weighed 438 grains. Still it was considerably lighter than the 530-gr. paper patch bullet from the custom mould and was deemed useful for comparison purposes. As will be seen, when fired over

such long distances, the higher muzzle velocity of the lighter bullet is offset by its lower ballistic coefficient and the higher BC of the heavier bullet allows it to retain its velocity better

than the lighter bullet over a long distance. The net effect is that at distances of 1500 or 1538 yards both bullets have similar flight times and remaining velocities. Examples of these bullets are shown in Figure 9. Full, mildly compressed charges of DuPont 2F black powder loaded into modern .50-2 ½" brass cases and primed with Federal Magnum large rifle primers produced average velocities of 1460f/s and 1300f/s for the 438-gr. and the 530-gr. paper patch bullet respectively when measured 20 feet beyond the muzzle and fired from the replica 1874 Shiloh Sharps with a 34-inch barrel. This barrel was rifled 6-right with a twist rate of 1 turn in 36 inches.

Multiple shots with this rifle and multiple bullets weights were carried out at the U.S. Army Yuma Proving Grounds in 1992 and 1995 using several departure angles to include angles ranging from about +5 degrees to about +10 degrees. Maximum range shots using a departure angle of +35 degrees were also carried out in the 1992 tests. The 5 to 10 degree angles produced relatively flat trajectories and radar tracks out to 1500 and 1600 yards. From the list files for these Doppler radar tracks the times of flight and down range velocities for these bullets to specific distances were recorded. These data allow for a calculation of their effective G1 ballistic coefficients. This involved the use of the iterative method (to be illustrated later in this article) and *Sierra Bullet's Infinity 5* exterior ballistics program. These data and calculations, in turn, allowed a much-improved scientific assessment of Billy Dixon's Long Shot and the answers to a number of interesting questions.

These questions include: What was the flight time of the bullet that killed Toh-hah-kah? Did he and his fellow warriors hear the shot before



Figure 8.
Two "Big .50" Sharps
Cartridges Loaded with
Paper Patch Bullets
(.22LR Cartridge for
Size Comparison).

the fatal bullet arrived? If so, how much time did he have to move into or out of harm's way? How high above the victim was Billy Dixon's Big 50 Sharps pointed when he fired the shot? What sort of impact velocity did the bullet have when it struck the victim? What are the wound ballistic capabilities of such a bullet at such long range? If we could find Toh-hah-kah's burial site, is the bullet likely to be in his remains?

Doppler Radar / Advantages over Chronograph Measurements

Aside from Doppler radar trackings and published exterior ballistic tables, the only other readily available means of deriving a ballistic coefficient from actual performance data is the use of Oehler's M43 PBL system. The use of this system is limited to a bullet's initial flight out to about 100 yards. This limitation presents several shortcomings. Few, if any bullets parallel the performance of the standard G_1 bullet (shown in Figure 10) from their initial muzzle velocity to sub-



Figure 9.
The Lyman 425-gr. Cast Bullet and Two, 530-gr. Custom Paper Patch Bullets

Lyman #515141 bullet (top) 20:1 Pb:Sn BHN hardness = 10, OABL = 0.962", Meplat = 0.18",

Bullet diameter = 0.512", length of bearing surface = 0.50".

Custom paper patch bullet (center) 20:1 Pb:Sn BHN hardness = 10, OABL = 1.195",

Round nose with slight, 0.09" Meplat,

Bullet diameter = 0.501", length of bearing surface approximately 0.60",

Wrapped with two revolutions of 0.018" 100% cotton paper.

sequent distant downrange velocities. This means that nearly all real-world bullets do not have a single G_1 BC throughout their flight particularly over long distances. This will be illustrated later in this paper with the 50 Sharps bullets used in this study. That bullets possess varying BCs over large differences in velocity is not a major problem if one is only dealing with shots over distances of a hundred yards or so but when the ranges are substantial (e.g., 1000 to 2000 yards) the errors induced by applying a single BC derived from velocity loss or time of flight over the bullet's first 50 to 100 yards of flight become significant. The second shortcoming inherent in any method (including Doppler radar) that uses a bullet's initial flight is the fact that such bullets are seldom fully stabilized during their early flight. This means that they are usually undergoing a slight but significant yawing motion during this phase of their flight. This produces additional drag and velocity loss compared to the same bullet traveling over the same distance in a fully spin-stabilized manner. BCs derived from the initial, partially stabilized flight of most any bullet will be lower than the true or ideal value for the bullet in this initial velocity regime. This effect can easily be demonstrated by simply firing multiple shots with the same gun and bullet combination and calculating the effective BC for each shot from Doppler radar data or using the Oehler M43 PBL system which automatically calculates the BC for each shot. Multiple values, rather than a single value, will be obtained with the highest BC representing the bullet that achieved the greatest stability.

