Introduction

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‘It is not the strongest of the species that survive, nor the most intelligent but the one most responsive to change’.

Attributed to C. Darwin, FRS.

It has been a privilege to be part of the adventure that culminated in the Royal Society’s twin events designed to enable and encourage the forensic science community to come together to discuss and plan a vision for the future, not only for the UK, but as partners in a global ecosystem. It is also an honour to present a collection of some of the presentations within the pages of the Philosophical Transactions of the Royal Society in its 350th year, an anniversary that it shares coincidently with the octocentennial celebration of the Magna Carta—the earliest moral and ethical script for the basis of our modern judicial system.

In 1297, the Magna Carta was finally incorporated into English statute law and while today it is perhaps viewed as a document of almost mythical influence, it retains the ability to transcend barriers of language and divisions of culture and ideology. It is based on the principles of freedom, democracy, justice and Rule of Law and philosophers allege that when these are denied, we should prepare to embrace the inevitability of injustice. The strength of the ethos embedded within the Magna Carta still resonates today in many laws associated with human rights including the US Bill of Rights (1791), the Universal Declaration of Human Rights (1948) and the European Convention on Human Rights (1950). Only the spirit of clauses 39 and 40 of the original document remain identifiable within English law:

Clause 39. No free man shall be seized or imprisoned, or stripped of his rights or possessions, or outlawed or exiled, or deprived of his standing in any way, nor will we proceed with force against him, or send others to do so, except by the lawful judgment of his equals or by the law of the land.

Clause 40. To no one will we sell, to no one deny or delay right or justice.

In the fourteenth century, these were broadly interpreted as a universal right to justice and a fair trial by our peers (a trial by jury).

As forensic scientists, we may overlook the subtlety of this document’s enduring spirit of influence, and it is likely that few give a second thought to its impact on our daily professional occupations. But we are certainly not immune to the resonance of its innate call of duty, and nowhere does this become more apparent than when there is systemic failure and we seek to identify the weakness that precipitated the breakdown. Science has often been accused by the law of adopting a laissez-faire approach to its responsibility to the courts, but equally the courts have been accused of abrogating responsibility by failing to understand or convey the nuances and limitations of the scientific evidence they present to support their case. There is no doubt that forensic science is of high significant value to the courts, but of late it has come under increasing criticism across a number of evidence types. If science is to continue to be of value to the court and to play its part in a ‘fair’ trial then we, as forensic scientists, must accept the onerous responsibility, in genuine partnership with our legal colleagues, to ensure that weaknesses are identified and addressed and that both our science and our scientists are fit for the purposes against which they will be measured and held to account in the court. Equally, our judiciary, jurists, policy-makers and politicians must accept and understand that science is rarely absolute and that the expert witnesses will articulate to the best of their ability the limitations within which their scientific
interpretations may be considered, and this requires to be conveyed both realistically and honestly to the jury.

The responsibilities placed on the shoulders of today’s forensic scientists can be unrealistic, with punishing demands to be consistently and unerringly accurate, precise, informed, impartial, definitive and right. In a perfect world, these would of course be achievable every single time, but science and its interpretation by scientists does not fall easily into a strictly defined binary categorization of right and wrong, or black and white. Further, it is this interpretation of evidence for a fundamentally lay audience that perhaps best conveys the subtle but critical difference between the conventional scientist and the forensic scientist. The former is free to express their limitations and reservations within a sympathetic and understanding environment of like-minded individuals, whereas the latter must be able to both interpret and convey the same information not only within that learned society but also to an almost exclusively lay audience with different expectations and exacting demands. Effective and efficient communication and understanding of science are viewed as significant constraints in the courtroom and the source of much angst and conflict. Avoidance of adverse discourse by achieving common agreement can only benefit the judicial process as lawyers seek to assist the undisputed triers of fact (the jury) to reach a sound and honest decision of guilt or innocence.

Indeed, it has been argued that forensic science is perhaps one of the most impactful examples of public and societal engagement with science, and, therefore, it is incumbent upon the scientists to be vigilant in self-governance and appraisal to ensure that the jury and the legal teams have a full and realistic understanding of the current state of play for the science that they seek to use and understand. Neither the science nor the scientists are infallible and indeed both must expect to come under intense scrutiny in an adversarial legal system, but there is also a duty of responsibility on all participants within the courtroom to have a clear and honest understanding of where the safe and undisputed boundaries are in relation to fact and strength of opinion. If either the science or the scientist is found to stray beyond those accepted limits, then it is imperative that we recognize that the costs may be high and the ramifications far reaching. They may not simply affect the future standing and career of those who performed or generated revenue irrespective of detriment to them, their discipline or the wider community? Accepting as we do that our system is fundamentally flawed (there has indeed been major disagreement with the views of the NAS report), then if we choose to continue taking risks with our scientific integrity, we must accept the consequences without complaint, when the courtroom holds us to account.

