

Educating Lawyers and Forensic Scientists about Probability and Statistics

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I. Institutional Context

**CRIMINAL LAW, FORENSIC SCIENCE,
PROBABILITY AND STATISTICS**

The Complexity of Forensic Science

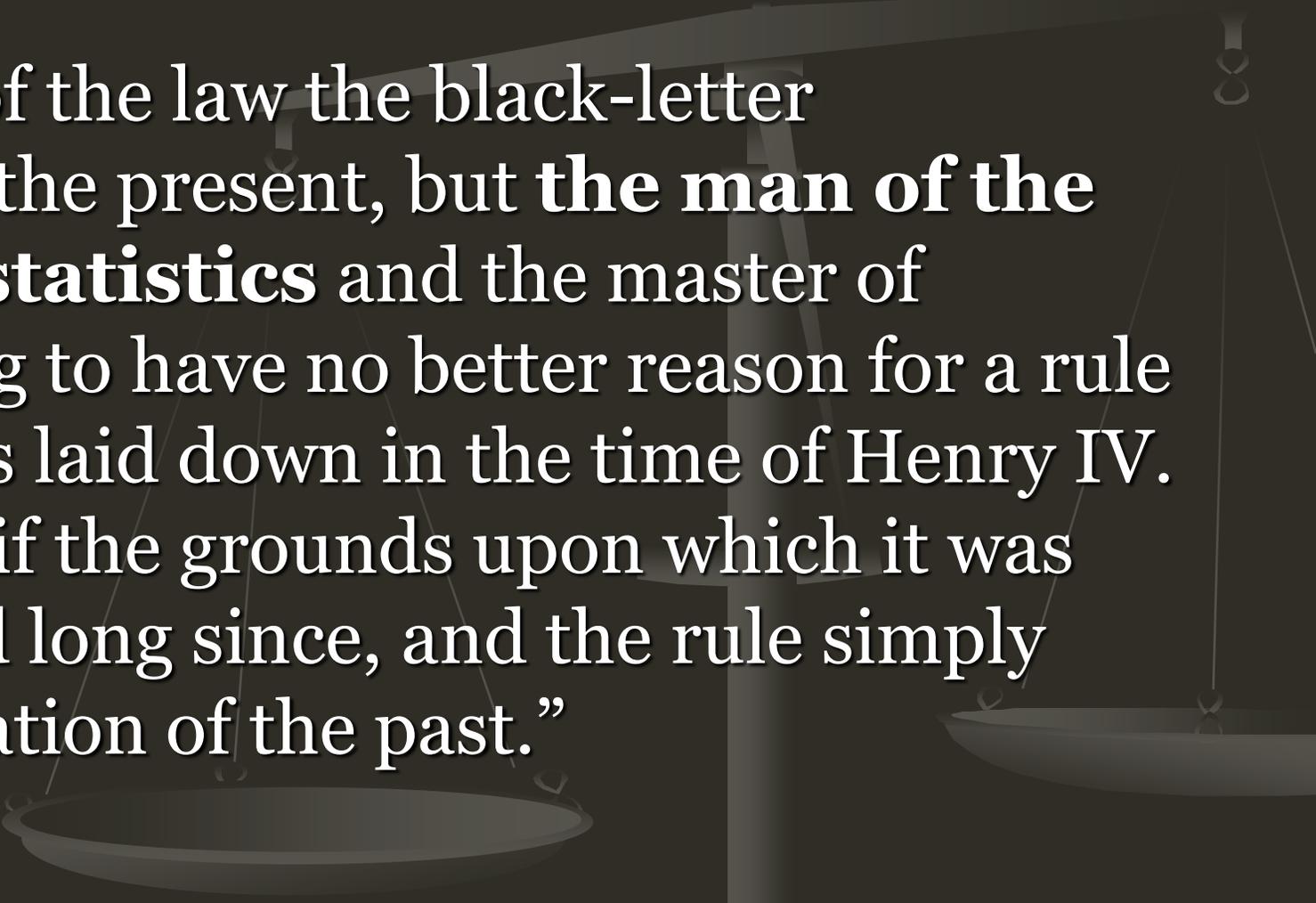


Non-reductive "(Criminal) Law"



Justice O W Holmes, 'The Path of Law' (1897)
10 *Harvard Law Review* 457, 469

“For the rational study of the law the black-letter man may be the man of the present, but **the man of the future is the man of statistics** and the master of economics. It is revolting to have no better reason for a rule of law than that so it was laid down in the time of Henry IV. It is still more revolting if the grounds upon which it was laid down have vanished long since, and the rule simply persists from blind imitation of the past.”



Richard A Posner, 'Philistinism in Law' (1989)
16 *Northern Kentucky Law Review* 415, 420-1

“Here are some of the skills that I believe are important for lawyers to acquire, and that are most easily acquired in a university setting rather than in on-the-job training... *First*, lawyers ought to know the principles of statistical inference. Law deals with probabilities rather than certainties... Lawyers and judges therefore ought to understand how to reason from probabilities. The law of evidence is based to a large extent on intuitions about probability, and many of these intuitions may be incorrect. Every law student should be required to demonstrate a minimum proficiency in statistical analysis. If he does not have it when he comes to law school, he should be required to take a course in the use of statistics in law before he graduates.”