Performance of the .50-100 Sharps – Doppler Radar Results

In an effort to remain as faithful as possible to the original composition of the Big 50 Sharps cartridge, 2F black powder was used with both bullets in the 1995 YPG tests and previously shown in Figure 9 as well as those fired in 1992 at the Yuma Proving Grounds. At the time of these tests the most common brand of black gunpowder was manufactured by DuPont. This became Goex in more recent times. Black powder is loaded in such a way as to fill the available powder space and, in fact, is usually subjected to some degree of compression to achieve the best possible performance.

The loads developed and used by this writer in the December 1995 YPG tests were 96 grains of DuPont 2F under the 438-gr. Lyman bullet and 90-gr. under the 530-gr. paper patch bullet producing velocities on the order of 1460f/s and 1300f/s respectively. The nominal meteorological (MET) data for these shots was a temperature of 60 degrees F, a relative humidity of 30%, barometric pressure ca. 29.92"Hg and a site elevation above mean sea level of 600 feet.

TABLE 1

NOVEMBER 6, 1992 YPG DOPPLER RADAR RESULTS

675-gr. Paper Patch bullet with 0.20-in. Meplat
Rd. #60 Muzzle Velocity = 1229f/s, Departure Angle ca. +10°,
Time of Flight to 1538-yds = 5.37 seconds
Remaining velocity at 1538-yds = 651f/s

650-gr. Paper Patch bullet with 0.20-in. Meplat
Rd. #61 Muzzle Velocity = 1326f/s, Departure Angle ca. +10°,
Time of Flight to 1538-yds = 5.66 seconds
Remaining velocity at 1538-yds = 573f/s

TABLE 2
DECEMBER 1, 1995 YPG DOPPLER RADAR RESULTS

438 gr. Lyman bullet

Rd. #2 Muzzle Velocity = 1458f/s, Departure Angle ca. +7°, Time of Flight to 1538-yds ca. 6.7 seconds, remaining velocity ca. 418f/s, Angle of Fall at 1538-yds ca. -10°.

Rd. #3 Muzzle Velocity = 1477f/s, Departure Angle ca. +6°, Time of Flight to 1538-yds ca. 6.7 seconds, remaining velocity ca. 428f/s, Angle of Fall ca. -10°.

530 gr. Paper Patch bullet

Rd. #4 Muzzle Velocity = 1298 f/s, Departure Angle ca. +7°, ToF to 1538-yds ca. 6.0 seconds, remaining velocity ca. 536f/s, Angle of Fall ca. -9°.

Rd. #5 Muzzle Velocity = 1318 f/s, Departure Angle ca. +6.5°, ToF to 1538-yds ca. 5.9 seconds, remaining velocity ca. 547f/s, Angle of Fall ca. -9°.

Iterative Method for BC Determination

The table on page 176 of the Lyman Reloading Handbook [Ref. 9] gives BCs of .25 and .225 for high velocity (above 1200f/s) and low velocity (below 1200f/s) performance of the Lyman 425-gr bullet. No literature values were available for the 675, the 650 or the 530-gr paper patch bullets. *Sierra Bullets Infinity 5* exterior ballistics program was initially used to derive the overall average or effective BC for a 1500-yd to 1600-yd flight by an iterative method. There are some exterior ballistic programs that will calculate the effective ballistic coefficient from two velocity values over a known distance but one must be cautious and aware that they may not take into consideration the existing MET data or site elevation. This will introduce some degree of error in any BC value so derived. The purpose and value of using a program such as Sierra's I-5 program is that it will provide a good estimate of these bullets' BCs and will then allow us to carry out exterior ballistic calculations using the Adobe Walls site information (e.g.- elevation of 2680-ft MSL and reasonable estimates for MET conditions on June 27th. The iterative method used here simply involves selecting some reasonable BC value, entering it in the "Custom Bullet" portion of the I-5 program and running the calculations out to 1500 or 1600 yards using the YPG muzzle velocity and meteorological conditions at the time of the shot. The calculated results are then compared to the Doppler radar results.

