Professional Review and Commentary[a]

M. R. Baylor (Editor)
Cary, North Carolina
United States of America

TABLE OF CONTENTS

Forensic Science Review's Professional Review and Commentary (R&C) section highlights contemporary issues and events in the profession of forensic science. To contribute updates or commentary or to recommend books for review, please contact Mike Baylor (mbaylor@nc.rr.com), Jeff Teitelbaum (Jeff.Teitelbaum@wsp.wa.gov), or Ray Liu (rayliu@uab.edu).

[a]The views expressed are those of the authors and do not necessarily reflect the view, the position, or the policy of *Forensic Science Review* or members of its editorial board.

1042-7201/29-2/July 2017/95–120/$0.00 • Copyright © 2017 Central Police University Press

News and Recent Developments

Utah Is First State in the United States to Set a .05 BAC Limit for Driving

James C. Fell

National Opinion Research Center
at the University of Chicago
Bethesda, Maryland
United States of America

Robert B. Voas*

Pacific Institute for Research and Evaluation
Opinion Research Center
Calverton, Maryland
United States of America

Background. In every state in the United States, it is illegal per se (i.e., no other evidence needed) for adults to drive with a blood alcohol concentration (BAC) of .08 grams per deciliter (g/dL) or greater, for drivers younger than age 21 to drive with any positive alcohol concentration (BAC > .02), and for commercial drivers (trucks, buses, taxis, etc.) to drive with a BAC of .04 or greater.

In 1986, when the US Department of Transportation (DOT) took its first formal step toward advocating that the legal BAC limit be lowered from .10 to .08, only two states had enacted such laws (Oregon and Utah in 1983). That federal government initiative involved a regulatory action specifying the enactment of a .08 law as a criterion for a supplemental alcohol traffic-safety grant under a program authorized by the US Congress (23 U.S.C. 408). Consequently, additional states began to consider .08 BAC per se levels, and three more states adopted the new level: Maine in 1988, California in 1990, and Vermont in 1991. Between 1992 and 1998, 10 additional US states adopted .08 BAC per se laws. The movement toward a national standard for .08 BAC received renewed attention in the 105th Congress. On June 15, 2000, the Senate passed H.R. 4475 (the DOT Appropriations Bill for FY 2001) that included a general provision encouraging states to adopt .08 BAC laws by withholding a portion of a state's federal highway funds, beginning in FY 2004, for states that did not adopt the .08 limit. Congress adopted the final .08 BAC bill (Section 351) in 2000, and the president signed it into law shortly thereafter. This federal legislation expired on September 30, 2013, but has been renewed by Congress each year since then.

On May 14, 2013, the National Transportation Safety Board (NTSB), an independent federal agency dedicated to promoting transportation safety, issued a report recommending, among other measures, that states should lower the illegal BAC limit for driving from .08 to .05 g/dL. The NTSB provided a sound rationale in their report and concluded that lowering the BAC limit to .05 or lower has a strong evidence-based foundation. Most industrialized nations have already enacted a .05 g/dL illegal BAC limit. However, there was a lack of enthusiastic support from some organizations, such as Mothers Against Drunk Driving, which questioned the potential benefit of a .05 g/dL BAC law. The DOT's National Highway Traffic Safety Administration (NHTSA) did not formally support the recommendation either. Officials at NHTSA have stated, however, that states are free to lower their illegal BAC limit to .05 or lower if they feel that is appropriate and NHTSA will evaluate the effects. The National Safety Council (NSC) recently adopted a policy statement recommending a limit of .05 g/dL BAC or lower. In 1997, the American Medical Association (AMA) recommended that the limit for driving should be .05 g/dL BAC.

To date, only Utah has adopted this criminal per se statute in the United States and it will not take effect until December 31, 2018. A recent study conducted under a grant from the National Institute on Alcohol Abuse and Alcoholism (NIAAA) found from a metaanalysis of studies around the world that lowering the BAC limit to .05 or lower was associated with an 11% decrease in alcohol-impaired-driving fatal crashes.

The Case for a .05 BAC Limit. The World Medical Association, the American Medical Association, the British Medical Association, the European Commission, the European Transport Safety Council, the World Health Organization, the Canadian Medical Association, the Centre for Addiction and Mental Health, and the Association for the Advancement of Automotive Medicine all have policies supporting a .05 BAC or lower as the illegal limit per se for drivers aged 21 and older. At least 91 countries around the world have adopted a .05 BAC or lower limit for driving; 54 countries use limits from .06 to .12 BAC. The rationale behind adopting a .05 BAC law include:

- ***Virtually all drivers are impaired with regard to driving performance at .05 BAC***. Laboratory and test track research shows that the vast majority of drivers, even experienced drinkers who typically reach BACs of .15 or greater, are impaired at .05 BAC and higher with regard to critical driving tasks. There are significant decrements in performance in areas such as braking, steering, lane changing, judgment, and divided attention at .05 BAC. Some studies report that performance decrements in some of these tasks are as high as 50% at .05 BAC.
- ***The risk of being involved in a crash increases significantly at .05 BAC.*** The risk of being involved in a crash increases at

each positive BAC level, but rises very rapidly after a driver reaches or exceeds .05 BAC compared to drivers with no alcohol in their blood systems. Recent studies indicate that the relative risk of being killed in a single-vehicle crash for drivers with BACs of .05 to .079 is at least 7 times that of drivers at .00 BAC (no alcohol) and could be as much as 21 times that of drivers at .00 BAC depending on the age of the driver. These risks are significant.

- ***Lowering the illegal per se limit to .05 BAC is a proven effective countermeasure*** that has reduced alcohol-related traffic fatalities in other countries, most notably Australia. While studies in Europe and Australia each use a different methodology to evaluate these effects, the evidence is consistent and persuasive that fatal and injury crashes involving drinking drivers decrease on the order of at least 5% and up to 18% after a country lowers their illegal BAC limit from .08 to .05 BAC.
- ***.05 BAC is a reasonable standard to set***. A .05 BAC is not typically reached with a couple of beers after work or with a glass of wine or two with dinner. It takes at least four drinks for the average 170-lb. male to exceed .05 BAC within 2 h, on an empty stomach (three drinks for a 137-lb. female). The BAC level reached depends on a person's age, gender, weight, whether there is food in their stomach, and their metabolism rate. No matter how many drinks it takes to reach .05 BAC, people at this level are too impaired to drive safely.
- ***The public supports levels below .08 BAC***. The NHTSA surveys show that most people would not drive after consuming two or three drinks in an hour and believe the limit should be no higher than the BAC level associated with that. That would be .05 BAC or lower for most drivers. A recent national survey revealed that 63.6% "strongly" or "somewhat" support lowering the limit to .05 BAC.
- ***Most other industrialized nations around the world have set BAC limits at .05 or lower***. All states in Australia have a .05 BAC limit. France, Austria, Italy, Spain, and Germany lowered their limit to .05 BAC years ago, while Sweden, Norway, Japan, and Russia have set their limit at .02 BAC.
- ***Further progress is needed in reducing alcohol-impaired driving.*** It has been 34 years since the first two states adopted a .08 BAC limit and 17 years since federal legislation provided a strong incentive to adopt a .08 BAC limit. Progress in reducing impaired driving has stalled over the past 20 years. Lowering the BAC limit from .08 to .05 will serve as a general notice to all those who drink and drive that the state is getting tougher on impaired driving and will not tolerate it. Such legislation typically reduces drinking drivers in fatal crashes at all BAC levels (BACs > .01; BACs > .05; BACs > .08; BACs > .15).

Summary. It is expected that .05 BAC laws will serve as a strong general deterrent to impaired driving and affect drinking drivers at all BAC levels. This is what happened when the first .08 BAC laws were adopted. Reductions were seen in fatal crashes involving drivers who were drinking (BAC > .01), who were intoxicated (BAC > .08) and who were at very high BACs (BAC > .15).

Most drunk-driving laws passed recently have been specific deterrent laws (sanctions for DWI offenders caught and convicted). A law that sends the message that the state will not tolerate impaired driving, such as lowering the limit to .05 BAC, has substantial potential to resume progress in reducing impaired-driving injuries and fatalities in the United States.

REFERENCES

1. Arnold LS, Tefft BC: *Driving Under the Influence of Alcohol and Marijuana: Beliefs and Behaviors, United States, 2013–2015*; AAA Foundation for Traffic Safety: Washington, DC; 1–19; May 2016.
2. Dang JN: *Statistical Analysis of Alcohol-Related Driving Trends, 1982–2005* (DOT HS 810 942); National Highway Traffic Safety Administration: Washington, DC; 2008; *http://www-nrd.nhtsa.dot.gov/Pubs/810942.pdf* (Accessed May 26, 2017).
3. Fell JC, Voas RB: The effectiveness of a 0.05 blood alcohol concentration (BAC) limit for driving in the United States; *Addiction* 109:869; 2014.
4. Fell JC, Beirness DJ, Voas RB, Smith GS, Jonah B, Maxwell JC, Price J, Hedlund J: Can progress in reducing alcohol-impaired driving fatalities be resumed? Results of a Workshop sponsored by the Transportation Research Board, Alcohol, Other Drugs, and Transportation Committee (ANB50); *Traffic Inj Prev* 17:771; 2016.
5. Ferrara SD, Zancaner S, Georgetti R: Low blood alcohol levels and driving impairment. A review of experimental studies and international legislation; *Int J Legal Med* 106:169; 1994.
6. Hingson R, Heeren T, Winter M: Lowering state legal blood alcohol limits to 0.08 percent: The effect on fatal motor vehicle crashes; *Am J Public Health* 86:1297; 1996.
7. Howat P, Sleet D, Smith I: Alcohol and driving: Is the 0.05% blood alcohol concentration limit justified? *Drug Alcohol Rev* 10:151; 1991
8. McKnight AJ, Langston E, McKnight AS, Lange J: Sobriety tests for low blood alcohol concentrations; *Accid Anal Prev* 34:305; 2002.
9. Moskowitz H, Burns M, Fiorentino D, Smiley A, Zador P: *Driver Characteristics and Impairment at Various BACs* (DOT HS 809 075); US Department of Transportation, National Highway Traffic Safety Administration: Washington, DC; 2000.
10. Moskowitz H, Fiorentino D: *A Review of the Literature on the Effects of Low Doses of Alcohol on Driving-Related Skills* (DOT HS 809 028); US Department of Transportation, National Highway Traffic Safety Administration: Washington, DC; 2000.
11. Voas RB, Tippetts AS, Fell JC: The relationship of alcohol safety laws to drinking drivers in fatal crashes; *Accid Anal Prev* 32:483; 2000.
12. Voas RB, Torres P, Romano E, Lacey JH: Alcohol-related risk of driver fatalities: An update using 2007 data; *J Stud Alcohol Drugs* 73:341; 2012.
13. Wagenaar A, Maldonado-Molina M, Ma L, Tobler A, Komro K: Effects of legal BAC limits on fatal crash involvement: Analyses of 28 states from 1976 through 2002; *J Safety Res* 38:493; 2007.
14. Zador PL, Krawchuk SA, Voas RB: Alcohol-related relative risk of driver fatalities and driver involvement in fatal crashes in relation to driver age and gender: An update using 1996 data; *J Stud Alcohol* 61:387; 2000.