Mirjan R Damaška, *Evidence Law Adrift*
(Yale UP, 1997), 143-4, 151

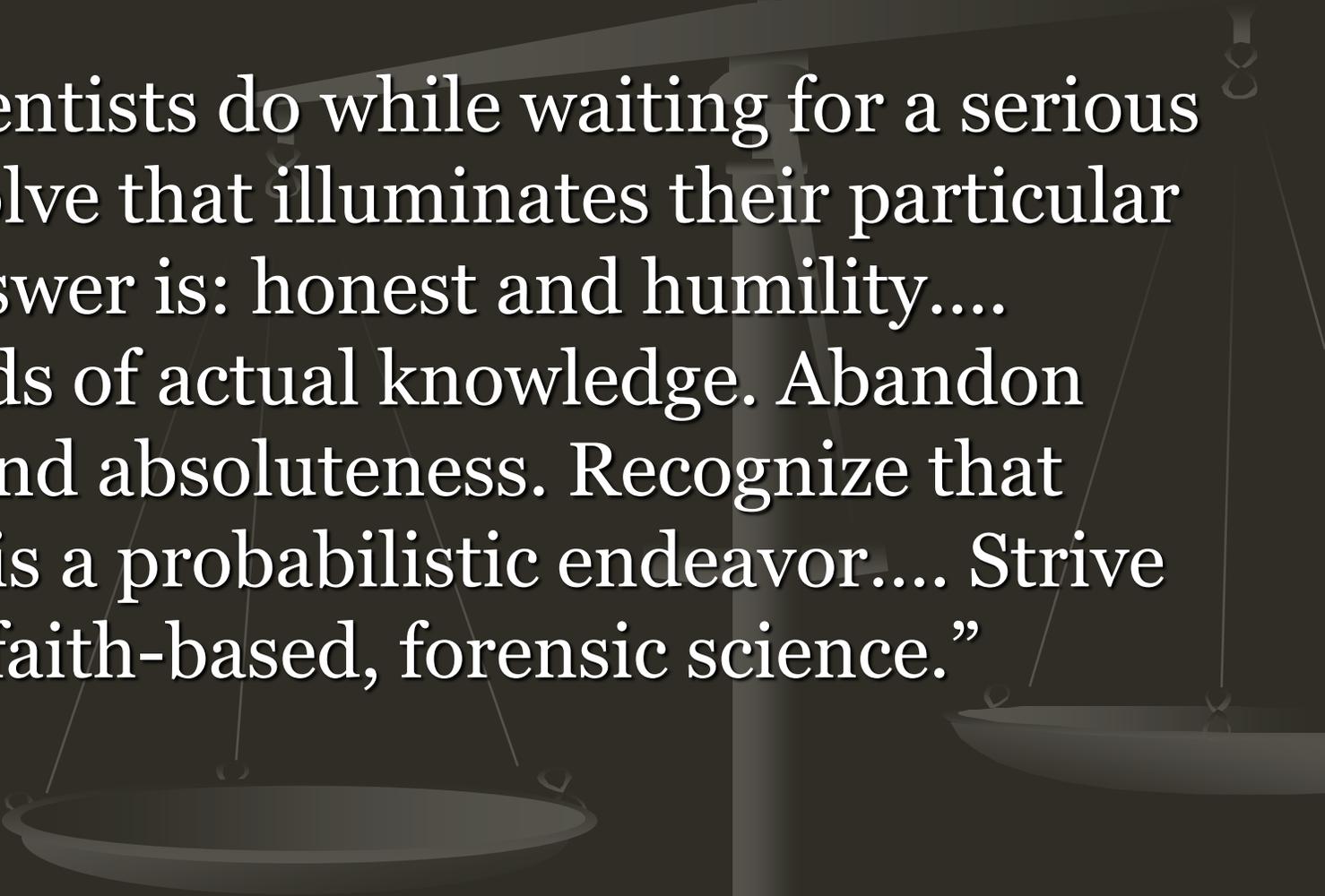
“To consider the future, in the closing years of the twentieth century, is largely to talk about the creeping scientization of factual inquiry. In the wake of stupendous scientific and technological advances made over the past fifty years, new methods of establishing facts have begun to compete with traditional fact-finding... With increasing frequency, then, courts are confronted with complex scientific and technical information... Let there be no mistake. As science continues to change the social world, great transformations of factual inquiry lie ahead for all justice systems.”

Michael J Saks and Jonathan J Koehler, 'The Coming
Paradigm Shift in Forensic Identification Science'
(2005) 309 *Science* 892, 895

“[W]e envision a paradigm shift in the traditional forensic identification sciences in which untested assumptions and semi-informed guesswork are replaced by a sound scientific foundation and justifiable protocols. Although obstacles exist both inside and outside forensic science, the time is ripe for the traditional forensic sciences to replace antiquated assumptions of uniqueness and perfection with a more defensible empirical and probabilistic foundation.”