The iterative method first involves making an educated guess regarding the bullet's BC and entering this value in the program along with the muzzle velocity and MET conditions and then running the calculations out to a selected distance where one has a measured value from the Doppler radar data files. The objective is to find that BC that produces agreement in the selected downrange velocity value.

First Try: an overall BC of 0.20 was assumed and entered in the I-5 program along with the YPG MET conditions, site elevation above sea level and the reported muzzle velocity of 1458f/s for Round 2 from YPG 1995. Figure 10 shows the 1600-yd results of this calculation. As can be seen, the calculated velocity of 427f/s after 7.4 seconds of flight exceeds the YPG Doppler value of 396f/s at 1600-yds therefore a lesser BC value is needed to produce agreement in remaining velocity at this distance.

Second Try: a re-calculation employing an effective BC of 0.18 resulted in a 1600-yd velocity of 387f/s following 7.95

seconds of flight. [See Figure 11] Several more iterations finally yielded an effective BC of 0.185 to achieve a matching 1600-yd velocity with a calculated flight time of 7.8 seconds. However, the actual flight time for Round 2 to reach 1600-yds was only 6.7 seconds. The reason for this time disparity as well as variations in calculated BC for two shots with the same bullet is the fact that the bullet was more stable (had a higher BC) in earlier portions of its flight and less stable (lower effective BC) toward the end of its flight. This can be verified by comparing the Doppler radar data over shorter distances and higher velocities with the calculated results using the previously derived effective BC. When one does this, one will discover that the bullet is performing better (has a BC greater than 0.185) over certain distances in the earlier portion of its flight. For example, the Doppler radar-measured 600-yd velocity and time of flight for the Lyman bullet in YPG 1995-Round 2 was 790f/s and 1.82 seconds respectively. The calculated downrange velocity and ToF using the previously derived BC of 0.185 gives 736f/s and 1.91 seconds. This demonstrates that this bullet was operating with a BC greater than 0.185 over this 600-yd distance. This is exactly why it must be recognized that there is no single BC for virtually any bullet over a wide range of velocity values. This is even more understandable when one looks at the shape of the "Standard Bullet" [see Figure 10] used to develop the G_1 drag functions and exterior ballistic tables and most any real-world bullet. It is also the reason why Sierra Bullets provides multiple BC values for its rifle bullets in selected velocity regimes. A ballistic coefficient can best be thought of as a performance-fitting factor. A bullet that perfectly paralleled the super-, trans- and subsonic performance of the standard bullet would have a constant BC value throughout all velocity regimes. For very long range shots the best predictive calculations of down range velocity and flight time can only be achieved with carefully worked out multiple BCs for selected velocity regimes. This was ultimately done for the 438-gr. Lyman bullet and the 530-gr. paper patch bullet used in the 1995 YPG tests for reasons that will be explained forthwith. Returning to the simpler matter at hand, the same iterative process was carried out for the other shot (YPG 1995-Rd 3) for the 438-gr. Lyman bullet over a distance of 1500-yds and resulted in an average BC of 0.195 for this shot.

The exterior ballistic data from the YPG Doppler radar tracks of the 530-gr. paper patch bullet were also used in con-

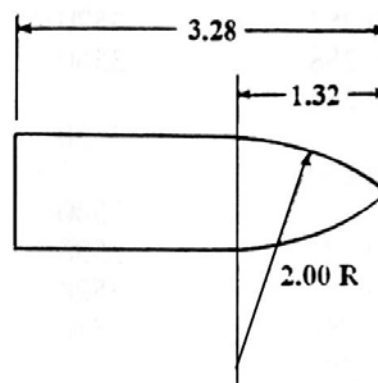


Figure 10. The Standard G_1 Projectile
Diameter = 1.00 inches, length = 3.28 inches, weight = 1 pound,
1.32-inch ogive has a 2-caliber radius, form factor (i) = 1
BC = 1.00 (by definition)