Upcoming Events

2nd International Forensic Science Error Management Symposium
July 24–28, 2017; NIST Campus
Gaithersburg, MD, US

International Association for Identification 102nd International Forensic Educational Conference
Aug. 6–12, 2017; Georgia World Congress Center
Atlanta, GA, US

NIST-DHS Standards for Pathogen Detection for Biosurveillance & Clinical Applications Workshop
Aug. 14–15, 2017; NIST Campus
Gaithersburg, MD, US

23rd Annual IACP Training Conference on Drugs, Alcohol, and Impaired Driving
Aug. 12–14, 2017; Gaylord National Resort & Conference Center
National Harbor, MD, US

21st Triennial Meeting of the International Association of Forensic Sciences
Aug. 21–25, 2017; Sheraton Centre Toronto
Toronto, ON, Canada

10th Congress of the European Pain Federation EFIC®
Sept. 6–9, 2017; Bella Center Copenhagen
Copenhagen, Denmark

Society of Forensic Toxicologists and the International Association of Forensic Toxicologists Joint Annual Meeting
Sept. 10–15, 2017; Boca Raton Resort & Club
Boca Raton, FL, US

Midwestern Association of Forensic Scientists and Southern Association of Forensic Scientists Joint Annual Meeting
September 16–22, 2017; The Westin Cincinnati
Cincinnati, OH, US

6th International Conference on Forensic Research & Technology
Sept. 18–20, 2017; Crowne Plaza Houston River Oaks
Houston, TX, US

Northwest Association of Forensic Scientists Annual Meeting
Sept. 17–22, 2017; Embassy Suites by Hilton (Airport)
Portland, OR, US

California Association of Criminalists Fall Conference 2017 (Hosted by Orange County Crime Laboratory)
Sept. 25–30, 2017; Fairmont Hotel
Newport Beach, CA, US

28th International Symposium on Human Identification
Oct. 2–5, 2017; Washington State Convention Center
Seattle, WA, US

Robert F. Borkenstein Course on the Effects of Drugs on Human Performance and Behavior
Oct. 9–13, 2017; AT&T Executive Education and Conference Center
Austin, TX, US

Southwestern Association of Forensic Scientists Annual Meeting
Oct. 22–26, 2017; Stockyards Hyatt Place and the Stockyards Station
Fort Worth, TX, US

International Forum for Drug & Alcohol Testing
Oct. 23–24, 2017; The Sheraton Sand Key Resort
Clearwater Beach, FL, US

4th International Congress of Forensics & Police Tech Expo-2017
Oct. 27–29, 2017; Venue to be announced
Dalian, China

Northeastern Association of Forensic Scientists Annual Meeting
Nov. 7–10, 2017; Kalahari Resort & Conference Center
Pocono Manor, PA, US

National Homicide Investigators Association 29th Annual Conference
Nov. 13–17, 2017; Orlando Marriott Lake Mary
Lake Mary, FL, US

1st International Caparica Conference in Translational Forensics
Nov. 20–23, 2017; Aldeia dos Capuchos Golf & Spa
Caparica, Portugal

1st Seminar in Forensic Toxicology — Opioids, Toxicology, and the Law
Dec. 11–12, 2017; Chemical Heritage Foundation
Philadelphia, PA, US

American Academy of Forensic Sciences — 70th Annual Meeting
Feb. 19–24, 2018; Washington State Convention Center
Seattle, WA, US

PITTCON Conference and Expo
Feb. 26–March 1, 2018; Orange County Convention Center
Orlando, FL, US

Emirates International Forensic Conference & Exhibition
Mar. 18–20, 2018; Dubai International Convention & Exhibition Centre
Dubai, UAE

International Association for Chemical Testing 2018 Conference
April 29–May 4, 2018; Hyatt Regency
Indianapolis, IN, US

American Society of Crime Laboratory Directors Annual Symposium
May 20–24, 2018; Venue to be announced
Atlanta, GA, US

Forensic Science Educational Program (V) — "Validated" Programs in the UK and Ireland*

Jose Gonzalez-Rodriguez

School of Chemistry, College of Science
University of Lincoln
Lincoln, Lincolnshire, England
United Kingdom

The study of the different aspects of collection, analysis, use, and interpretation of any sort of forensic evidence, as well as the relevant training and knowledge in the techniques of the forensic sciences, are still in demand. Professionals in this discipline are still needed to join police forces, forensic institutes, and private companies around the world. Forensic science programs are still flourishing in many countries in Africa and Asia and still firmly established in many other countries such as US, UK, and Australia that have been delivering these for years. One example of the latter is the UK and Ireland, where the number of forensic courses in the different disciplines exceeds 300 with over 60 providers offering different combinations of forensic science programs.

In the UK these courses have all been *validated* by universities with degree-awarding powers, usually granted by a Royal Charter. This system in the UK guarantees an agile and reliable implementation of courses where the universities can independently implement courses that are in demand without the long process of getting ministerial or government approval. The process of validation involves an external input from other external independent assessors (usually from another reputable university) and the quality office of the university. A second quality stamp for some of these courses comes from the accreditation process, where an external body — in the case of forensic science in the UK, the Chartered Society of Forensic Sciences (CSFS) — awards *accreditation* for different standards. The three main standards are "crime scene", "laboratory analysis and interpretation", and "evaluation and presentation of evidence". Other standards covered are "digital forensics" and "anthropology and archaeology". A process of audits on curricular contents, evidence of quality of work, forensic practitioner's input in the program, and interviews with students is usually followed to establish the quality of the program in order to award accreditation. The Chartered Society of Forensic Sciences has been also accrediting courses outside the UK, which demonstrate how these high standards are becoming more international every day. However, only UK and Ireland programs are included in this review.

The present review of undergraduate (**Table 1**) and postgraduate (**Table 2**) courses concentrates on those *validated* by the universities only and not previously included in a list of accredited courses (*www.forensicsciencereview.com • Forensic Sci Rev* 27:78–82; 2015). The courses in the UK have been obtained using the list of courses offered by the Universities and Colleges Admissions Service (UCAS) using as a filter "forensic science" as a "single subject". (This excludes combinations of subjects where forensic science is only a minor or a part of a more extensive program). For Ireland the website *www.hotcoursesabroad.com* identifies the highest number of institutions offering undergraduate forensic programs under the already mentioned criteria. In the case of master courses, the website *www.studyportals.com* identifies master programs in the UK and Ireland using "forensics" and "forensic science" as key words to extract information.

* The author wants to thank Dr. Anya Hunt and Mrs. Katharine Mitchell from the Chartered Society of Forensic Sciences for their help in collating the information for this review.

Table 1. Validated, not accredited by CSFS, forensic undergraduate courses in the UK and Irish universities (only courses where forensic science is presented as a single subject and not just as a part of the program)

Institution/Program's housing unit/ Address/Main website	Faculty contact	Course title
Anglia Ruskin University Dept. of Biomedical and Forensic Science Science and Technology Anglia Ruskin University East Road Cambridge CB1 1PT UK *http://www.anglia.ac.uk/study/undergraduate/crime-and-investigative-studies*	Dr. Sarah Hall Sarah.Hall@anglia.ac.uk +44 (0)1223 363271 x 2170	Crime and Investigative Studies Crime and Investigative Studies (with placement year)
Institute of Technology Blanchardstown School of Informatics & Engineering Blanchardstown Road North Dublin 15 Ireland *http://www.itb.ie/StudyatITB/bn034.html*	Dr. Anthony Keane Anthony.keane.itb.ie +353 01 8851085	Computing in Digital Forensics and Cyber Security
University of Bedforshire School of Life Sciences/Computer Science and Technology University Square, Luton LU1 3JU UK *https://www.beds.ac.uk/howtoapply/courses/undergraduate/next-year/forensicscience*	Dr. Barry Haggett barry.haggett@beds.ac.uk +44 (0)1582 743701	Forensic Science Forensic Science (with Foundation Year) Forensic Science (with Professional Practice Year)
Bournemouth University Dept. of Archaeology, Anthropology & Forensic Science Christchurch House C239 Talbot Campus, Fern Barrow, Poole BH12 5BB UK *https://www1.bournemouth.ac.uk/study/*courses*/bsc-hons-forensic-science*	Dr. Paul Kneller pkneller@bournemouth.ac.uk +44 (0)1202 961876	Forensic Biology Forensic Investigation Forensic Science
University of Bradford Faculty of Life Sciences University of Bradford Bradford, West Yorkshire BD7 1DP UK *http://www.bradford.ac.uk/study/courses/info/forensic-science-bsc-3-years*	Dr. Chris Gaffney C.Gaffney@bradford.ac.uk +44 (0)1274 233542	Forensic Archaeology and Anthropology Forensic Archaeology and Anthropology (with Placement Year) Forensic Science Forensic Science (with Placement Year) — 4 years
Bristol, University of the West of England (UWE) Dept. of Applied Sciences Frenchay Campus Coldharbour Lane Bristol BS16 1QY UK *http://courses.uwe.ac.uk/F410/forensic-science*	Dr. Antony Hill Antony.Hill@uwe.ac.uk +44 (0)117 32 83653	Forensic Science Forensic Science (with Foundation Year)
Canterbury Christ Church University School of Law, Criminal Justice and Computing N. Holmes Road Canterbury CT1 1QU UK *https://www.canterbury.ac.uk/social-and-applied-sciences/law-criminal-justice-and-computing/our-courses/our-courses.aspx*	Dr. Dominic Wood dominic.wood@canterbury.ac.uk +44 (0)1227 782718	Forensic Investigation Forensic Investigation (with Foundation Year) Forensic Investigation (including International Foundation Year) — EU only
University of Chester Dept. of Biological Science Parkgate Rd Chester CH1 4BJ UK *https://www1.chester.ac.uk/undergraduate/forensic-biology*	Mr. Chris Davis cj.davis@chester.ac.uk +44 (0)1244 511404	Forensic Biology (including a Foundation Year)
Coventry University Faculty of Health and Life Sciences Richard Crossman Building Jordan Well, Coventry CV1 5RW UK *http://www.coventry.ac.uk/study-at-coventry/course-search/*	Dr. Peter Hall aa3999@coventry.ac.uk	Forensic Investigations Forensic Investigations (4 years)

Table 1. (Continued)

Institution/Program's housing unit/ Address/Main website	Faculty contact	Course title
University of Cumbria Faculty of Health and Science Dept. of Science, Natural Resources and Outdoor Studies Fusehill Street Carlisle CA1 2HH UK *https://www.cumbria.ac.uk/study/courses/undergraduate/forensic-and-investigative-science/*	Mr. Nigel Smith nigel.smith@cumbria.ac.uk +44 (0)1539 430622	Forensic and Investigative Science Forensic and Investigative Science (with integrated foundation year) (4 years) Forensic Science Top-up (1 year)
De Montfort University School of Computer Science and Informatics The Gateway, Leicester LE1 9BH UK *http://www.dmu.ac.uk/study/courses/undergraduate-courses/computing-bsc/computing-bsc-degree.aspx*	Prof. Helge Janicke heljanic@dmu.ac.uk +44 (0)116 257 7617	Forensic Computing
University of Derby College of Life and Natural Sciences Dept. of Natural Science Kedleston Road Derby DE22 1GB UK *https://www.derby.ac.uk/forensic-science-courses/forensic-science-bsc-hons-foundation/*	Mr. Adam S. Long a.long@derby.ac.uk +44 (0) 1332 591759	Forensic Science (with Foundation Year)
Galway Mayo Institute of Technology School of Science Dept. of Life and Physical Sciences Dublin Road Galway H91 T8NW UK *https://www.gmit.ie/forensic-science/bachelor-science-honours-forensic-science-and-analysis*	Dr. Seamus Lennon seamus.lennon@gmit.ie +353 091 742081	Forensic Science and Analysis
Glasgow Caledonian University Dept. of Engineering Cowcaddens Road Glasgow G4 0BA UK *http://university.which.co.uk/glasgow-caledonian-university-g42/forensic-investigation-4-years-7000-f410*	Dr. John Maclachlan jmc4@gcu.ac.uk	Forensic Investigation
Glyndwr University, Wrexham Dept. of Chemistry Wrexham LL11 2AW UK *https://www.glyndwr.ac.uk/en/Undergraduatecourses/ForensicScience/*	Dr. Jixin Yang j.yang@glyndwr.ac.uk +44 (0)1978 293123	Forensic Science Forensic Science (including Foundation Year)
Kingston University Faculty of Science, Engineering and Computing 2981 Penrhyn Road Kingston upon Thames KT1 2EE UK *http://www.kingston.ac.uk/undergraduate-course/forensic-science/*	Prof. Raid Alany R.Alany@kingston.ac.uk +44 (0)20 8417 9000	Forensic Science Forensic Science (Foundation)
Letterkenny Institute of Technology, Donegal Dept. of Science Port Road Letterkenny, Co. Donegal F94 DV52 Ireland *http://lyit.ie/courses/science/ly827/*	Dr. Joanne Gallagher joanne.gallagher@lyit.ie +353 (074) 918 6302	Analytical and Forensic Science
University of Lincoln School of Chemistry Brayford Pool, Lincolnshire LN6 7TS UK *http://www.lincoln.ac.uk/home/course/chmfrsub/*	Dr. Tasnim Munshi tmunshi@lincoln.ac.uk +44 (0)1522 83 7477	Forensic Chemistry (3 years) Forensic Chemistry (4 years)