This important community has a responsibility to address the current crisis, be brave enough to embrace change, identify what works and what does not, protect no sacred temples of tradition and work with vigour towards a solution that will improve the core health of the ecosystem. When will the community become sufficiently brave to stand up and refuse to comply with a demand to undertake a task because the science is not fit for purpose or is fundamentally flawed will not carry any confidence of securing a positive fix. Indeed, it can serve to reinforce the entrenchedment of the bad practices of the past by conveying a sense of tacit and obliged approval to traditionalists, who may seek to maintain the comfort of the status quo.

Ironically, while we may all be guilty of focusing too frequently on our limitations and restrictions, the greatest benefit and value of forensic science lies in its holistic application to the matter at hand, by providing a contextualized input into both the investigative and evaluative processes. If forensic science is to contribute both effectively and informatively to the judicial process then it must be accepted as more than an isolated scientific test, delivering a prescriptive result by a lone bench scientist. Confining forensic science to silos produces both one-dimensional data and one-dimensional thinking, both of which have reduced inherent value and lead to a less robust environment. By addressing aspects of the inter-relationship between science and the court as well as that between science and the investigators, we can begin to create a holistic vision of the future which encourages forensic science to develop as a robust and scientifically accepted resource for effective use across the entire modern criminal justice system.

A catalyst moment occurred in 2009 when the US National Academy of Sciences (NAS) report informed that the forensic science community failed to deliver on the standards necessary to meet its responsibilities. The report conveyed forcefully and definitively, for the avoidance of all doubt, something which many practitioners and academics had long known—that without immediate intervention, forensic science was heading for a crisis on an international scale.

Probably the most damaging general statements from the NAS report concluded that there was a:

...dearth of peer-reviewed, published studies establishing the scientific basis and validity of many forensic methods. (p. 8)

and that—

Among existing forensic methods, only nuclear DNA analysis has been rigorously shown to have the capacity to consistently, and with a high degree of certainty, demonstrate a connection between an evidentiary sample and a specific individual or source. (p. 100)

The NAS report delivered a stark reality check for forensic science, and one that shocked a normally complacent and conservative community into accepting that there were significant issues that required to be addressed and critical jobs to be done if the forensic science house was to be brought into order. That this task was largely laid at the door of the scientist has not been so readily accepted and we have tended to hide behind the laziest solution that first springs to mind—we need more funds to be made available. But it is well recognized that increasing the cash flow to a system that is not fit for purpose and is fundamentally flawed will not carry any confidence of securing a positive fix. Indeed, it can serve to reinforce the entrenchedment of the bad practices of the past by conveying a sense of tacit and obliged approval to traditionalists, who may seek to maintain the comfort of the status quo.

This important community has a responsibility to address the current crisis, be brave enough to embrace change, identify what works and what does not, protect no sacred temples of tradition and work with vigour towards a solution that will improve the core health of the ecosystem. When will the community become sufficiently brave to stand up and refuse to comply with a demand to undertake a task because the science is not fit for purpose or the practitioner is not sufficiently experienced? Where is the integrity of the scientist who allows either themself or their science to be victimized to perform or to generate revenue irrespective of detriment to them, their discipline or the wider community? Accepting as we do that our system is fundamentally flawed (there has been no major disagreement with the views of the NAS report), then if we choose to continue taking risks with our scientific integrity, we must accept the consequences without complaint, when the courtroom holds us to account.

Although the ripple effect of the NAS report was felt in the UK, it is what occurred since that time that has truly focused attention on the future health of forensic science in the UK and its role in the wider global community—leading to it no longer being fit for purpose. What can only be described as seismic changes occurred in the UK forensic science community and fragmentation escalated in England and Wales in 2012 when the UK Government closed the Forensic Science Service (FSS) and their operational services...
transferred into an almost exclusively commercial market, causing a market value collapse of 40% in just 24 months.\textsuperscript{2} The House of Commons Select Committee on Science and Technology launched an inquiry into the possible long-term effects of the FSS closure and produced two highly critical reports.\textsuperscript{3} In late 2014, a National Audit Office briefing\textsuperscript{4} was equally critical of the management of forensic science provision in England and Wales and expressed serious concern for its future health. These reports served to consolidate mounting fears that forensic science is failing and if we remain inactive, then we should prepare ourselves for miscarriages of justice and not just a national but a global crisis in confidence and capability.