Units	Custom: 5 LYMAN 50-CAL 425-gr (1)						
Full English	Sierra Bullets: 243 dia. (6mm) 70 gr. HPBT MatchKing						
Muzzle Velocity	Sierra Bullets: 308 dia. 155 gr. HPBT Palma MatchKing						
1458	Sierra Bullets: 338 dia. 250 gr. HPBT MatchKing						
Maximum Range	Sierra Bullets: 425 dia. (44 cal) 250 gr. FPI Match						
1600							
Range Increment							
160							
Zero Range							
1600							
Elevation Angle							
0							
Sight Height							
1.00							
Accept Values							

Range (Yards)	Velocity (FV/Sec)	Energy (FV/Lbs)	Momentum (Lb-Sec)	Drop (inches)	Bullet Path (inches)	Wind Drift (inches)	Time of Flight (Seconds)
0	1458.0	2067.1	2.84	0.0	-1.0	0.0	0.000000000
160	1095.4	1166.9	2.13	-25.98	746.17	0.0	0.384367632
320	926.4	834.5	1.80	-125.63	1419.67	0.0	0.864843893
480	822.2	657.4	1.60	-328.88	1989.57	0.0	1.416606655
640	740.5	533.2	1.44	-664.26	2427.34	0.0	2.033542015
800	671.1	437.9	1.31	-1163.12	2701.63	0.0	2.717543138
960	610.0	361.8	1.19	-1862.21	2775.69	0.0	3.473762044
1120	555.5	300.0	1.08	-2805.99	2605.06	0.0	4.309907152
1280	506.9	249.8	0.99	-4049.41	2134.79	0.0	5.236062870
1440	463.9	209.3	0.90	-5661.53	1295.83	0.0	6.264926561
1600	426.8	177.1	0.83	-7730.5	0.0	0.0	7.412520982

Figure 11.
Sierra Infinity-5 Calculation to 1600-yds. Using an Effective BC of 0.20. The YPG 1995 RD 2 muzzle velocity of 1458f/s and the nominal MET data were used for this computation.

Units	Custom: 5 LYMAN 50-CAL 425-gr (2)						
Full English	Sierra Bullets: 243 dia. (6mm) 70 gr. HPBT MatchKing						
Muzzle Velocity	Sierra Bullets: 308 dia. 155 gr. HPBT Palma MatchKing						
1458	Sierra Bullets: 338 dia. 250 gr. HPBT MatchKing						
Maximum Range	Sierra Bullets: 425 dia. (44 cal) 250 gr. FPI Match						
1600							
Range Increment							
160							
Zero Range							
1600							
Elevation Angle							
0							
Sight Height							
1.00							
Accept Values							

Range (Yards)	Velocity (FV/Sec)	Energy (FV/Lbs)	Momentum (Lb-Sec)	Drop (inches)	Bullet Path (inches)	Wind Drift (inches)	Time of Flight (Seconds)
0	1458.0	2067.1	2.84	0.0	-1.0	0.0	0.000000000
160	1069.8	1112.9	2.08	-26.59	838.16	0.0	0.390280303
320	900.0	787.7	1.75	-130.29	1600.21	0.0	0.883545339
480	793.1	611.6	1.54	-343.87	2252.38	0.0	1.453466182
640	708.1	487.6	1.38	-699.6	2762.4	0.0	2.096008702
800	635.6	392.8	1.24	-1234.42	3093.33	0.0	2.815172163
960	571.8	310.0	1.11	-1993.05	3200.45	0.0	3.618824993
1120	515.3	258.2	1.00	-3031.45	3027.8	0.0	4.518041685
1280	465.6	210.8	0.91	-4421.13	2503.87	0.0	5.527125853
1440	422.6	173.7	0.82	-6255.06	1535.69	0.0	6.664299734
1600	386.6	145.3	0.75	-8656.5	0.0	0.0	7.953297354

Sierra Infinity-5 Calculation to 1600-yds. Using an Effective BC of 0.18. This re-calculation uses a reduced BC of 0.18 producing a significantly lower downrange velocity and lengthened flight time compared to the previous computation.

cert with the *Sierra Infinity-5* program in the same manner as before to derive effective, overall BC values for this bullet out to distances of 1500 and 1600 yards. Values of 0.267 (for Round 4) and 0.270 (for Round 5) were obtained for this relatively long, sleek bullet. Now for the surprise. If one employs any one of the average or effective BC values reported above and carries out a calculation for a 1538-yd. shot using the muzzle velocities for Rounds 2, 3, 4 or 5, the 1538-yd. velocity value will be in agreement with the radar data but the *times of flight will not*. As previously pointed out, this is because of the variations in exterior ballistic performance (and therefore variations in BC values) in different velocity regimes.