Table 1. (Continued)

Institution/Program's housing unit/ Address/Main website	Faculty contact	Course title
Liverpool John Moores University Faculty of Engineering and Technology Dept. of Computer Science 3 Byrom Street Liverpool, Merseyside L3 3AF UK *https://www.ljmu.ac.uk/study/courses/undergraduates/2017/computer-forensics-mcomp*	Dr. Martin Hanneghan M.B.Hanneghan@ljmu.ac.uk +44 (0) 0151 231 2577	Computer Forensics (4 years) Computer Forensics (Sandwich) Computer Forensics (Foundation Year)
London Metropolitan University School of Human Sciences 166-220 Holloway Road London N7 8DB UK *http://www.londonmet.ac.uk/courses/undergraduate/forensic-science---bsc-hons/*	Dr. Daniel Stratton d.stratton@londonmet.ac.uk +44 (0)20 7133 2514	Crime Scene and Forensic Investigation (Top-up) (1 year) Forensic Science Forensic Science Extended Degree (4 years)
The Manchester Metropolitan University School of Science & The Environment Oxford Road Manchester M15 6BH UK *http://www2.mmu.ac.uk/study/undergraduate/courses/2017/14142/*	Dr. Liz Price e.price@mmu.ac.uk +44 (0)161 247 6200	Forensic Biology Forensic Biology (Sandwich) Forensic Biology (with Study in Europe, North America or Australia) — 4 years Forensic Chemistry (with Study in Europe, North America or Australia) — 4 years
Nottingham Trent University School of Science and Technology Burton Street Nottingham NG1 4BU UK *https://www.ntu.ac.uk/study-and-courses/courses/find-your-course/science-technology/ug/2017-18/computer-systems-forensic-and-security*	Dr. Joanna Hartley joanna.hartley@ntu.ac.uk +44 (0)115 848 8369	Computer Systems (Forensic & Security)
Northumbria University Computer and Information Sciences Pandon Building, Newcastle City Campus Newcastle-upon-Tyne NE1 8ST UK *https://www.northumbria.ac.uk/study-at-northumbria/courses/computer-and-digital-forensics-bsc-ft-uuscof1/*	Mr. Garry Elvin garry.elvin@northumbria.ac.uk +44(0) 0191 227 4467	Computer and Digital Forensics Computer and Digital Forensics (4 years) Computer and Digital Forensics (Sandwich) Computer and Digital Forensics (study abroad)
Waterford Institute of Technology School of Science and Computing Dept. of Computing and Mathematics Main Campus Cork Road Waterford City, Co. Waterford X91 K0EK Ireland *https://www.wit.ie/courses/school/science/department_of_computing_maths_physics/bsc_hons_in_computer_forensics_and_security*	Mr. John Sheppard jsheppard@wit.ie	Computer Forensics and Security
The University of West London School of Human and Social Sciences Boston Manor Road Brentford, Middlesex TW8 9GA UK *http://www.uwl.ac.uk/course/forensic-science-0/35126*	Dr. David Chappell david.chappell@uwl.ac.uk +44 (0)800 036 8888	Forensic Science Forensic Science (with Foundation Year)
University of West of Scotland School of Science and Sport High Street Paisley PA1 2BE UK *http://www.uws.ac.uk/undergraduate/forensic_science/*	Dr. Ciaran Ewins ask@uws.ac.uk +44 141 849 4101	Forensic Science Forensic Science (Sandwich) Forensic Science (4 years)
University of Winchester Faculty of Humanities and Social Sciences Dept. of Applied Social Sciences Medecroft Annex Building, King Alfred Campus Sparkford Road Winchester SO22 4NR UK *http://www.winchester.ac.uk/Studyhere/Pages/ba-hons-forensic-studies.aspx*	Ms. Anna Chaussee Anna.Chaussee@winchester.ac.uk +44 (0)1962 824912	Forensic Studies

Table 2. Validated, not accredited by CSFS, forensic postgraduate courses in the UK and Irish universities (only courses where forensic science is presented as a single subject and not just as a part of another program)

Institution/Program's housing unit/ Address/Main website	Faculty contact	Course title
University of Bedforshire School of Computer Science and Technology University Square, Luton LU1 3JU UK *https://www.beds.ac.uk/howtoapply/courses/undergraduate/next-year/forensicscience*	Dr. Gregory Epiphaniou gregory.epiphaniou@beds.ac.uk +44 (0)1234 400400 x3935	Computer Security and Forensics
Birmingham City University University House 15 Bartholomew Row Birmingham B5 5JU UK *http://www.bcu.ac.uk/courses/forensic-psychology-msc-2017-18*	Prof. Michael Brookes OBE michael.brookes@bcu.ac.uk +44(0) 121 331 6408	Forensic Psychology
Bournemouth University Dept. of Archaeology, Anthropology & Forensic Science Christchurch House C239 Talbot Campus Fern Barrow, Poole BH12 5BB UK *https://www1.bournemouth.ac.uk/study/courses/msc-forensic-anthropology* *https://www1.bournemouth.ac.uk/study/courses/msc-forensic-archaeology*	Dr. Martin Smith mjsmith@bournemouth.ac.uk +44(0)1202 965063 Mr. Paul Cheetham pcheetham@bournemouth.ac.uk +44 (0)1202 961409	Forensic Anthropology Forensic Archaeology
Cardiff University School of English, Communication and Philosophy John Percival Building Colum Road Cardiff CF10 3EU UK *http://www.cardiff.ac.uk/study/postgraduate/taught/courses/group/forensic-linguistics*	Dr. Michelle Aldridge-Waddon aldridgem@cardiff.ac.uk +44 (0)29 2087 9017	Forensic Linguistics
Cardiff Metropolitan University Cardiff School of Health Sciences Dept. of Psychology Llandaff Campus 200 Western Ave Cardiff CF5 2YB UK *http://www.cardiffmet.ac.uk/health/courses/Pages/Forensic-Psychology---MSc-.aspx*	Dr. Joselyn Sellen jsellen@cardiffmet.ac.uk +44 (0)29 2041 7127	Forensic Psychology
University of Central Lancashire School of Forensic and Applied Sciences School of Psychology Preston, Lancashire PR1 2HE UK *http://www.uclan.ac.uk/courses/msc_cybercrime_investigation.php* *http://www.uclan.ac.uk/courses/msc_pgdip_pgcert_forensic_and_conservation_genetics.php* *http://www.uclan.ac.uk/courses/msc_pgdip_pgcert_forensic_psychology.php*	Mr. Bob Barnes rpbarnes@uclan.ac.uk +44 (0)1772 894151 Dr. Arati Iyengar AIyengar@uclan.ac.uk +44 (0) 1772 89 3925 Dr. Roxanne Khan rkhan2@uclan.ac.uk +44 (0) 1772 89 5175	Cybercrime Investigation Forensic and Conservation Genetics Forensic Psychology
University College London Faculty of Engineering Science Dept. of Security and Crime Science 35 Tavistock Square Kings Cross, London WC1H 9EZ UK *https://www.ucl.ac.uk/prospective-students/graduate/taught/degrees/crime-forensic-science-msc*	Dr. Ruth Morgan ruth.morgan@ucl.ac.uk +44 (0)20 3108 3206	Crime and Forensic Science

Table 2. (Continued)

Institution/Program's housing unit/ Address/Main website	Faculty contact	Course title
Coventry University Faculty of Health and Life Sciences School of Psychological, Social and Behavioural Sciences Faculty Engineering, Environment and Computing School of Computing, Electronics and Mathematics Jordan Well, Coventry CV1 5RW UK *http://www.coventry.ac.uk/study-at-coventry/course-search/*	Dr. Chris Hiley ab0589@coventry.ac.uk Dr. Sandy Taramonli ab7680@coventry.ac.uk +44 (0)24 7765 7688	Forensic Psychology and Crime Forensic Psychology Forensic Computing
Cranfield University Shrivenham Campus Shrivenham SN6 8LA UK *https://www.cranfield.ac.uk/courses/taught/digital-forensics*	Dr. Sarah Morris s.l.morris@cranfield.ac.uk +44 (0) 1793 785738	Digital Forensics
University of Dundee School of Science and Engineering Fulton Building Dundee DD1 4HN UK *https://www.dundee.ac.uk/study/pg/forensic-art-facial-identification/*	Dr. Christopher Rynn C.Rynn@dundee.ac.uk +44 (0)1382 386433	Forensic Art and Facial Identification
University College Dublin School of Computer Science and Informatics School of Medicine Belfield, Dublin 4 Ireland *http://www.ucd.ie/online/courses/course-finder/mscindigitalinvestigationandforensiccomputing/* *https://www.cs.ucd.ie/PostgraduateProgrammes/MSc_FCCI* *http://www.ucd.ie/medicine/studywithus/graduatestudies/healthcareriskmanagementquality/mscforensicmedicine/*	Mr. Travis Grotewold +353 1 716 2953 Dr. Nhien An Le Khac an.lekhac@ucd.ie +351 1 716 2929 Dr. Myra Flynn myra.flynn@ucd.ie +353 1 7166641	Digital Investigation and Forensic Computing MSc in Forensic Computing and Cybercrime Investigation MSc Forensic Medicine
Edinburgh Napier University School of Computing Merchiston Campus 10 Colinton Road Edinburgh EH10 5DT UK *http://www.napier.ac.uk/courses/msc-advanced-security-and-digital-forensics-postgraduate-fulltime*	Mr. Richard Macfarlane r.macfarlane@napier.ac.uk +44 (0)131 455 2335	Advanced Security and Digital Forensics
University of Glasgow School of Medicine Dentistry & Nursing, Forensic Medicine & Science Joseph Black Building Gilmorehill Campus Glasgow G12 8QQ UK *http://www.gla.ac.uk/postgraduate/taught/forensictoxicology/*	Dr. Calum Morrison Calum.Morrison@glasgow.ac.uk	Forensic Toxicology
Glasgow Caledonian University School of Health and Life Sciences Dept. of Psychology and Allied Health Sciences Cowcaddens Road Glasgow G4 0BA UK *http://www.gcu.ac.uk/study/courses/details/index.php/P00974-1FTA-1718/Forensic_Psychology?utm_source=XXXX&utm_medium=web&utm_campaign=courselisting*	Dr. Helen L Gallagher h.l.gallagher@gcu.ac.uk +44 141 331 3398	Forensic Psychology

Table 2. (Continued)

