JOURNAL OF CHEMICAL EDUCATION

Editorial

pubs.acs.org/jchemeduc

Forensic Chemistry and Its Flip Side

Robert Q. Thompson*

Department of Chemistry and Biochemistry, Oberlin College, Oberlin, Ohio 44074, United States

ABSTRACT: Forensic chemistry is the focus of this year's National Chemistry Week and a strengthening and growing discipline of research and teaching. Forensic science deals mainly with the aftermath of crime. The flip side is the science of eliminating or ameliorating violent acts before they happen. In our laboratories and classrooms, are there ways to address the targeted violence and terrorism that fill the news cycle and generate fear in us and our students? While we have conversations on our individual campuses, a conversation among us chemistry educators on a regional or national scale would be even more helpful.

KEYWORDS: *General Public, Forensic Chemistry, Public Understanding/Outreach*

FORENSIC CHEMISTRY

This year's National Chemistry Week theme is "Solving Mysteries through Chemistry", a focus on forensic chemistry.[1] Chemical scientists who practice forensic science assist society in bringing to justice those who would circumvent the law and cause harm to themselves and others. After scathing reports on forensic science at the beginning of this decade,[2] practitioners have begun to build better scaffolding in many evidence areas with ties to bedrock scientific and statistical principles. National working groups have issued guidelines and best practices in several areas of forensic science, such as in trace evidence,[3] and ASTM International has published a set of forensic science standards.[4] Most recently, the ACS has responded to the need to develop chemistries to support the legal marijuana industry in several U.S. states by establishing a new subdivision on cannabis.[5]

As forensic chemistry research and practice has improved and expanded, so has education in forensic chemistry. Responding to the public's interest in forensic science and later to dispel myths from television shows such as *CSI* (the *CSI* effect[6]), many of us developed courses that could bring chemistry to those even reluctant to learn it. For a decade or more the NSF-sponsored Chemistry Collaborations Workshops and Communities of Scholars (cCWCS) has supported Lawrence Kaplan's week-long workshop on forensic science for faculty.[7] ACS meetings and the Biennial Conference on Chemical Education are additional venues for learning about best practices for teaching forensic chemistry. Resources, such as forensic science textbooks, have proliferated for majors' courses, for the analytical chemistry laboratory,[8] nonmajors' courses, and even for general chemistry.[9] This *Journal* and others have published excellent experiments and commentary in forensic chemistry.[10]

So I am upbeat about forensic science research and education. But I am also concerned and conflicted by the fact that forensic science in the main deals only with the aftermath of horrible and heinous acts. Forensic science is only a response, only a reaction to crime and violence.

FLIPPED FORENSIC CHEMISTRY

What about preventing or mitigating the effects of illegal activity? What can chemists do? We have had some impact. Stephanie Kwolek at DuPont in 1965 developed Kevlar, used for years in bullet-proof vests, and now the next generation of chemical scientists are studying graphene, nanocellulose, spider silk, and recycled plastic as even lighter and stronger materials for protection. The scourge of opioid overdose and death has been blunted by the drug Nalaxone, first synthesized in 1961 by Jack Fishman. Concerned parents and police now carry the drug in most communities, ready to be administered to save a life. We need to renew these efforts. My mind runs to the many seemingly senseless shootings by police and of police in the United States this past year and violent reactions to these events. Can scientists create bullets that slow and stop a person targeted by police but that do not kill so easily? Can we make imagers that detect guns in cars and on persons from far away? Can we replace pepper sprays for crowd control with vapors that safely produce calm? There are many current examples of how chemical inventions have saved lives, but there are even more possibilities.

This past summer has certainly been one of anxiety and fear, born of targeted violence and terrorism and fed by political rhetoric. Open carry of firearms in some public universities adds to the burden. Our students come to us in this tense environment. How are we to respond? Can we as educators mitigate the effects? I certainly feel adrift and woefully underprepared to respond in my chemistry classroom. I am not skilled in such conversations with students. I believe that all lives matter and that we need to acknowledge Black Lives Matter and that blue lives, LGBTQ lives, Muslim lives, and so on, have value, yet I am not sure I have the right words. I fear being misunderstood. How can I use the subject of forensic chemistry to foster communication on these social issues without changing the nature of my class?

HOW TO RESPOND

Steven Volk, an Oberlin College faculty colleague who heads our teaching center, writes eloquently on many subjects, and his recent words best reflect my feelings.[11]

Published: October 11, 2016

DOI: 10.1021/acs.jchemed.6b00713
J. Chem. Educ. 2016, 93, 1677−1678

> *Addressing the crises of this and other summers does not mean that we drop everything to examine the moment in which we live and ignore what we are trained to teach. Our responsibilities as teachers are much greater. But we should, I would argue, acknowledge the emotional and mental costs of the ongoing turmoil on our students, and recognize them in ourselves. We are humans before we are biologists or computer scientists, and many of our students want to know that we are not oblivious to what is happening in the world or to the pain that many of them feel.*

John Moore, former editor of this *Journal*, commented similarly in an editorial after the horror of 9/11.[12]

> *Lack of expertise or eloquence ought not prevent us from attempting to think and act to the best of our abilities. Our message will come through loud and clear, even if it is not stated explicitly or in beautiful phrases. Students observe our behavior as people as well as what we write on the chalkboard as teachers.*

Content and caring are both required in the classroom.