Table 3 shows the refinement in calculated BC values for the two 1995 bullets in the supersonic, trans-sonic and sub-sonic regimes. These multi-step BC values were subsequently employed in the *Sierra Infinity-5* program for a recalculation of both downrange velocity *and* time of flight (ToF). This resulted in a much-improved agreement in the ToF values with continued good agreement for the downrange velocity values.

All of this is desirable and necessary if one wishes to carry out exterior ballistic calculations related to the Adobe Walls site as will be demonstrated at the conclusion of this article.

TABLE 3
BCs BY VELOCITY SEGMENTS

Rd 3/YPG 1995 – 438-gr Lyman Bullet

MV 1477f/s →
1151f/s @ 151-yds
1006f/s @ 276-yds
800f/s @ 603-yds
440f/s @ 1500-yds Total ToF to 1500-yds = 6.40 seconds

Calculated BCs:

1477f/s to 1151f/s (151-yds of flight) = 0.227 [supersonic flight]
1151f/s to 1006f/s (125-yds of flight) = 0.240 [trans-sonic flight]
1006f/s to 800f/s (327-yds of flight) = 0.227 [subsonic flight]
800f/s to 440f/s (897-yds of flight) = 0.181 [slow flight]

Using these multiple BCs, *Sierra I-5* program and the previous YPG MET data, the calculated 1538-yard velocity and ToF were 434f/s and 6.78 seconds.

Using the average BC of 0.195, the same calculation gives a 1538-yd velocity of 432f/s and a ToF of 7.03 seconds.

The YPG Doppler track on Rd. 3 gave 435f/s and 6.70 seconds for the ToF after 1538 yards of flight.

Rd 5/YPG 1995 – 530-gr Paper Patch Bullet

MV 1318f/s →
1129f/s @ 142-yds
1004f/s @ 336-yds
801f/s @ 784-yds
499f/s @ 1704-yds Total ToF to 1704yds = 6.80 seconds

Calculated BCs:

1318f/s to 1129f/s (142-yds of flight) = 0.322 [supersonic flight]
1129f/s to 1004f/s (194-yds of flight) = 0.415 [trans-sonic flight]
1004f/s to 801f/s (448-yds of flight) = 0.313 [subsonic flight]
801f/s to 499f/s (920-yds of flight) = 0.233 [slow flight]

Using these multiple BCs, *Sierra I-5* program and the previous YPG MET data, the calculated 1538-yard velocity and ToF were 544f/s and 5.94 seconds.

Using the average BC of 0.270, the same calculation gives a 1538-yd velocity of 540f/s and a ToF of 6.21 seconds.

The YPG Doppler track on Rd. 5 gave 435f/s and 5.85 seconds for the ToF after 1538 yards of flight

The refinement in BC values for these two bullets shows a marked improvement in agreement for the ToF values. These values will be applied to the Adobe Walls site in order to answer several of the questions posed earlier in this article. The application of the classic formula, $BC = w/id^2$ and the appropriate form factor for each of these bullets (from the Bugless and Coxe table) produced BCs of 0.20 and 0.32 respectively. These values are only in fair to marginal agreement with the values derived from actual test-firings and radar trackings. Were they to be used for downrange velocity estimates and times of flight for long distance shots (such as 1500-yds), substantial errors would result.

Wound Ballistics Considerations

Reduced loads were prepared with the lighter 438-gr Lyman bullet to give velocities comparable to the YPG results of 1995 for each of these bullets at the 1538-yard mark. Multiple shots were fired into blocks of calibrated 10%w/w ordnance gelatin. This standard tissue simulant was located just beyond a ballistic chronograph allowing for a reliable measurement of the impact velocity of each bullet.

At an impact velocity of 456f/s the Lyman bullet penetrated 20.4 inches of 10%w/w -4°C ordnance gelatin. The bullet yawed and reversed itself after 15.5 inches of travel in the gelatin. A second bullet at 352f/s penetrated 18.25-in without yawing. A third bullet at 453f/s exited a 24.75-in block without significant yawing during its passage through the gelatin. [Steel BB calibration shots at 606, 608, and 613f/s impact velocities gave 3.9-in, 4.0-in and 4.1-in gelatin penetration respectively]

Additional gelatin blocks were prepared for the following two (2) shots with the 438-gr Lyman bullet:

Shot #1 with an impact velocity of 422f/s gave 21.4-in. of penetration with bullet reversing itself after about 14.5-in of penetration.