Institution/Program's housing unit/ Address/Main website	Faculty contact	Course title
Goldsmith University of London Department of Psychology New Cross, London SE14 6NW UK *http://www.gold.ac.uk/pg/msc-forensic-psychology/*	Prof. Fiona Gabbert f.gabbert@gold.ac.uk +44 (0)20 7078 5496	Forensic Psychology
University of Gloucestershire Natural and Social Sciences Francis Close Hall Campus Swindon Road Cheltenham GL50 4AZ UK *http://www.glos.ac.uk/courses/postgraduate/fpy/pages/forensic-psychology-postgraduate-certificate-postgraduate-diploma-msc.aspx*	Dr. Claire Cooke ccooke@glos.ac.uk +44(0) 1242 715361	Forensic Psychology
University of Greenwich Faculty of Architecture, Computing and Humanities Old Royal Naval College Dept. of Computing & Information Systems Park Row, London SE10 9LS UK *http://www.gre.ac.uk/pg/ach/cfsm*	Eur Ing Alexander Fedorec A.M.Fedorec@greenwich.ac.uk +44 (0)20 8331 8511	Computer Forensics and Cyber Security
University of Hull Dept. of Chemistry Cottingham Road Hull HU6 7RX UK *http://beta.www.hull.ac.uk/Study/PGT/analytical-forensic-chemistry.aspx*	Dr. Phil King p.j.king@hull.ac.uk +44 (0)1482 466880	Analytical and Forensic Chemistry
University of Kent School of Physical Sciences School of Psychology School of Anthropology and Conservation Canterbury, Kent CT2 7NZ UK *https://www.kent.ac.uk/courses/postgraduate/5/forensic-science* *https://www.kent.ac.uk/courses/postgraduate/69/forensic-psychology* *https://www.kent.ac.uk/courses/postgraduate/1231/forensic-osteology-and-field-recovery-methods*	Prof. Michael J. Went M.J.Went@kent.ac.uk +44(0)1227 82 (3540) Prof. Theresa Gannon T.A.Gannon@kent.ac.uk +44 (0)1227 824827 Prof. Jim Groombridge J.Groombridge@kent.ac.uk +44 (0)1227 (82)4097	Forensic Science Forensic Psychology Forensic Osteology and Field Recovery Methods
King's College London Institute of Psychiatry, Psychology & Neuroscience Dept. of Forensic & Neurodevelopmental Sciences Strand, London WC2R 2LS UK *http://www.kcl.ac.uk/study/postgraduate/taught-courses/forensic-mental-health-msc-pg-dip.aspx*	Dr. Joel Harvey[a] Dr. Nigel Blackwood[b] Dr Shubulade Smith[c] forensicmsc@kcl.ac.uk [a]Clinical Forensic Psychology pathway; [b]Forensic Mental Health Research pathway; [c]Clinical Forensic Psychiatry pathway	Forensic Mental Health
Kingston University Faculty of Arts and Social Sciences Penrhyn Road Kingston upon Thames Surrey KT1 2EE UK *http://www.kingston.ac.uk/postgraduate-course/forensic-psychology-msc/*	Dr. Delphine Theobald D.Theobald@kingston.ac.uk +44 (0)20 8417 9000 Ext. 62345	Forensic Psychology
University of Leicester Dept. of Chemistry University of Leicester Leicester LE1 7RH UK *https://le.ac.uk/courses/forensic-science-and-criminal-justice-msc-dl*	Forensic Science Team sep-dl@le.ac.uk +44 (0)116 252 2612	Forensic Science and Criminal Justice

Table 2. (Continued)

Institution/Program's housing unit/ Address/Main website	Faculty contact	Course title
University of Lincoln School of Chemistry School of Psychology Brayford Pool, Lincolnshire LN6 7TS UK *http://www.lincoln.ac.uk/home/course/forscims/* *http://www.lincoln.ac.uk/home/course/hsmsfpt/*	Dr. Jose Gonzalez-Rodriguez jgonzalezrodriguez@lincoln.ac.uk +44 (0) 1522 88 6878 Prof. Todd Hogue thogue@lincoln.ac.uk +44 (0)1522 837391	Forensic Science Forensic Psychology
Liverpool John Moores University School of Pharmacy and Biomolecular Sciences School of Natural Sciences and Psychology School of Computer Science James Parsons Building Byrom Street Liverpool L3 3AF UK *https://www.ljmu.ac.uk/study/courses/postgraduates/analytical-forensic-science-msc* *https://www.ljmu.ac.uk/study/courses/postgraduates/forensic-anthropology* *https://www.ljmu.ac.uk/study/courses/postgraduates/computer-forensics* *https://www.ljmu.ac.uk/study/courses/postgraduates/forensic-bioscience-msc*	Dr. Suzzanne McColl S.M.Mccoll@ljmu.ac.uk +44(0)151 231 2156 Dr. Matteo Borrini M.Borrini@ljmu.ac.uk +44 (0) 151 231 2369 Dr. Rubem Pereira R.Pereira@ljmu.ac.uk +44(0)151 231 2103	Analytical Forensic Science Forensic Bioscience Forensic Anthropology Computer Forensics
Royal Holloway, University of London School of Law Egham, Surrey TW20 0EX UK *https://www.royalholloway.ac.uk/courses/2017/postgraduate/law/forensic-psychology.aspx*	Dr. Emily Glorney Emily.Glorney@rhul.ac.uk +44 1784 276283	Forensic Psychology
Middlesex University School Science & Technology Middlesex University The Burroughs, Hendon, London NW4 4BT UK *http://www.mdx.ac.uk/courses/postgraduate/forensic-psychology* *http://www.mdx.ac.uk/courses/postgraduate/electronic-security-and-digital-forensics*	Dr. Jackie Gray J.Gray@mdx.ac.uk +44 (0)20 8411 5458 Dr. Carlisle E. George c.george[at]mdx.ac.uk +44 (0)20 8411 2726	Forensic Psychology Electronic Security and Digital Forensics
Newcastle University School of Psychology 4th Floor, Ridley Building 1 Queen Victoria Road Newcastle upon Tyne NE1 7RU UK *http://www.ncl.ac.uk/postgraduate/courses/degrees/forensic-psychology-msc/*	Dr. Gavin Oxburgh gavin.oxburgh@ncl.ac.uk +44 (0)191 208 6557	Forensic Psychology
University of Portsmouth Dept. of Psychology School of Computing University House, Winston Churchill Avenue Portsmouth PO1 2UP UK *http://www.port.ac.uk/courses/psychology/bsc-hons-forensic-psychology/* *http://www.port.ac.uk/courses/computing-and-creative-technologies/msc-forensic-information-technology/*	Dr. Claire Nee claire.nee@port.ac.uk +44 (0)23 9284 6308 Prof. Debi Ashenden debi.ashenden@port.ac.uk +44 (0)23 9284 6382	Forensic Psychology Forensic Information Technology
Queen Mary University of London Wolfson Institute of Preventative Medicine William Harvey Research Institute Charterhouse Square London EC1M 6BQ UK *http://www.qmul.ac.uk/postgraduate/taught/coursefinder/courses/191500.html* *http://www.qmul.ac.uk/postgraduate/taught/coursefinder/courses/121371.html*	Dr. Mark Freestone m.c.freestone@qmul.ac.uk +44 (0)20 3465 6942 Prof. Peter Vanezis pgsmd@qmul.ac.uk +44 (0)20 7882 3401	Forensic Mental Health (with East London NHS Foundation Trust) Forensic Medical Sciences

Table 2. (Continued)

Institution/Program's housing unit/ Address/Main website	Faculty contact	Course title
University of South Wales Faculty of Computing, Engineering and Science Faculty of Business and Society Pontypridd Campus Llantwit Road Treforest, Pontypridd CF37 1DL UK *http://www.southwales.ac.uk/courses/msc-computer-forensics/* *http://www.southwales.ac.uk/courses/msc-forensic-audit-and-accounting/*	Mr. Andrew Bellamy andrew.bellamy@southwales.ac.uk +44(0) 1443 4 83261 Mr. Geraint Evans geraint.evans@southwales.ac.uk +44(0) 1443 4 83780	Computer Forensics Forensic Audit and Accounting
Teesside University School of Health and Social Care School of Social Sciences, Business & Law Tees Valley TS1 3BA UK *http://www.tees.ac.uk/prospectus/pg/PG_course.cfm?courseid=324&fos=23&fossub=53* *http://www.tees.ac.uk/prospectus/pg/PG_course.cfm?courseid=347&fos=24&fossub=54#coursecontent*	Dr. Ruth McDonald r.mcdonald@tees.ac.uk +44 (0)1642 384193 Dr. Victoria Heckels v.heckels@tees.ac.uk +44 (0)1642 342391	Forensic Radiography Forensic Psychology
University of Winchester Faculty of Humanities and Social Sciences Dept. of Applied Social Sciences Medecroft Annex Building King Alfred Campus Sparkford Road Winchester SO22 4NR UK *http://www.winchester.ac.uk/Studyhere/Pages/msc-forensic-psychology.aspx*	Dr. Wendy Kneller Wendy.Kneller@winchester.ac.uk +44 (0)1962 827519	Forensic Psychology
University of York Dept. of Language and Linguistic Science Dept. of Psychology Heslington, York YO10 5DD UK *https://www.york.ac.uk/language/postgraduate/taught/forensic-speech-science/* *https://www.york.ac.uk/psychology/prospective/postgraduate/taught/afp/#tab-3*	Prof. Peter French peter.french@york.ac.uk +44(0)1904 634821 Dr. Jane Clarbour jane.clarbour@york.ac.uk +44(0)1904 323168	Forensic Speech Science Applied Forensic Psychology

ADVANCING THE PRACTICE OF FORENSIC SCIENCE IN THE US — UPDATE

National Institute of Standards and Technology Forensic Science Updates

Rich Press

National Institute of Standards and Technology
Gaithersburg, Maryland
United States of America

The National Institute of Standards and Technology (NIST) is an agency of the US Department of Commerce. NIST plays a key role in enabling the hard work and innovative ideas of the American people to strengthen the infrastructure for innovation to advance manufacturing, service, and science; to promote trade; and to improve public safety and security. One of the key special programs at NIST is Forensic Science. Forensic science can be a powerful force in support of justice and public safety.

The Forensic Science Program at NIST attempts to strengthen forensic practice through scientific research and improved standards. The program at NIST involves three key components:

- **Policy.** In 2013 NIST and the US Department of Justice (DOJ) signed a memorandum of understanding for a new initiative to strengthen the practice of forensic science. NIST co-chaired, with the DOJ, the National Commission on Forensic Science, which formulated recommendations for the US Attorney General on matters such as accreditation requirements for forensic science service providers.
- **Practice.** NIST administers the Organization of Scientific Area Committees (OSAC), which fosters the development and promotion of technically sound, consensus-based documentary standards and guidelines that can be used to strengthen the practice of forensic science. The OSAC consists of a Forensic Science Standards Board (FSSB), three resource committees, five scientific area committees, and 25 subcommittees with members from various disciplines and organizations including federal, state, and local government, private sector, and academia.
- **Science.** NIST conducts scientific research in several forensic disciplines, including DNA, ballistics, fingerprint analysis, trace evidence, and digital, among others. NIST also provides physical reference standards and data that help forensic laboratories validate their analytical methods and ensure accurate test results.

Standard for Sampling Seized Drugs Approved for OSAC Registry

The Organization of Scientific Area Committees for Forensic Science (OSAC) has approved the Standard Guide for Sampling Seized Drugs for Qualitative and Quantitative Analysis for inclusion on the OSAC Registry. This registry serves as a trusted repository of high-quality, science-based standards and guidelines for forensic practice.

OSAC, which is administered by NIST, is working to strengthen forensic science by facilitating the development of discipline-specific, science-based standards and guidelines for a broad array of forensic disciplines. To be posted to the OSAC Registry, standards and guidelines must have been developed using a consensus-based process and must pass a review of technical merit by forensic practitioners, academic researchers, statisticians, and measurement scientists.

The American Society for Testing and Materials (ASTM) E2548-11e1: Standard Guide for Sampling Seized Drugs for Qualitative and Quantitative Analysis covers minimum recommendations for sampling seized drugs in a forensic chemistry laboratory. The document discusses the difference between statistical and nonstatistical sampling of a population and lists factors to consider when designing a sampling strategy. It also outlines procedures for random sampling and provides recommendations on appropriate reporting based on sampling strategies.

The Seized Drugs Subcommittee began routing this standard through OSAC process in 2015. More recent versions of this standard are also available through ASTM.

"This document will raise awareness of the importance of sampling procedures in the seized drugs laboratory," said Sandra Rodriguez-Cruz, who chairs OSAC's Seized Drugs Subcommittee. "That includes everything from implementation and execution, to communicating sampling protocols, to implications for the customer receiving the results." She added that ASTM will continue working to improve this guide, and will consider feedback and suggestions received from the forensic community, statisticians, and attorneys.

The Seized Drugs Subcommittee has submitted two additional ASTM documents for potential inclusion on the OSAC Registry: A Standard Practice on Quality Assurance for Seized Drugs Laboratories, and A Standard Guide on Analysis of Clandestine Drug Laboratory Evidence. These standards are still working their way through the review process.

OSAC does not have authority to enforce standards. However, by placing standards on the OSAC Registry, OSAC promotes their adoption by forensic science service providers. The goal of OSAC and its 550-plus members is to facilitate the development of science-based standards for each of 25 distinct forensic science disciplines and to promote their widespread adoption.

