CSIRO PUBLISHING

www.publish.csiro.au/journals/ajc

Aust. J. Chem. **2010**, *63*, 1–2

Research Front Essay: Forensic Chemistry

James Robertson[A]

[A]Forensic and Data Centres, Australian Federal Police, GPO Box 401, Canberra, ACT 2601, Australia. Email: jim.robertson@afp.gov.au

It is a great pleasure to have been asked to write this introduction to the *Australian Journal of Chemistry* Research Front on Forensic Chemistry. I have had a long held interest in the promotion and the application of chemistry in the forensic domain in Australia. Through collaborations with many excellent 'chemist' colleagues, Chris Lennard, Claude Roux, Michael Collins and others, I have been fortunate enough to contribute to research in the areas of fibres[1] and illicit drugs[2] over a career nearing 35 years in forensic science. My research interests were initiated during my time as an academic at Strathdyde University, further developed by my operational experience in South Australia and matured by two decades of science management and leadership. I have seen the growth of forensic science during four decades and, sadly the retraction of chemistry in universities. Indeed it would not be unfair to state that around the world forensic science has 'saved' several chemistry departments from closure or amalgamation into generic departments.

The influence of forensic science on basic science is not of itself detrimental to science. After all science is just science. We need to have a broad spectrum from science simply pursued for its own intrinsic search for understanding, through to the opposite end of the spectrum, the introduction of services and products. This was well understood by no less a figure than Louis Pasteur encapsulated in Pasteur's Quadrant (Fig. 1).[3]

The application of chemistry to answering questions of interest which may end up in court, forensic questions, is at the more applied end of the science continuum but it benefits from advances arising from more basic science and science developed for the other applied applications. The key to maximising the use of science is to avoid unnecessary silos. Forensic applications draw on all aspects of 'basic' chemistry.

In Australia, forensic chemistry is very strong with several well regarded programs producing both excellent graduates and excellent research. My own organization has a very strong record of research collaboration. Currently, our research is focussed on six themes, these are:

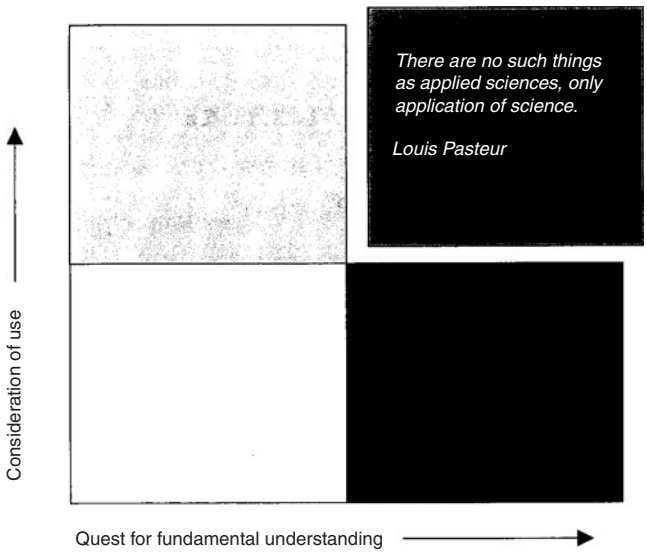

Fig. 1. Pasteur's Quadrant.

- Increasing the value of forensic services to users
- Increasing service efficiency
- Increasing forensic contribution to intelligence
- Readiness for 2020
- More powerful science in the field
- Building knowledge