Shot #2 at an impact velocity of 442f/s, achieved 22.4-in of penetration with the bullet once again reversing itself after about 14.5-in of penetration.

[Four (4) std. BB calibration shots into this gelatin gave: 3.5-in @ 583f/s, 3.75-in @ 586f/s, 3.75-in @ 589f/s and 3.8-in @ 595f/s]

Ordnance gelatin shots with the 530-gr paper patch bullet were also carried out but only with partial success. Three (3) shots at 481, 486 and 491f/s all yawed, followed a curved path and exited the side of the gelatin blocks after 19.5 inches of travel. A fourth shot with an impact velocity of 499f/s penetrated 24.4 inches of gelatin before it likewise exited the side of the block.

These results clearly demonstrate the potential lethality of such seemingly slow moving bullets at the considerable distances of 1500 to 1600 yards. It should also be pointed out that in an actual case situation, these bullets would probably *not* reverse themselves or deviate so radically during gelatin or tissue penetration because of the much greater spin stabilization of a normally discharged bullet as compared to one launched with a reduced powder charge and at close range. Remaining nose-forward would increase the depth of penetration to something in excess of 24 inches. The heavier paper patch bullets fired in the 1992 Yuma tests with their 651f/s and 573f/s remaining velocities at 1538-yds would be just as lethal if not more so. In retrospect, and considering the average torso thickness of a lean adult male, as many as two Indians stood to die that fateful day from the single shot fired by Billy Dixon from nearly a mile northwest of the warriors' gathering place on the mesa. Horses would fare little better if struck by one of these large caliber, heavy bullets.

This effectively answers the question posed earlier regarding the lethality of these bullets at long range but what of the other questions?

Q: If we could find Toh-hah-kah's burial site, is the bullet likely to be in his remains?

Answer: No. It is not at all likely that the fatal bullet would have stopped in his body given the penetration depths reported above.

Exterior Ballistic Considerations

Q: What was the flight time of the bullet that killed Toh-hah-kah?

Answer: If we use the popular distance of 1538-yd., the YPG 1995 tracks for the lubricated 428-gr Lyman bullet show a flight time of 6.7 seconds. Two shots using the 530-gr paper patch bullet gave flight times of 6.0 and 5.9 seconds.

But the Yuma Proving Grounds is not Adobe Walls. The site elevations are different (600-ft MSL vs. 2680-ft MSL) and the meteorological conditions were likely different, all of which have some effect on the exterior ballistic performance of projectiles. So what might we assume about the MET conditions at Adobe Walls on June 27, 1874? It is known that it was very hot on the day before the battle causing some of the men at Adobe Walls to pitch their bedrolls outside. A historical review of the daily weather conditions for an 11-year period at Borger, Texas (about 15 miles from the Adobe Walls site and at a comparable elevation) revealed an average daily temperature of 77 degrees F. The average high temperature value was about 90 degrees F. The average relative humidity values for this same 11-year period was 52% and the average barometer was 29.94"Hg. For the purpose of calculation, a temperature of 80 degrees F was utilized along with the other parameters just described. The refined BC values for the two types of bullets used in the 1995 YPG tests and average muzzle velocities of 1460f/s for the 438-gr Lyman bullet and 1300f/s for the 530-gr paper patch bullet were used to re-calculate downrange velocity, time of flight and several other parameters yet to be addressed with the following results:

The 428-gr. Lyman bullet fired to 1538-yds at the Adobe Walls site and with MET data described above would have a remaining velocity of 481 f/s and a ToF of 6.36 seconds.

Note: It might be recalled that YPG 1995 Round 2 with this bullet and a similar muzzle velocity of 1458f/s had a remaining velocity of 418f/s at 1538-yds and a ToF of 6.7 seconds.

The 530-gr. paper patch bullet fired to 1538-yds. at the Adobe Walls site and with the previously described MET data would have a remaining velocity of 587f/s and a ToF of 5.69 seconds.

Note: YPG 1995 Round 4 with this bullet and a similar muzzle velocity of 1298f/s had a remaining velocity of 536f/s at 1538-yds and a ToF of 6.0 seconds.