Sniffing Like a Dog Can Improve Trace Detection of Explosives

By mimicking how dogs get their whiffs, government and university researchers have demonstrated that "active sniffing" can improve by more than 10 times the performance of current technologies that rely on continuous suction to detect trace amounts of explosives and other contraband.

"The dog is an active aerodynamic sampling system that literally reaches out and grabs odorants," explained Matthew Staymates, a mechanical engineer and fluid dynamicist at NIST. "It uses fluid dynamics and entrainment to increase its aerodynamic reach to sample vapors at increasingly large distances. Applying this bio-inspired design principle could lead to significantly improved vapor samplers for detecting explosives, narcotics, pathogens — even cancer."

Following nature's lead, Staymates and colleagues from NIST, the Massachusetts Institute of Technology's Lincoln Laboratory, and the US Food and Drug Administration fitted a dog-nose-inspired adapter to the front end of a commercially available explosives detector. Adding the artificial dog nose — made on a 3-D printer — to enable active sniffing improved odorant detection by up to 18 times, depending on the distance from the source.

Trace detection devices now used at points of entry and departure such as airports and seaports, and other sensitive locations, typically employ passive sampling. Examples include equipment that requires swabbing hands or other surfaces and then running the sample through a chemical detector — typically an ion mobility spectrometer. Wand-like vapor detectors accommodate more sampling mobility, but unless the detector scans immediately above it, the chemical signature of a bomb-making ingredient will go unnoticed.

Aiming to uncover clues on how to improve trace detection capabilities, the researchers turned to one of nature's best chemical detectors: the dog. Through their review of previous studies, the team distilled what occurs during sniffing. Five times a second, dogs exhale to reach out, pull and then inhale to deliver a nose full of aromas for decoding by some 300 million receptor cells.

Using a 3-D printer, Staymates replicated the external features of a female Labrador retriever's nose, including the shape, direction, and spacing of the nostrils. Moving air through the artificial nose at the same rate that a dog inhales and exhales allowed them to mimic the air sampling — or sniffing — of dogs.

With schlieren imaging — a technique widely used in aeronautical engineering to view the flow of air around objects — and high-speed video, the team first confirmed that their imitation nose could indeed sniff much like the real thing, a property documented in previous studies of live dogs.

With each sniff, air jets exit from both nostrils, moving downward and outward. Though it might seem counterintuitive, the air jets entrain — or draw in — vapor-laden air toward the nostrils. During inhalation, the entrained air is pulled into each nostril.

The team's first set of experiments compared the air-sampling performance of their "actively sniffing" artificial dog nose with that of trace-detection devices that rely on continuous suction. The head-to-head comparison with an inhalation system used with a real-time monitoring mass spectrometer found that sampling efficiency with the sniffing artificial dog nose was four times better 10 cm (3.9 in) away from the vapor source and 18 times better at a stand-off distance of 20 cm (7.9 in).

On the basis of those results, the team chose to outfit a commercially available vapor detector with a bio-inspired, 3-D–printed inlet that would enable it to sniff like a dog, rather than to inhale only in 10-second intervals, the device's normal mode of operation. The switch resulted in an improvement in odorant detection by a factor of 16 at a stand-off distance of 4 cm (1.6 in).

"Their incredible air-sampling efficiency is one reason why the dog is such an amazing chemical sampler," Staymates said. "It's just a piece of the puzzle. There's lots more to be learned and to emulate as we work to improve the sensitivity, accuracy, and speed of trace-detection technology."

The research is reported in the journal *Scientific Reports*: Staymates ME, MacCrehan WA, Staymates JL, Kunz RR, Mendum T, Ong T-H, Geurtsen G, Gillen GJ, Craven BA: Biomimetic sniffing improves the detection performance of a 3D printed nose of a dog and a commercial trace vapor detector; *Scientific Reports* 6 Article No.: 36876; December 1, 2016 (DOI: 10.1038/srep36876).

NIST Research Contributes to Enhanced DNA Profiles

This year marks an important milestone in the development of forensic DNA profiling in the United States. Since the FBI's National DNA Index System, or

NDIS, came online in 1998, US forensic laboratories have been generating DNA profiles by analyzing a specific set of 13 genetic markers. On January 1, 2017, the FBI started requiring that all DNA profiles submitted to NDIS be based on 20 markers.

The expansion of the core set of markers was made possible by close collaboration between scientists at the FBI and NIST. The additional markers will vastly increase the statistical certainty of DNA identifications and allow investigators to identify suspects that could slip through the cracks today.

This upgrade was necessary in part due to the rapid growth of NDIS, which has expanded to include nearly 16 million profiles related to criminal investigations and 30,000 related to missing persons. As the number of profiles in the system increases, the probability that a search might return a false match goes up. Adding new markers mitigates that risk.

In addition, this upgrade will make international DNA searches more effective by increasing the number of markers that the US system has in common with those of other nations. The number of markers used in both the United States and Europe, for example, will rise from 8 to 15.

Partial Profiles. The new markers will also help solve a problem that often comes up in cases that involve degraded DNA. In those cases, forensic analysts can't always get a read on all 13 markers, and they end up with a partial profile.

"If you've got a case where seven markers drop out, the statistics may be too weak to establish an identity," said Mike Coble, a research geneticist at NIST. When that happens, a perpetrator might escape the notice of investigators and remain free to commit more crimes. "But if you start with 20 markers, seven can drop out and you might still have enough to establish an identity," Coble said.

Of the seven new NDIS markers, three were first identified by Coble and his colleagues at NIST. And those three markers were chosen because they are particularly useful in cases that involve degraded DNA.

A genetic marker is a stretch of DNA that occurs at a specific location on a chromosome. Forensic markers don't code for anything, but they contain a section of genetic code that repeats itself, like a word typed over and over. The number of repeats at each marker varies from person to person, and the chances that two people that are not closely related have the same number of repeats at the original set of 13 markers is less than one in a trillion.

If you lined up the number of repeats for all the markers, you'd have something like a very long social security number that can be used to identify people, and that's what a DNA profile is. Because we have two copies of each marker — one inherited from each parent — a DNA profile based on 13 markers is 26 numbers long. Since the recent upgrade to 20 markers, DNA profiles in the United States are a series of 40 numbers.

To get those numbers, forensic analysts measure how long the markers are, and then deduce the number of repeats from that length. But DNA is fragile. Heat, sunlight, and bacteria can all damage the molecule, and if a break occurs within a marker, scientists can't measure how long it is. In that case, they'll get a partial profile.

The Search for "Mini-markers". But some markers withstand damage better than others. When DNA is damaged, it starts breaking apart, like a ribbon cut to pieces. Shorter markers tend to remain intact during that process just because they're small pieces already.

But only a few of the markers in the original set of 13 are particularly short, so in 2004, Coble and his NIST colleagues set out to find a few new ones.

"We were looking for markers that were short and that showed a lot of variability," Coble said. "If half the population has the same number of repeats, it won't be very good for telling people apart."

They started with a list of more than 1,000 candidate markers, most of which were unknown when the original set of 13 markers was chosen a decade earlier. After running thousands of tests, including tests using artificially degraded DNA, they found 27 "mini-markers" that worked.

Of those 27, 3 are among the 7 new NDIS markers. The other 4 new markers aren't minis, but they have exceptionally high variability.

Much of the research that yielded the mini-markers grew out of the effort to identify the victims of the 9/11 terror attacks. That effort was complicated by the fact that fires smoldered for months in the rubble at Ground Zero and, because heat damages DNA, the remains recovered there often yielded partial profiles. To help resolve those profiles, NIST scientist John Butler worked with colleagues at the New York City Medical Examiner's Office to develop new methods for working with badly degraded DNA—methods that made it possible to identify remains that otherwise would have never been returned to the victims' families.

That research was the precursor to the search for mini-markers at NIST. More recently, NIST worked closely with the FBI to validate the new 20-marker profiling kits that forensic labs use to generate DNA profiles. The agencies coordinated a series of trials in which crime labs used the kits against test DNA with known profiles to ensure that the results were accurate and that kits from different manufacturers produced equivalent results.

For crime victims seeking justice, for defendants seeking a fair trial, and for families looking for missing loved ones, a lot depends on the accuracy and reliability of DNA profiles. The expansion to 20 markers will ensure that, even as the national DNA database continues to grow, this technology will remain an incredibly powerful tool for solving cases.

Database of Software "Fingerprints" Expands to Include Mobile Apps

A group of computer scientists at NIST has been working for more than 15 years on an impossible task: to maintain an up-to-date archive of the world's software. Because the amount of software in circulation keeps growing, they will never enjoy the satisfaction of completing their assignment. But they have succeeded in creating the largest publicly known collection of its kind in the world.

Called the National Software Reference Library (NSRL), the collection recently got a whole lot larger. On December 15, 2016, the NSRL expanded to include its first batch of 23,000 mobile apps for Android and iOS. Another 200,000 are expected to be added in 2017.

The NSRL is a critical tool used in law enforcement and national security investigations. Every file in the NSRL is run through a computational procedure that generates a unique digital fingerprint for that file, expressed as a string of 40 letters and numbers. NIST publishes those fingerprints in a Reference Data Set (RDS) that is updated quarterly and freely available to the public.

Software applications often include hundreds or even thousands of files — think of all the graphics files and templates that are placed on your computer when you install a word processing application. The RDS contains fingerprints for all the files in the NSRL, more than 50 million so far.

The NSRL is jointly funded by NIST and the Department of Homeland Security Science and Technology Directorate's Cyber Forensics Project, and the addition of mobile apps was done in collaboration with their Mobile App Security R&D project.

An Essential Tool for Forensic Investigators. "When we seize a computer or hard drive as part of an investigation, we need to eliminate files that are irrelevant to our investigation and focus on those that might contain evidence," said Sam Brothers, a digital protection specialist with US Customs and Border Protection. In homeland security investigations, time is of the essence, so Brothers and his colleagues use the RDS to filter out known files. "It allows us to separate the wheat from the chaff very quickly."

Occasionally, investigators use the RDS not to exclude known files, but to find them, even if the filenames have been altered. For example, after Malaysia Airlines flight MH370 disappeared somewhere over the Pacific in March 2014, the FBI called NIST. "They wanted every hash of every file associated with every flight simulator we had," recounted Doug White, the NIST computer scientist who runs the NSRL. "All the maps. All the routes. They wanted every flight path the pilot might have practiced on, so they could figure out where he might have gone."

To assist the FBI in their investigation, White and his colleagues updated the NSRL with more than 120,000 flight-map–related files.

Much of the software in the NSRL is donated by the companies that publish it. Another segment of the collection is composed of free software. After that, White decides which titles to purchase with limited funds.

"Our goal is to help investigators, so we prioritize the software they are most likely to encounter in the field," White said. "We also focus on what we consider dual-use software—things that can be used for good or bad," including keystroke loggers and network-monitoring tools.

A Unique National Resource. The NSRL is unique not only because of its size, but also because the original files are kept under evidence-locker conditions. For software that was distributed physically, the original discs are kept under lock and key. For software that is distributed electronically, the original distribution files are archived on secure servers. That means that the original software can be retrieved, if necessary, as evidence in court or to verify the provenance of a title.

Although NIST generally does not distribute the software in the NSRL — only the software fingerprints — researchers can come to NIST and use the NSRL to develop and test forensic and security tools. Researchers also use the NSRL to study how software evolves over time and to trace newly discovered security vulnerabilities back to their first appearance. Beyond the world of law enforcement and national security, the NSRL also functions as a cultural repository that is used by historians and other scholars.

How large the NSRL will ultimately grow is anyone's guess. Perhaps centuries from now, NIST scientists will still be feeding it software. On the other hand, archaeologists might dig up its discs and set them spinning to unlock a record of an earlier civilization. But for now, the NSRL is a potent tool for forensic investigators, and with the addition of mobile apps, it just got a whole lot more powerful.