In just the first three months of 2015, we have seen criticism of the scientific validity of low copy number DNA\textsuperscript{5} and the mathematical software used to de-convolute DNA mixtures in both the USA\textsuperscript{5} and Australia\textsuperscript{6}. The validity of conclusions drawn by the FBI on hair evidence has been heavily criticized\textsuperscript{7} and the scientific validity of ballistics has been challenged\textsuperscript{8,9}. However, in this ruling there also lurks an astonishing judicial compliance accepting that the status quo of poor, if not absent scientific underpinning for some areas of forensic evidence is acceptable. Forensic science is rightly being held to account and so are her scientists. Are we now experiencing the end of the beginning or the beginning of the end of that predicted crisis?

Whichever it is, we must stop paying lip service to the problems at the heart of our community, and simply demanding more funding will not make it all disappear like a bad dream. Only changes to culture and communication, in true partnership with our legal colleagues, will turn this situation around and it will require bold and uncompromising scientific redress of the highest caliber. There can be no tolerance for shoddy science and no space for the unqualified in the courtroom. It is time to stop doing ‘forensics’ and start doing real ‘science’ by real scientists that the courtroom can use with confidence.

It is almost inconceivable that the most sadly neglected relationship within the forensic science ecosystem is actually the one that is most fundamental to successful change—that between the scientists and their legal colleagues. This relationship is core to the effective functioning of any future partnership and has long been a source of friction for reasons that have little logical basis. This was the paradigm shift that the Royal Society events sought to address. That each side has that is most fundamental to successful change—that relationship within the forensic science ecosystem is actually the one that is most fundamental to successful change—that between the scientists and their legal colleagues. This relationship is core to the effective functioning of any future partnership and has long been a source of friction for reasons that have little logical basis. This was the paradigm shift that the Royal Society events sought to address. That each side has that are emerging and they began subtly when like-minded and mature enough to face the reality of where we currently stand—as to ignore reality is, in our view, not a viable option.

There is no doubt that the forensic science ecosystem stands at a critical crossroads and there must be a common responsibility taken for the changes that need to be enforced. Of one thing we are absolutely certain, our current path is destined for disaster if we choose to carry on simply doing more of the same. If we have a will to change our culture and communicate more effectively with our legal partners, then perhaps we have a realistic chance of meeting the enduring values at the heart of the Magna Carta.

We believe that the green shoots of this paradigm shift are emerging and they began subtly when like-minded and equally concerned scientific colleagues from around the world congregated at the Royal Society for two days in February to talk openly and honestly in front of some of our most senior judiciary—many did not even know they were in the room as they watched, listened and absorbed our views of
our own world. This delicate, fledgling relationship grew and blossomed beyond our wildest expectations in the second Royal Society funded event, culminating in a unified will for disruption of the status quo and an appetite for action. Without the support of the Royal Society this would never have happened, and our community should recognize and applaud the trust that was placed in us all as we tentatively edged across the stormy and largely unchartered waters between science and law. Like the infamous Christmas football game in the trenches of World War 1, for a time we made peace, we gained mutual respect and claimed common ground. That precious space cannot now be allowed to disappear and it is imperative that we seize the moment and nurture and encourage those emerging synergies with our senior legal colleagues. The time has come to reject the inadequacies of the past and embrace a healthy new culture that can steer our ecosystem into calmer and more productive waters, a culture of confidence and professionalism which supports openness and trust, where research, technology, leadership and workforce development are all valued as a collegiate part of the holistic community. If this is the bright future that we wish to achieve and the legacy we wish to leave behind, then we must genuinely work together and not let the current woes of the discipline and the egos of an intransigent old guard smother the green shoots of a paradigm shift that broke new ground in the octocentennial year of the Magna Carta.

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Endnotes
1 Strengthening Forensic Science in the United States: A Path Forward, Committee on Identifying the Needs of the Forensic Sciences Community. 2009 National Research Council of the National Academies.
8 FBI testimony on microscopic hair analysis contained errors in at least 90 percent of cases. (accessed May 2015).
9 2015 IL App (1st) 121016 No. 1-12-1016, THIRD DIVISION Modified opinion filed April 22, 2015 [77–80] and [121–124].