The improvement in exterior ballistic performance for both of these bullets when fired at Adobe Walls is the consequence of thinner air (due to the increased site elevation and the warmer air temperature).

Q: Did Toh-hah-kah and his fellow warriors hear the shot before the fatal bullet arrived?

Answer: Yes. The discharge of one of these rifles can easily be heard from a downrange position of 1538 yards. The large puff of black powder smoke is also quite visible from this distance. This is the result of firsthand experience observing and hearing the discharge of the author's Big Fifty Sharps from 1500 yards distance.

Q: If so, how much time did he have to move into or out of harm's way?

Answer: The speed of sound at 80 degrees F is 1143f/s. Therefore, the time for the sound of the shot to reach the victim at 1538-yds (4614-ft) would be 4.04 seconds. This time interval subtracted from the ToF values just reported in the answer to an earlier question gives a lagtime of 2.32 seconds for the Lyman bullet and 1.65 seconds for the paper patch bullet. The approach of one of these subsonic bullets is also quite audible and has been both witnessed firsthand and recorded from a remote downrange position with a digital tape recorder. So, did Toh-hah-kah do nothing after he heard the distance report of Dixon's Big Fifty Sharps and the hissing sound of the bul-

let's approach or did he attempt to move to safety only to intercept the bullet's arrival? The answer to this question will never be known.

Q: What sort of departure angle was required for Billy Dixon to make this long distance shot?

Answer: The drop values provided in the calculated flights of each of these bullets can be used to calculate the departure angles at Adobe Walls. A shot with the Lyman bullet fired over level ground requires a departure angle of +6.0 degrees whereas the better performing paper patch bullet requires a departure angle of + 5.1 degrees.

To each of these must be added the 100-ft change in elevation between the impact area and Billy Dixon's position at the "Walls". A 100-ft increase in terrain elevation at 1538-yds (4614-ft) equals 1.2 degrees. The departure angles then become +7.2 and +6.3 degrees respectively.

Q: How high above the victim was Billy Dixon's Big 50 Sharps pointed when he fired the shot?

Answer: The previously calculated departure angles represent an extension of the axis of the bore. Projecting these angles to 1538-yds. amounts to an over-hold of 485-ft. (162-yds.) for a shot with the Lyman bullet and 412-ft. (137-yds.) for the paper patch bullet.

Summary and Concluding Comments

Whether 800-yds., 1200-yds., 1400-yds. or the popular and often cited range of 1538-yds., there should be no question as to the potential lethality of such large caliber bullets fired at relatively low departure angles.

One need merely look at the labeling on a common box of 22LR cartridges to see the warning- "Dangerous within 1½ mile". The 1992 and 1995 tests at the U.S. Army Yuma Proving Grounds provided useful data on flight times, down range velocities and bullet stability out to distances of 1600 yards and beyond in many cases. From these data such things as meaningful ballistic coefficients were derived that could then be used to carry out calculations specific to the Adobe Walls site. A number of these have been undertaken in this article and reported in the form of answers to specific questions.

This historic event has provided an interesting example of how modern technology and exterior ballistic programs can be used to provide reasonably reliable answers to questions that might be raised in more recent cases. Contemporary exterior ballistics programs also allow one to isolate and evaluate various "what if" questions such as variations in selected MET parameters, the effect of winds, variations in muzzle velocity and BC values.

Finally, there is also no question or even suggestion that Billy Dixon was able to single out and hit one adversary at such a great distance. But these powerful, large-caliber firearms loaded with carefully crafted ammunition of the day and fired by a skilled marksman can consistently land bullets in the zone represented by the hilltop some 1500-yds east-southeast of Adobe Walls. Add to this fact the presence of a group of individuals in the impact zone, the chances of an injurious or fatal wound significantly increase.

On this point the reader should examine Ruprecht Nennstiel's interesting evaluation of Billy Dixon's hit probability [Ref. 11].

The story of Billy Dixon's Long Shot and the Battle of Adobe Walls presents an opportunity to apply modern technology and contemporary exterior ballistics programs to answer a number of fascinating questions. These same tools can be applied to present day casework in the same way as demonstrated

here whenever the shooting distances are substantial. Reliable answers to such questions as bullet flight time, downrange velocity, the angle of fall, the departure angle for a particular shot, sight picture and possibly other forensically important issues can be found with the procedures described here.