Forensic Technology Center of Excellence

Forensic Technology Center of Excellence: Informing the Advancement of Emerging Technologies — A 2017 Update —

J. D. Ropero-Miller, N. D. Bynum

Center for Forensic Sciences
RTI International
Research Triangle Park, North Carolina
United States of America

The Forensic Technology Center of Excellence (FTCoE), a program of the National Institute of Justice (NIJ), Office of Investigative and Forensic Sciences, serves as an authoritative resource for both practitioners and developers in their technology areas of focus. The FTCoE is a Cooperative Agreement from the NIJ to RTI International (Current Award 2016-MU-BX-K110; Past Award 2011-DN-BX-K564). RTI International leads a consortium of partners and collaborations including academic institutions, forensic professionals, and federal, state, and local laboratories. It assists in the transition of forensic science and law enforcement technology from applied research into practice. The goals of the FTCoE are to determine technology needs; develop technology program plans to address those needs; provide solutions; demonstrate, test, evaluate, and transition potential solutions into practice; develop and update technology guidelines; build capacity; and conduct knowledge transfer and outreach. Since 2011, the FTCoE has comprised RTI International and its academic partners. The FTCoE is committed to improving the practice and strengthening the impact of forensic science through rigorous technology corroboration, evaluation, and adoption; effective knowledge transfer and education; and comprehensive dissemination of best practices and guidelines to agencies dedicated to combating crime. The FTCoE bridges the gap between the scientific and the justice communities. Through these efforts, the FTCoE increases the capacity of state and local law enforcement to effectively and professionally serve society in matters involving forensic science, crime, and public safety.

In 2017, the FTCoE released a rebranding campaign to restyle our logo (**Figure 1**) and to enhance color palettes, visual language, and photographic style within our website (*www.forensicCOE.org*) and outreach materials. We also launched our social media presence in LinkedIn, You Tube, Twitter, and Facebook (#FTCOE. @ForensicCOE). The intent was to enhance the look, improve our user interface, engage our stakeholders, and create a consistent and recognizable identity.

Figure 1. Logo of the Forensic Technology Center of Excellence.

This 2017 update provides example activities and resources that the FTCoE participated in and developed over the past year. Conferences, online webinars, workshops, reports, success stories, and podcasts are summarized. For complete knowledge of all FTCoE activities and resources that can benefit you and your criminal justice or forensic science organization, please visit our website.

Conferences

AAFS. The FTCoE assisted the NIJ in hosting the annual NIJ Forensic Science Research and Development (R&D) Symposium on February 14, 2017, at the American Academy of Forensic Sciences (AAFS) meeting in New Orleans, LA. The NIJ Forensic Science R&D Symposium was a free and open meeting where attendees learned about NIJ-funded research across a variety of forensic science areas. The four focus areas were impression, pattern and trace evidence, forensic biology and DNA, anthropology and microbial forensics, and controlled substances and toxicology. Presentation topics included "Illuminating Lifestyles by Metabolomics of Personal Objects" and "Characterization of Organic Firearms Discharge Residue: Progress and Potential".

ASCLD. Over 500 people attended The American Society of Crime Laboratory Directors (ASCLD) Annual Symposium held April 30–May 4, 2017, in Dallas, TX. International guests included a group delegation from Panama, as well as nearly 40 attendees representing 10 other countries: Belgium, Canada, Mexico, Pakistan, Philippines, Puerto Rico, Qatar, South Africa, United Arab Emirates, and the United Kingdom. Designed for leaders and managers in the forensic laboratory field, the symposium included six workshops and two days of scientific platform and poster sessions. Plenary session topics included technology, lab performance, and mentoring and training staff. Jeri Ropero-Miller, Director of the FTCoE, presented "The Forensic Technology Center of Excellence — Continuous Improvement of Laboratory Efficiency, Technology Implementation, and Leadership Excellence", on Wednesday, May 3, 2017.

Online Webinars

Humanitarian and Human Rights Series. The FTCoE in collaboration with the American Academy of Forensic Sciences Humanitarian and Human Rights Resource Center (HHRRC) began hosting a live webinar series in May 2017. The Academy HHRRC, established in 2015 and chaired by AAFS Past President Doug Ubelaker (Anthropology), promotes the application of contemporary forensic science and forensic medicine principles to global humanitarian and/or human rights projects requiring special forensic assistance. HHRRC projects highlighted in this Webinars Series are those selected for support by the International Advisory Council. Topics included in this Webinar series include:

- Nerve Agent Uptake and Detection in Human Bone;
- Analysis & Conservation of Human Remains in Cambodia;
- Stable Isotope Forensics & Unknown Persons Investigations.

Upon completion of the live online events, the FTCoE will also make these available as archived webinars. To learn more, go to "webinars" under "resources" tab, Humanitarian and Human Rights special initiatives at *www.forensicCOE.org* (*https://forensiccoe.org/special-initiatives/*).

Workshops

From Cradle to Cane: Investigation of Crimes Against Vulnerable Victims. The "From Cradle to Cane: Investigation of Crimes Against Vulnerable Victims" workshop took place March 21–23, 2017, at Charleston Southern University. Presented by Jamie Downs, M.D., forensX LLC, and The Shaken Baby Alliance, this conference focused on crimes against the vulnerable — including the elderly, children, human-trafficking victims, and people with disabilities. The target audience included law enforcement, death scene investigators, social workers, and legal personnel. The agenda comprised nine platform presentations. Topics included human trafficking, forensic investigation techniques, and the impact of abusive head trauma on the family. Onsite and online attendance totaled nearly 200 participants with attendance from several countries including Brazil, Colombia, Italy, Jordan, Spain, and the UAE. In addition, a one-day, hands-on workshop was given entitled "Death Scene Investigation — A Forensic Entomology Field Training". Its purpose was to provide death scene investigators with knowledge of entomological techniques used for recovering evidence from death scenes such as handling and shipping of specimens.

Advanced Radiologic Imaging in Medicolegal Death Investigation. The Advanced Radiologic Imaging in Medicolegal Death Investigation workshop took place November 11–13, 2016, at the Center for Forensic Imagining (CFI) at the University of New Mexico in Albuquerque. The goal of the workshop was to enable and enhance the effective transfer of advanced imaging technology into forensic practice in the United States. This goal was accomplished by introducing attendees to the history and status of radiology and advanced imaging in forensics, basic concepts in the production of CT and MR imaging, protocols, image-viewing software, 3D rendering, and interpretation/reporting of advanced imaging. The targeted audience was forensic pathology professionals and decision makers including medical examiners/coroners, leaders, and members of the National Association of Medical Examiners, and members of the College of American Pathologists' Technology Assessment Committee.

Podcasts

In May 2017, RTI International's Center for Forensic Science began presenting Just Science (**Figure 2**), a podcast for forensic science professionals and anyone with an interest in learning more about how real crime laboratories are working to do their job better, produce more accurate results, become more efficient, and solve more crimes. This podcast deals with a range of issues, including leadership in the crime lab, new technologies, sexual assault response, and broader challenges for science and public security. It covers every type of forensic discipline, including DNA, fingerprints, trace evidence, toxicology, controlled substances, crime scene investigation, and much more! The first season of Just Science was developed through the FTCoE. To learn more, go to "podcast" under newsroom at *www.forensicCOE.org* (*https://forensiccoe.org/#newsroom*).

Landscape Study Reports

A landscape study report provides a broad view of issues and products identified as having value and usefulness in forensic applications. These reports offer laboratory managers and investigators a survey of current

Figure 2. Just Science Podcast logo.

commercially available forensic technologies. In addition, the reports provide decision makers and potential end users with issues to consider related to implementation, and use examples that illustrate successful adoption of a technology. Upon review, the reader may better understand whether a technology can benefit an organization and how to proceed with selecting a platform and implementing use. To learn more, go to "reports" under resources, special initiatives at *www.forensicCOE.org* (*https://forensiccoe.org/special-initiatives/*).

Forensic Optical Topography. The field of firearms identification is undergoing a major change in technology and capability with the introduction of optical topography into forensic laboratory practice. Optical topography provides a three-dimensional (3D) view of the surface of a bullet or cartridge case at resolutions that capture the full range of subclass and individual characteristics. This technology offers an additional method to the comparison microscope for one-to-one firearm evidence comparisons, and may provide an objective measurement of similarity to aid in source identification. Combined with the National Integrated Ballistics Information Network (NIBIN) of the US Bureau of Alcohol, Tobacco, Firearms and Explosives (ATF) organization, systems can be used to provide more interjurisdictional links with greater reliability than was previously possible. NIBIN is designed to work with Ultra Electronics Forensic Technology, Inc.'s (Ultra FTI) systems, but other systems produce reliable data for local use. New data standards should permit the use of any optical topographic system in the future within national or international data-sharing frameworks. The report can be found at *https://rti.connectsolutions.com/p1ltkot8nfi/*.

Mobile Evidential Breath Alcohol Instruments (Figure 3). The FTCoE, in collaboration with key stakeholders and manufacturers, performed a landscape study of mobile breath alcohol instruments. This study (a) compiled performance statistics of available mobile (transportable and handheld) instruments approved for evidential data collection; (b) summarized variables for these devices including price, features, and accessories; (c) identified any procedures and best practices from agencies currently using portable instruments; and (d) provided feedback regarding ease of use in the field and overall satisfaction for the most widely used instruments. The report includes devices manufactured by CMI Intoxilyzer, Dräger Intoximeter, and Lifeloc. In an initial survey of breath alcohol program personnel, concerns over reliability or defensibility of data acquired using mobile breath alcohol instruments was cited as the primary barrier to implementation. The report includes case studies of defensibility of evidential

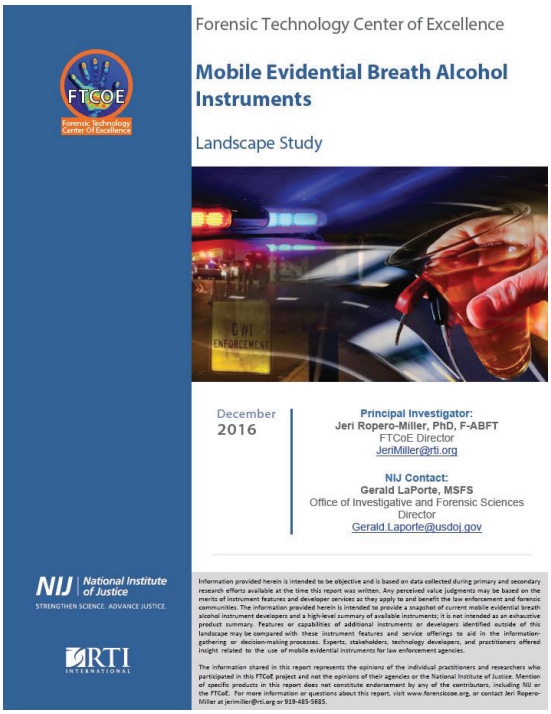


Figure 3. Cover of breath alcohol landscape study.

data from agencies currently using mobile instruments. The report can be found at *https://rti.connectsolutions.com/brac/*.

Success Stories

Annually, the NIJ facilitates research and development to improve how the criminal justice system gathers and uses evidence. From research on DNA identification and biomarkers, to fire and arson and controlled substances, to anthropology and toxicology, the agency supports the enhancement and creation of innovative tools and techniques to identify, collect, analyze, interpret and preserve evidence. The main goal of FTCoE Success Stories is to get these innovations into the hands of practitioners. Taking such an innovation from its earliest concept stage to actual use can be complex and takes time. These Success Stories feature NIJ grant awardees and practical implementation of their research.

NIJ and DNA Polymerase Technologies. With NIJ grant support (2010-DN-BX-K141), DNA Polymerase Technologies developed novel, genetically engineered mutants of Taq DNA polymerase that are highly resistant to polymerase chain reaction (PCR) inhibitors. Additionally, DNA Polymerase Technologies optimized buffers and PECs to be compatible with the novel Taq polymerases. The technology enables PCR in 40% blood (treated with anticoagulants), plasma, and serum and can overcome

other PCR inhibitors including urine, tannins, indigo dyes, melanin, feces/bile salts, sperm, soil/humic acid, plant extract, ethanol, GITC, milk, cheese, chocolate, seafood, meat, and water. More information can be found at *https://rti.connectsolutions.com/p6esw658opj/*.