On our campus and yours, I'm sure, there have been many discussions about the effects of the world on us and our students. Some have been instructive, others not so much, particularly for science faculty. Would it be helpful for science educators, chemical scientists, to gather to discuss this important parameter in our science classrooms? I think so. Would we all benefit from learning of discipline-specific practices that provide a relevant path into these topics and improve the classroom climate? Surely, yes. Perhaps someone could organize a symposium at a regional or national meeting or devote a *Journal* issue to "The Chemistry Classroom: Addressing Anxiety over Targeted Violence and Terrorism". How will you contribute? How will your research and teaching flip forensic chemistry?

AUTHOR INFORMATION

Corresponding Author

*E-mail: robert.q.thompson@oberlin.edu.

Notes

Views expressed in this editorial are those of the author and not necessarily the views of the ACS.

Biography

Rob Thompson is an analytical chemist and Professor of Chemistry at Oberlin College with a long-standing interest in forensic science. He teaches a popular course for nonscientists, *Chemistry and Crime*, includes a forensic project laboratory in his majors' analytical chemistry course, and performs research in forensic analytical chemistry with undergraduates. His work has resulted in a book, *Instrumental Investigations: A Laboratory Manual of Forensic Analytical Chemistry*, for use by college faculty teaching analytical chemistry laboratory courses. The book includes 25 instrumental analysis experiments with references, helpful faculty notes, and student laboratory procedures, as well as five crime scenarios that can serve as vehicles for project laboratories. Thompson has gained valuable hands-on experience in forensic science on sabbaticals at the U.S. Federal Bureau of Investigation Research and Training Center and at the U.S. National Institute of Standards and Technology. His published work over 30 years has touched on many areas of analytical chemistry in and outside of forensics such as immobilized enzymes, liquid chromatography of explosives residues, electrochemical immunoassay, identification of capsaicinoids (hot agents of chili peppers), trace cadmium by ICP-MS, and teaching experiments for analytical chemistry and general chemistry courses. Thompson served as Secretary of the Analytical Division of the ACS from 1996 to 1999. He received an Oberlin College Excellence in Teaching Award in 2014 for his pedagogical innovations, including evidence-based, workshop-style teaching of general chemistry.

REFERENCES

(1) American Chemical Society. *National Chemistry Week 2016: Solving Mysteries through Chemistry*. http://www.acs.org/content/acs/en/education/outreach/ncw/about.html (accessed Sep 2016).

(2) *Strengthening Forensic Science in the United States: A Path Forward*; National Academy of Sciences, August 2009. https://www.ncjrs.gov/pdffiles1/nij/grants/228091.pdf (accessed Sep 2016).

(3) Scientific Working Group for Materials Analysis. http://www.swgmat.org/ (accessed Sep 2016).

(4) ASTM International's forensic science standards. https://www.astm.org/Standards/forensic-science-standards.html (accessed Sep 2016).

(5) ACS Division of Chemical Health and Safety, Cannabis Subdivision. http://dchas.org/cann/ (accessed Sep 2016).

(6) *Managing the CSI Effect in Jurors*; American Bar Association. http://apps.americanbar.org/litigation/committees/trialevidence/articles/winterspring2012-0512-csi-effect-jurors.html (accessed Sep 2016).

(7) *Chemistry Collaborations, Workshops, and Communities of Scholars*. http://www.ccwcs.org/ (accessed Sep 2016).

(8) Thompson, R. Q. *Instrumental Investigations: A Laboratory Manual of Forensic Analytical Chemistry*. https://new.oberlin.edu/arts-and-sciences/departments/chemistry/Forensic%20Chemistry.pdf (accessed Sep 2016).

(9) Johll, M. *Investigating Chemistry: Introductory Chemistry from a Forensic Science Perspective*. http://www.macmillanlearning.com/Catalog/product/investigatingchemistry-thirdedition-johll (accessed Sep 2016).

(10) See for example: (a) Cresswell, S. L.; Loughlin, W. A. An Interdisciplinary Guided Inquiry Laboratory for First Year Undergraduate Forensic Science Students. *J. Chem. Educ.* **2015**, *92* (10), 1730−1735. (b) Charkoudian, L. K.; Heymann, J. J.; Adler, M. J.; Haas, K. L.; Mies, K. A.; Bonk, J. F. Forensics as a Gateway: Promoting Undergraduate Interest in Science, and Graduate Student Professional Development through a First-Year Seminar Course. *J. Chem. Educ.* **2008**, *85* (6), 807−812.

(11) Volk, S. *Center for Teaching Innovation and Excellence*; Oberlin College. http://languages.oberlin.edu/blogs/ctie/2016/08/16/between-the-world-and-our-students/ (accessed Sep 2016).

(12) Moore, J. W. Technology and Tragedy. *J. Chem. Educ.* **2001**, *78* (11), 1439.

DOI: 10.1021/acs.jchemed.6b00713
J. Chem. Educ. 2016, 93, 1677−1678