Author's note: Copies of this paper were sent to the Panhandle Plains Museum in Amarillo and the Hutchinson Co. Museum in Borger, TX.

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22. Woodin, William, *Personal communication*, Woodin Laboratories, Tucson, AZ
23. Benz, Edward (Dir.) *Personal communication*, Hutchinson County Historical Museum, Borger, TX

Films of interest depicting long range marksmanship, bullet flight times and lagtime: *Quigley Down Under* (1990) starring Tom Sellick; *Joe Kidd* (1972) starring Clint Eastwood; *Valdez is Coming* (1971) starring Burt Lancaster.

Choose a Fall Workshop!

ETHICS FOR THE FORENSIC SCIENTIST

Sunday, October 3

Pete Barnett and Carolyn Gannett

This workshop will focus on the practical aspects of ethics in forensics. Students will be given several scenarios, taken from or inspired by real-life incidents. The students will then be asked to define the ethical issues at stake, weigh them against the contents of several forensic ethics codes, and draw conclusions. Lecture material will offer insight into the various types of codes, their features and purpose, and the differences and similarities between the codes of over twenty forensic associations. Concepts dealing with professional relations and competent practice will be discussed, as will issues surrounding filing or being the subject of an ethics allegation.

SEARCH AND RESCUE CANINES

Monday, October 4

Ron Seitz and Frances Roelfsema

Canine resources represent a capable and complementary resource in the arsenal of tools used by search and rescue to locate missing individuals whether alive or deceased. This 4 hour workshop will introduce you to the world of unpaid professionals who train with their canine partners and respond 24/7 to missing person and law enforcement scenarios. It will explain the fundamental science behind canine anatomy and physiology, plus the high level training progression and certification programs which serve as a critical foundation to promote effective, reliable performance on real search applications. It will provide examples of what every canine team faces as they move from their partner's theoretical capabilities to what they can reliably contribute in a variety of "messy" real world search scenarios.

FIRE DEATH INVESTIGATION WORKSHOP

Monday, October 4

John D. DeHaan

Fires can be accidental or intentional, and fatalities may occur as a direct result, as a trigger event, or even in a manner unrelated to the fire. A successful and accurate investigation depends on cooperation among fire investigators, medico-legal specialists, criminalists, and, often, homicide investigators.

DIGITAL AND MULTIMEDIA FORENSICS WORKSHOP

Monday, October 4

Dan Brodie

The field of digital and multimedia forensics grows as quickly as technology advances. Computers, cell phones, and digital cameras have become ubiquitous and digital and multimedia evidence can be found in virtually every type of criminal investigation.

DNA WORKSHOP

Monday, October 4

This is a full day workshop intended to satisfy the FBI Quality Assurance Continuing Education requirement. The presentations will include various topics of interest to the forensic DNA community.

FORENSIC PHOTOGRAPHY WORKSHOP

Monday, October 4

Philip Hess

Footwear impressions are one of the most overlooked forms of evidence at every crime scene, and yet they are present at virtually all crime scenes. This workshop will help students create suitable comparison quality photographs of 3-dimensional and 2-dimensional footwear impressions. Bloodstain patterns are present in many crime of violence, but the patterns are often improperly and/or insufficiently documented to interpret their significance when reconstruction issues arise long after the crime scene has been processed.

Advanced DNA Mixture Interpretation

2 Day Workshop

Save the Dates!

Choose **December 6-7, 2010** @ U.C. Davis
OR **December 9-10, 2010** @ Cal State L.A.

Focus:

- the new SWGDAM mixture guidelines... discussion & implementation
- 3-person mixtures... various lab approaches to the same data
- low-level mixtures... addressing the hard questions

Cost: Free to CAC members, \$100 for non-members

- For experienced casework analysts only
- 100 attendees per venue
- Lunch not included

Coming this Fall:

- Stay tuned to www.cacnews.org for registration, agenda, data sets
- Questions? Contact jeanette.walton@doj.ca.gov or ahiliver@co.sanmateo.ca.us

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CAC 2010 Fall Seminar



Unearthing The Truth

October 3-7, 2010

**Oakland Marriott Convention Center
1001 Broadway Oakland, CA 94607**



Hosted by the Alameda County Sheriff's Office
Criminalistics Laboratory