NIJ and CHORI-Collaboration with SoftGenetics® and California Department of Justice. Through a grant (2010-DN-BX-K141) from the NIJ, Dr. Calloway and colleagues at CHORI collaborated with SoftGenetics to improve the company's commercially available NextGENe® MPS data analysis software for analysis of mtDNA and STR data. As a direct result, the current commercially available version of the NextGENe® software (v2.4.1) contains alignment analysis modules for STRs, mtDNA amplicon, and the whole mitochondrial genome. More information can be found at *https://rti.connectsolutions.com/p589kxj1wmg/*.

TEITELBAUM'S COLUMN ON FORENSIC SCIENCE — HISTORICAL PERSPECTIVE —

First Use of a Microscope in a Criminal Trial

J. Teitelbaum

Forensic Science Library Services
Washington State Patrol
Seattle, Washington
United States of America

Although Mathieu Orfila (1787–1853), widely regarded as the founder of toxicology, generally receives credit in forensic science histories as the first scientist to use a microscope to assess blood, semen stains, and other substances of a forensic nature, it is quite likely that another doctor, Charles-Prosper Ollivier d'Angers (1796–1845; **Figure 1**), was the first to use the results of a microscopic examination in a criminal trial.

On the morning of October 17, 1836, the victims of a triple homicide were discovered in Saint-Martin-le-Gaillard, a farming village in Northern France. The local priest, his niece, and his maidservant were found beaten to death so savagely that their skulls were crushed. The priest, l'Abbe l'Hermina, and Celeste Paris, his servant, were found in the priest's residence. A shovel lying nearby had blood and hair on it. The priest's niece, Marie Cayeux, was found in a nearby building. The instrument that she was struck with was not found, but the viciousness of the murder suggested something that was made of hardwood or metal. Asked to examine the victims, the local surgeon concluded that the murders were committed by several people, and, based on the angles of the attacks, that at least one of them was left-handed.

Over the course of the next year, the authorities interrogated numerous suspects and ultimately apprehended four men who they believed to be guilty of the murders. According to newspaper accounts (**Figure 2**) that followed the investigation, the primary motive of the men was money and other items of potential value. The men were tried in court and executed on June 13, 1838.

Figure 1. Charles-Prosper Ollivier d'Angers (1796–1845).

Prior to the start of the trial, a prominent Parisian doctor, Charles-Prosper Ollivier d'Angers, was asked to conduct an examination on evidence that had been found during the course of the investigation. A rusty axe and a bloody blouse had been found in the house of one of the accused, and the court wanted Ollivier to examine the objects and report his results. Ollivier did so, making extensive use of a microscope to examine the evidence, making this the first time that a microscope was used in a criminal trial.

There were numerous contemporary references to Ollivier's work in the trial. Two samples are shown in **Figures 3** and **4**.

Soon after the trial, Ollivier published his own results in a scientific journal (**Figure 5**). On the following pages is an English translation of his entire article: New application of the use of the microscope in medico-legal expertise.

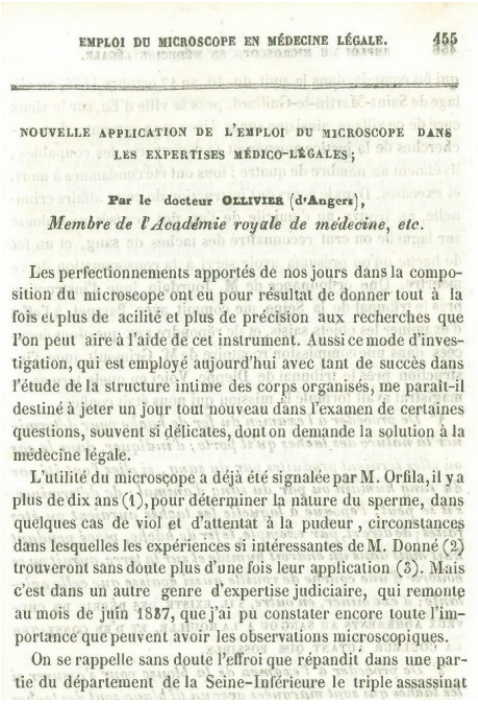
Figure 2. Regional newspaper that first reported the murders on this day: Oct. 21, 1836.

It is to M. *Ollivier* that we are indebted for the first conclusive application of the microscope in medico-legal experiments. In June 1837, he was appointed to determine *if there was any hair or portion of hair adheriny to a hatchet found in the house of a person accused of murder, and, if so, to say whether these hairs were human or not.* After a very careful examination, M. O. deposed that there were certainly portions of hair sticking to the blade of the instrument, but that it was not human hair, but that of some of the lower animals.* The correctness of the opinion was confirmed by the result of the judicial enquiry.

Figure 3. Use of the microscope in legal medicine — *Medico-Chirurgical Review and Journal of Practical Medicine* Volume 32; 1840.

M. Ollivier (d'Angers) was the first who applied the microscope practically in a medico-legal investigation. In June, 1837, he was directed to ascertain whether any human hair was attached to the blade of a hatchet seized in the house of a person suspected of murder, and if this were the case, to determine the color of the hair. With the microscope M. Ollivier ascertained that the filaments attached to the hatchet were the hairs of an animal and not of a human being, and this was afterwards fully proved, (Arch Gen. de Med., Dec., 1838).

Figure 4. Use of the microscope in medico-legal researches — Louis Mandl, M.D. *Provincial Medical Journal* 23(2); Sept. 10, 1842.



EMPLOI DU MICROSCOPE EN MÉDECINE LÉGALE. 455

NOUVELLE APPLICATION DE L'EMPLOI DU MICROSCOPE DANS LES EXPERTISES MÉDICO-LÉGALES;

Par le docteur OLLIVIER (d'Angers),
Membre de l'Académie royale de médecine, etc.

Les perfectionnements apportés de nos jours dans la composition du microscope ont eu pour résultat de donner tout à la fois et plus de acilité et plus de précision aux recherches que l'on peut aire à l'aide de cet instrument. Aussi ce mode d'investigation, qui est employé aujourd'hui avec tant de succès dans l'étude de la structure intime des corps organisés, me paraît-il destiné à jeter un jour tout nouveau dans l'examen de certaines questions, souvent si délicates, dont on demande la solution à la médecine légale.

L'utilité du microscope a déjà été signalée par M. Orfila, il y a plus de dix ans (1), pour déterminer la nature du sperme, dans quelques cas de viol et d'attentat à la pudeur, circonstances dans lesquelles les expériences si intéressantes de M. Donné (2) trouveront sans doute plus d'une fois leur application (3). Mais c'est dans un autre genre d'expertise judiciaire, qui remonte au mois de juin 1887, que j'ai pu constater encore toute l'importance que peuvent avoir les observations microscopiques.

On se rappelle sans doute l'effroi que répandit dans une partie du département de la Seine-Inférieure le triple assassinat

Figure 5. Nouvelle application de l'emploi du microscope dans les expertise medico-legales — M. Ollivier (d'Angers); *Archives Generales de Medicine* Series 3, Volume 3; Dec. 1838.

Other References

1. Valérie Letellier (April 5, 2017): Les drames de Saint-Martin-le-Gailliard; Retrieved from *http://ohmesaieux.blogspot.com/*.
2. Assassinat commis sur la personne d'un pretre, de sa niece et de sa servante, dans la vallee de criel; *Journal De Rouen* Oct. 21, 1836.
3. Novel application of the microscope in medico-legal experiments; *The Eclectic Journal of Medicine* 4(3); 1840.
4. Walusinski O: Charles-Prosper Ollivier d'Angers (1796–1845); *Journal of Neurology* 259:1255; 2012.

New application of the use of the microscope in medico-legal expertise

By Dr. OLLIVIER (d'Angers),
Member of the Royal Academy of Medicine, etc.

The improvements made these days concerning the composition of the microscope have resulted in a more precise and easier use of the instrument to researches that can be done with this tool. This method of investigation, now used with much success in the study of the intimate structure of organized bodies, seems to be destined to give a whole new perspective in the examination of certain questions, often very delicate, asked of forensic medicine.

The use of the microscope has already been pointed out by Mr. Orfila more than ten years ago [1], in order to determine the nature of semen in some cases of rape and indecent exposure, circumstances in which Mr. Donne's interesting experiments [2] will find their application more than once, without a doubt [3]. However, it is within another kind of judicial expertise, dating back to the month of June 1887, that I was able to notice the importance of microscopic observations.

We may recall the terror spread in a part of the department of the Seine-Inférieure, in the village of Saint-Martin-le-Gaillard, near the town of Eu, when the triple murder of the old parish priest, as well as his niece and his maid, was committed on the night of October 16th to 17th, 1836. The search for justice led to the discovery of four culprits: all were condemned to death and executed. In the course of the investigation of this criminal case, a blouse upon which bloodstains were suspected and an axe-head which was presumed to be the murder weapon were found in the house of one of the accused. An order of M. Jourdain, an investigating judge at the tribunal of the Seine, made me and Barruel examine the articles seized, and answer the questions set forth in letters of request by Mr. Grimoult, judge of the court of Dieppe.

Here are the terms of the mission the magistrate had formulated to us.

1. *To examine the axe-head to determine the nature of the spots it bears; to indicate, if they were produced by blood, whether they were produced by human blood or animal blood; to determine, if possible, the period at which the spots could have been made; to say whether, for example, the axe-head, placed for eight months in a damp place and on earth, could have covered itself with a layer of rust as thick as the existing one; to examine, in addition,* whether there are any debris of hair in the blood or in the rust, and to determine their color as much as possible.
2. *To examine the blouse to make sure that the stains marked with a white thread are blood stains, and that there are no other marks on the garment; and if these spots were produced by blood, to make a chemical analysis of them, only if this analysis could provide the means to recognize the nature of the blood.*

Here is a summary of the research and experiments we have done to answer the various questions we have just transcribed.

Inspection of the axe-head.

The whole surface of this axe-head, as well as the walls of its openings, or of the eye, which holds the handle of this kind of instrument, was covered with a thick layer of rust: on one of its faces there was greyish and dried mud. Near the cutting edge, there were two brown and shiny spots, which had, by their appearance, an analogy with spots made by blood.

On these spots were attached five filaments similar to hair. (We will describe them later.)

All the points on the surface of the ax that presented a doubtful aspect, that is to say the ones that seemed covered with a substance which did not evidently appear to us to be rust, were carefully scraped over a glass capsule, in which we also added all the materials the friction had detached from the surface of the ax-iron.

All this product collected by the scraping was introduced into a test-tube and was allowed to macerate in distilled water for several hours. At the end of this time, the liquor was not colored. However, since we could suppose that the liquor contained blood, its coloring matter was combined with hydrated sesqui-oxide of iron (rust), and would therefore have been insoluble in water. Consequently, we added to this liquor two drops of a solution of caustic potash. We agitated the mixture, then we let it rest for a few hours. After this new operation, the liquor had no change in color, which demonstrated in a positive way that it contained no blood.

These experiments had been made on the liquor still in contact with the solids arising from the scratching; it was therefore filtered. The solid matter remaining on the filter was carefully desiccated, and then the five filaments were separated with fine tweezers. They were ultimately set aside for later examination.

Finally, to prove that the substance remaining on the filter was none other than hydrated sesqui-oxide of iron (rust), we have treated some of it with hydrochloric acid; it dissolved completely, and the solution presented a greenish-yellow color; the other part, treated by the prussiate of potash, produced an abundant precipitate of Prussian blue.

From these experiments, we concluded that there was no trace of blood on the axe-head submitted to our examination; that the suspicious aspect which its surface presented on some points was due to rust, and that the oxidation of this axe-head could very well have resulted from its laying in a damp place on the ground for eight months.

Examination of the filaments which adhered to the axe-head.

With the results of the chemical analysis clearly stating that there were no traces of blood on the surface of the axe-head, the examination of the filaments which adhered to it, and which had the appearance of hair, became very important; and we proceeded with the greatest care, by means of a microscope magnifying from 150 to 250 times the volume of the object [4].

In order to establish points of comparison to enable us to discover the true nature and color of the filaments submitted for our observation, we first examined black, white, and dark-blond hair under the microscope.