James Robertson has been in charge of the Australian Federal Police's (AFP) Forensic group (now including Data Centres) since moving to the AFP in 1989. Originally from Glasgow he obtained his B.Sc. (atoms) and Ph.D. from the University of Glasgow in 1972 and 1976. An Agricultural Scientist, his doctoral work was on Plant Hormonal Control of Seed Dormancy. After a short post doctoral spell in London he moved to the University of Strathdyde, Glasgow, as a lecturer in Forensic Science, immigrating to South Australia in 1985 where he then worked as a Forensic Scientist in the state Forensic Laboratory. He has a broad range of Forensic interests including hairs, fibres, botanical trace, and illicit drugs. He has published extensively, edited a book series, co-edited four books, and established an active research culture within the Forensic and Data Centres (FDC) group of the AFP. He holds adjunct professional appointments at several Australian and overseas universities. The University of Canberra awarded him an Honorary Doctor of the University in 2007 and he was awarded the Public Service Medal (PSM) in 2004 for services to Forensic Science and law enforcement. James will retire from the AFP in 2010 and take up an appointment at the University of Canberra as a Professorial fellow. James was recently also appointed as the chair of the National Institute of Forensic Science (NIFS) advisory forum.

10.1071/CH09672 0004-9425/10/010001

Clearly our goals are end user driven and focussed on delivering a quicker and more effective service to the justice system.

After all, a slow service is no service and all too often speed (of lack of!) is the principle concern of our end user community. However, we recognize the need to have a reasonable longer term focus and to try and ensure forensic science benefits from being better informed by advances coming from basic research or from other fields of science application.

A recent major report on forensic science from the USA[4] reached to conclusion that '*of the various facets of under resourcing, the committee is most concerned about the knowledge base*'. The committee further concluded that '*Forensic Science research is not well supported and there is no unified strategy for developing a Forensic Science research plan . . . relative to other areas of science the forensic disciplines have extremely limited opportunities for research funding.*'

Although the situation may be a little better in Australia the observation is relevant across the world.

The Australian Federal Police's (AFP) Research and Development (R&D) plan not only recognizes the need for basic research and knowledge acquisition but supports a considerable body of R&D through honours to post doctoral research. As an example we are supporting over 20 individual projects in 2009/2010 with a chemistry component in areas as diverse as, illicit drugs, fingerprints, explosives, gun shot residues, fibres, mobile instrument evaluation, and oil spills.

In terms of the application of chemistry, our main ongoing areas of focus have been on trace evidence (generally chemical criminalistics) and illicit drugs. Much of our work on chemical criminalistics has been in partnership with our colleagues at the University of Technology, Sydney. Along with Professor Chris Lennard at the University of Canberra, a special focus has been on the chemistry of fingerprint deposits and how to enhance these for identification purposes.[5–7]

More recently the focus on Counter Terrorism and National Security has seen a heavy focus on the forensic examination of explosives with work on the application of stable isotope ratio mass spectrometry (IRMS) and on producing field deployable analytical capability.

Starting in the early 1990s, the AFP in partnership with Australia's National Measurement Institute, has developed an illicit drug profiling program specifically aimed at amphetamine type substance, cocaine, and heroin.[2]

As this short paper was being written the Commonwealth Government announced a further $7.6 million over 4 years to extend this program to produce a truly national picture of drug availability. In the fight against illicit drugs international and national efforts have been to inhibit or stop the use of licit drugs and precursor chemicals in the manufacture of illicit drugs.

Recent trends have seen a more distant 'precursors of precursors' approach which test traditional methods of detection at the border and offer significant analytical chemistry challenges. For example, Collins et al.[8] identified methyl 3-[3′,4′-(methylenedioxy) phenyl]-2-methylglycidate as a 'precursor of a precursor' and demonstrated this could be manufactured into MDMA (ecstasy). This work involved synthetic organic chemistry and advanced analytical techniques.

Hence, any previously held view that the examination of illicit drugs is relatively trivial science, if ever true, is certainly no longer the truth.