We have recognized in this examination, done with the utmost attention and with all due precautions:

1. That the hairs were all of *the same size, in all their length,* from the base to the point;
2. Their size was, on average, 6/100 of a millimeter;
3. A central channel, which formed a lesser colored or silver line, was distinguished perfectly in all the filaments, if the hair was of a color more or less dark;
4. All had a certain transparency in their entire thickness, whether their color was dark or not.

With these different characteristics observed and repeatedly noticed on a certain number of hairs, we then studied in the same manner the filaments analogous to the hairs which we had separated from the material of the scratching. Here are the curious results provided by the microscopic examination of these filaments.

1. In none of them did the length exceed *five lines*;
2. Their thickness *diminished sensibly from one end to the other*; they were all *spindle-shaped*.

   This disposition was mostly manifested on one of them, which ended at one of its extremities by a mossy tip, while at the other, one could distinguish a kind of fringed edge, as if torn, evidently corresponding to the circumference of the hair which embraces the bulb or the root; for on this side a conical cavity, hollowed out in its center, was

perfectly distinguishable, as there is one at the base of all the hairs, a cavity which encloses the prolongation of the bulb. This infundibulum, in which the bulb fits, gave this part of the hair a very noticeable transparency, which cut off the opacity of the rest of the hair.

We have said that this hair ended in a point, that it was, like all the others, fusiform; in fact, its size at its middle part was of 8/100th of a millimeter, then of 7/100th, 3/100th and finally, at the point, of 1/100th millimeter.

3. A central line, somewhat transparent, was distinguishable in only one of them; all the others were completely opaque in all their extent; thus they did not appear to have a central channel in their length.
4. In all of them, the color was of a russet-yellow color, which varied only in its more or less dark tint: their cloth did not possess the transparency which was exhibited by the hair, whatever their color; it was, on the contrary, generally opaque.
5. Finally, several had lateral bulges along their length; one of them was surmounted at a point in its extent by an extremely thin filament which detached itself almost at right angles, in the same manner of a branch separating itself from the branch which supports it.

It is implied from all the characteristics which we have just described that the filaments which adhered to the rust of the axe-head were hair; that this hair differed completely from human hair, while it resembled perfectly *the hair of a horse, an ox, or a cow*, which we examined comparatively.

The analysis of the blotches on the blouse, indicated as being produced by blood, showed us that they were by no means due to this liquid.

The debates in this case later informed us that one of the defendants was a butcher, which we were unaware of during our investigation, and our conclusions were fully confirmed by the information provided by the judicial inquiry.

According to the facts in this report, it may be seen how important could be a microscopic examination to determine of the structure of animal hair and human hair in some cases. Here, other overwhelming charges were raised against the accused, so our conclusions did not change his position. But have we not seen, in more than one circumstance, a single fact, seemingly probative, as it appeared to be the one in question, to furnish the most serious presumptions against an accused? If it had been so in the particular case I am referring to, couldn't our observations have sufficed to remove all suspicions of guilt [5]?

Notes

1. (1827) Du sperme considéré sous le point de vue médico-légal, Journal de chimie med., t. III, p. 469
2. Nouvelles expériences sur les animalcules spermatiques et sur quelques-unes des causes de la stérilité chez la femme, suivies de recherches sur les pertes séminales involontaires et sur la présence du sperme dans l'urine. Paris, 1837, in-8.
3. Mr. Devergie has just proposed the same means of recognizing suspension during life.
4. I made these observations with Mr. Fontan; the experience which our skillful friend has acquired in this kind of research is a guarantee of the accuracy of the results which I point out here. We propose to continue a review which promises to shed new light on the organization of hair and corneal productions in general.
5. In a judicial appraisal I had commissioned last May with Messrs. Gaultier de Claubry and Labarraque, I saw another no less useful application of the microscope. Here was an opportunity. A large quantity of denatured and falsified opium was introduced into commerce at the beginning of this year. Fraud was soon reported to the authority, and in the inquiries of the colleague M. Gaultier de Claubry, the microscopic examination procured him important results, which were in support of those of the analysed chemical. His observations have even led him to discover the very different processes employed in the extraction of opium from Smyrna and opium from Egypt. I can only mention here this fact, which M. Gaultier de Claubry proposes to publish shortly with all the details he requires.

The author is greatly indebted to Kim Lavoie and Ariane Joncas of the forensic science program at the Université du Québec à Trois-Rivières for translating this article. Thanks also to their professors, Cyril Muehlethaler and Frank Crispino, for facilitating this translation.

NEW BOOKS AND BOOK REVIEW

New Forensic Science Books

***Color Atlas of the Autopsy,* 2nd ed**
S. A. Wagner
CRC Press: Boca Raton, FL, US; 2016

Comparative Bone Identification: Human Subadult to Nonhuman
D. L. France
CRC Press: Boca Raton, FL, US; 2016

Contemporary Digital Forensic Investigations of Cloud and Mobile Applications
K. Kwang, R. Choo, A. Dehghantanha, Eds
Academic Press/Elsevier: Waltham, MA, US; 2016

Creating Digital Faces for Law Enforcement
M. W. Streed
Academic Press/Elsevier: Waltham, MA, US; 2017

Digital Forensics Trial Graphics: Teaching the Jury Through Effective Use of Visuals
J. Sammons, L. Daniel
Academic Press/Elsevier: Waltham, MA, US; 2017

***Disposition of Toxic Drugs and Chemicals in Man,* 11th ed**
R. C. Baselt
Biomedical Publications: Seal Beach, CA, US; 2017

Essentials of Medicolegal Death Investigation
M. Lunn
Academic Press/Elsevier: Waltham, MA, US; 2017

Forensic Anthropology
M. Houck, Ed
Academic Press/Elsevier: Waltham, MA, US; 2017

***Forensic Anthropology: A Comprehensive Introduction,* 2nd ed**
N. R. Langley, M. A. Tersigni-Tarrant, Eds
CRC Press: Boca Raton, FL, US; 2017

Forensic Engineering
M. Houck, Ed
Academic Press/Elsevier: Waltham, MA, US; 2017

Forensic Investigations: An Introduction
B. Turvey, S. Crowder
Academic Press/Elsevier: Waltham, MA, US; 2017

***Forensic Pathology in Civil and Criminal Cases,* 4th ed**
C. H. Wecht, M. A. Graham, R. L. Hanzlick
Juris Publishing: Huntington, NY, US; 2016

***Forensic Podiatry: Principles and Methods,* 2nd ed**
D. W. Vernon, J. A. DiMaggio
CRC Press: Boca Raton, FL, US; 2017

Forensic Psychiatry: Fundamentals and Clinical Practice
B. Puri, I. H. Treasaden, Eds
CRC Press: Boca Raton, FL, US; 2017

Forensic Science Reform: Protecting the Innocent
W. Koen, C. M. Bowers, Eds
Academic Press/Elsevier: Waltham, MA, US; 2017

Human Remains: Another Dimension (The Application of Imaging to the Study of Human Remains)
T. Thompson, D. Errickson, Eds
Academic Press/Elsevier: Waltham, MA, US; 2017

Introduction to Forensic Psychology: Essentials for Law Enforcement
S. Scott-Snyder
CRC Press: Boca Raton, FL, US; 2016

***Mass Spectral and GC Data of Drugs, Poisons, Pesticides, Pollutants, and Their Metabolites,* 5th ed**
H. Maurer, K. Pfleger, A. Weber
Wiley-Blackwell: Somerset, NJ, US; 2016

Measurement Uncertainty in Forensic Science: A Practical Guide
S. Bell
CRC Press: Boca Raton, FL, US; 2016

Osteoarchaeology: A Guide to the Macroscopic Study of Human Skeletal Remains
E. Nikita
Academic Press/Elsevier: Waltham, MA, US; 2017

***Practical Aspects of Rape Investigation: A Multidisciplinary Approach,* 5th ed**
R. R. Hazelwood, A. Wolbert Burgess, Eds
CRC Press: Boca Raton, FL, US; 2016

***Principles and Practice of Forensic Psychiatry,* 3rd ed**
R. Rosner, C. Scott, Eds
CRC Press: Boca Raton, FL, US; 2016

Taphonomy of Human Remains: Forensic Analysis of the Dead and the Depositional Environment
E. Schotsmans, N. Márquez-Grant, S. Forbes, Eds
Wiley-Blackwell: Somerset, NJ, US; 2017

The Art of Science in the Canadian Justice System: A Reflection of My Experiences as an Expert Witness
D. Milward, C. Ferguson
CRC Press: Boca Raton, FL, US; 2017

Book Review

Disposition of Toxic Drugs and Chemicals in Man, 11th ed

R. C. Baselt

Biomedical Publications: Seal Beach, CA, US; 2017

Reviewed by: *F. W. Fochtman, Duquesne University, Pittsburgh, PA, US.*

The 11th edition of Randall Baselt's monographs of drugs and chemicals is indeed worth adding to anyone's library. It is true that the font has gotten much smaller and the paper stock is thinner; however, the information is exponentially greater.

The "Baselt book" has evolved into the most comprehensive resource for information regarding the identity, chemistry, dose, exposure, mechanism, biotransformation, as well as body fluid and tissue concentrations of chemical compounds used for drug therapy or those where exposure is of interest for interpretation of effects in humans. The descriptive title of the book is exactly what can be comprehensively found within. The author has provided thorough, up-to-date information and data gleaned from worldwide references relating to drugs and chemicals that are reported to have potential or documented deleterious effects. Whether the effects are adverse reactions and toxicity from drugs, or results of exposure to known toxic chemicals in the environment or workplace, you will likely find very useful information in any one of the monographs.

Each monograph extensively identifies the agent and its use. It also provides a great deal of information relating to blood, plasma, and serum concentrations resulting from various routes of exposure and dose. For drugs, the pharmacological classification typically based on mechanism of action is provided. For chemicals, the economic use and/or typical type of exposure is provided. For each entity there is a section on metabolism that details extent of metabolism, metabolic products, and pharmacogenomics information regarding phenotypic characteristics. Ratios and distribution of parent chemical versus metabolite as well as the activity of metabolites are frequently provided. Metabolism is followed by a section on toxicity that provides extensive referenced information regarding typical adverse effects and toxicity associated with reported body fluid and tissue concentrations. Averages and ranges of blood concentrations associated with reported illicit use and overdoses resulting in recovery with therapy as well as those leading to death are provided. Typically used analytical methods of testing for the presence of the drug or chemical are included. An important feature in this section is the extensive postmortem information that includes reports and references to postmortem changes in blood concentrations that can occur. It must be noted that all of the information provided in the monographs is referenced and the source is included as part of the monograph.

The 11th edition has been expanded to include 275 new entries for a total of about 1,800 drugs and chemicals that an individual could be exposed to and experience toxicity. Like the 10th edition, it continues to provide indexed drug categories and chemical categories. This edition has expanded those to include many new psychoactive substances (NPS) of current interest such as fentanyls, etc. An added index provides CAS numbers, a valuable source for cross-referencing and locating chemical entities. The new edition also has added a list of abbreviations. The guidelines for interpretation of analytical results have been updated and expanded in the postmortem toxicology area.

This reviewer has been using earlier editions of this book for many years and has found it to be an invaluable resource, particularly for interpretation of postmortem forensic cases. I have made references to the book in classes that I have taught in forensic, clinical, and environmental toxicology as well as using the information within for lecture preparation. I actually found my copy of the 4th edition on a "way up top" bookshelf. Flipping through the dog-eared pages really made me appreciate this latest edition. Through the years I have continued to use each newly published edition and was particularly pleased with each expansion as it faithfully includes new drugs and stays up to date with illicitly used chemicals.

In a recent discussion of the new edition, a colleague related to me that blood concentrations of a drug were just published in a peer-reviewed journal and Dr. Basalt had literally contacted the author shortly afterward to discuss the new data. An addendum to the text actually includes a number of entries that were added after the book had already been submitted for publication.

In conclusion, this 11th edition definitely meets my high expectations as a reference and will provide many different forensic practitioners with invaluable information for the interpretation of exposures to drugs and chemicals. And, of course, the sources referenced certainly will provide the background information for anyone needing to "mine" additional details.