Finally, although the AFP does not have in-house toxicology, here in Australia, there are many excellent examples of first class applications of chemistry to answering forensic questions.[9]

Turning to the papers selected for this Research Front, it is clear these could have come from many contributors across a very wide range of forensic application. The focus in this issue is on illicit drugs and national security and this is reflected in the choice of topics and authors. It is particularly pleasing to see the partnership between academia and the non-University sector. Two of the papers involve the Defence Science and Technology Organisation and look at respectively the detection of impurities in organic peroxide explosives from precursor chemicals[10] and a study of specimen determination in *Ricinus communis* (the source of castor oil but in context the topic plant protein, ricin).[11]

The other two papers focus on the use of stable isotope ratio mass spectrometry. David et al. look at isotope composition of methamphetamine synthesized using three variations of the hydriodic acid (red phosphorus route).[12] Readers may also find of interest a recent paper by Collins et al. on IRMS of ephedrine and pseudoephedrine used to produce methamphetamine.[13]

Finally, Niamh Nic Daeid and colleagues from the Centre for Forensic Science at the University of Strathdyde discuss the use of IRMS for forensic uses.[14] The reader is also referred to an earlier review by Benson et al.[15]

In conclusion, the forensic world provides almost untapped opportunities to apply chemistry in a practical and useful way. The best outcomes will be achieved where the right people with the best technologies are brought together and by breaking traditional siloed thinking.

These papers are testament to that approach. I hope this Research Front will encourage even greater collaboration for chemists to provide answers and ways forward in areas of genuine national interest.

References

[1] J. Robertson, M. Grieve, *Forensic Examination of Fibres* **1999** (Taylor and Frances: London).

[2] M. Collins, J. Huttunen, J. Evans, J. Robertson, *Aust. J. Forensic Sci.* **2007**, *39*, 25. doi:10.1080/00450610701324924

[3] D. E. Stokes, *Pasteur's Quadrant: Basic Science and Technological Innovation* **1997** (Brookings Institution Press: Washington, D.C.).

[4] Annon, *Strengthening Forensic Science in the United States: a Path Forward* **2009** (National Academies Press: Washington, D.C.).

[5] C. Lennard, *Aust. J. Forensic Sci.* **2007**, *39*, 55. doi:10.1080/00450610701650021

[6] C. Lennard, *Aust. J. Forensic Sci.* **2007**, *39*, 73. doi:10.1080/00450610701650039

[7] P. Maynard, J. Jenkins, C. Edey, G. Payne, C. Lennard, A. McDonagh, C. Roux, *Aust. J. Forensic Sci.* **2009**, *41*, 43. doi:10.1080/00450610802172248

[8] M. Collins, A. Heagney, F. Cordaro, D. Odgers, G. Jarrant, S. Stewart, *J. Forensic Sci.* **2007**, *52*, 898. doi:10.1111/J.1556-4029.2007.00480.X

[9] O. H. Drummer, *Aust. J. Forensic Sci.* **2003**, *35*, 141. doi:10.1080/00450610309410573

[10] A. Patridge, S. Walker, D. Armitt, *Aust. J. Chem.* **2010**, *63*, 30. doi:10.1071/CH09481

[11] S. P. B. Ovenden, B. R. Gordon, C. K. Bagas, B. Muir, S. Rochfort, D. J. Bourne, *Aust. J. Chem.* **2010**, *63*, 8. doi:10.1071/CH09293

[12] G. E. David, D. B. Hibbert, R. D. Frew, A. R. Hayman, *Aust. J. Chem.* **2010**, *63*, 22. doi:10.1071/CH09429

[13] M. Collins, A. J. Lawley, A. C. Heagney, L. Kissane, J. Robertson, H. Salouros, *Rapid Commun. Mass Spectrum.* **2009**, *23*, 2003.

[14] N. N. Daeid, H. A. S. Buchanan, K. A. Savage, J. G. Fraser, S. L. Cresswell, *Aust. J. Chem.* **2010**, *63*, 3. doi:10.1071/CH09414

[15] S. Benson, C. Lennard, P. Maynard, C. Roux, *Forensic Sci. Int.* **2006**, *157*, 1. doi:10.1016/J.FORSCIINT.2005.03.012