Michael J Saks, 'Forensic Identification: From a Faith-Based "Science" to a Scientific Science' (2010) 201 *Forensic Science International* 14, 16

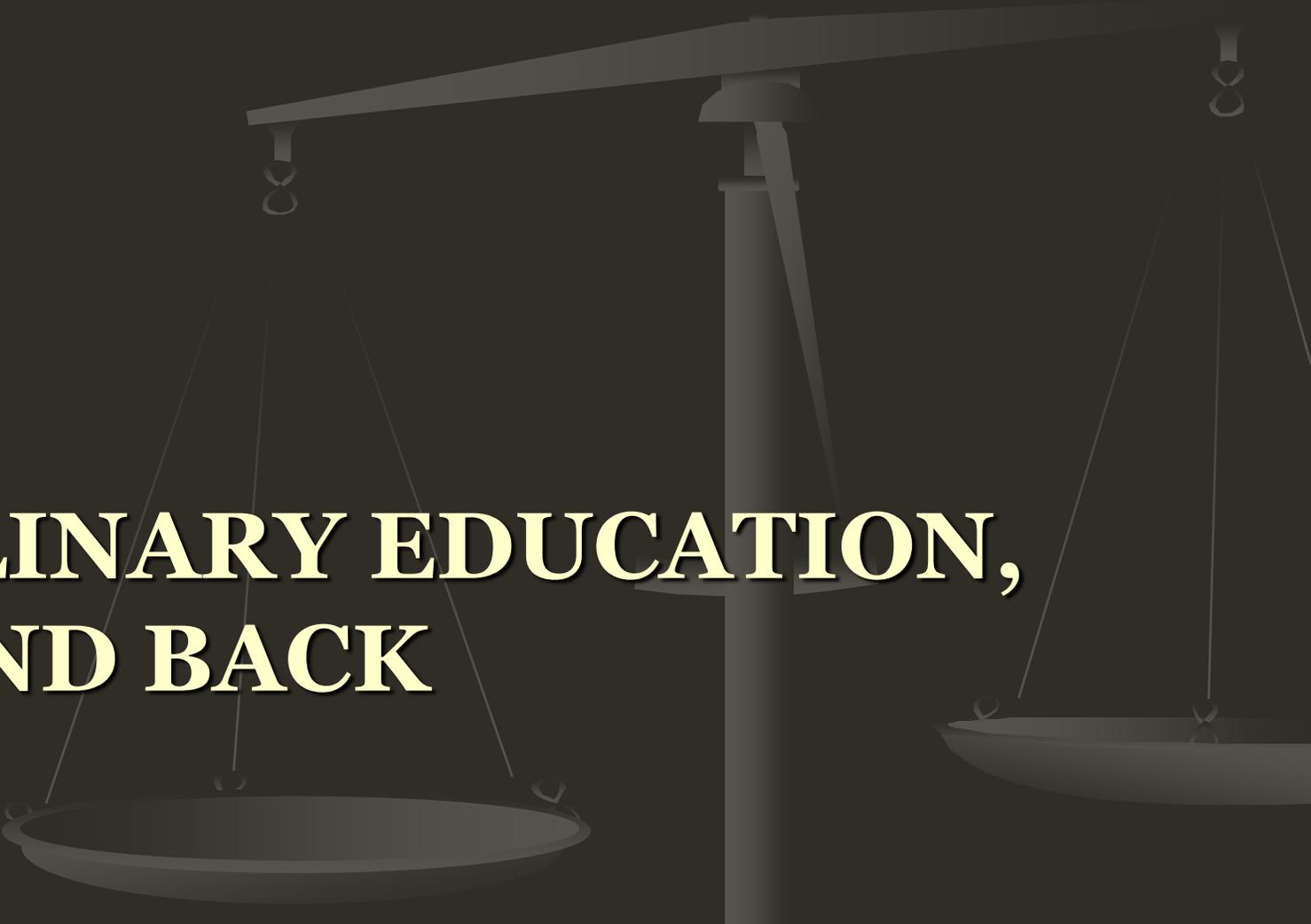
“What can forensic scientists do while waiting for a serious body of research to evolve that illuminates their particular subfield? The short answer is: honest and humility.... Remain with the bounds of actual knowledge. Abandon claims to uniqueness and absoluteness. Recognize that forensic identification is a probabilistic endeavor... Strive for science-based, not faith-based, forensic science.”



Forensic Science Regulator, *Annual Report: November 2014-November 2015* (FRS, 4 December 2015), 27

‘The personal perspective of the Regulator is that the highest priorities for innovation to drive up the quality of forensic science are the provision of data to support the evaluation of evidential significance, combined with robust interpretation methods.’





II. Diagnosis

**INTERDISCIPLINARY EDUCATION,
FORWARDS AND BACK**

David H Kaye, 'Thinking Like A Statistician: The Report of the American Statistical Association Committee on Training in Statistics in Selected Professions' (1984) 34 *Journal of Legal Education* 97, 100

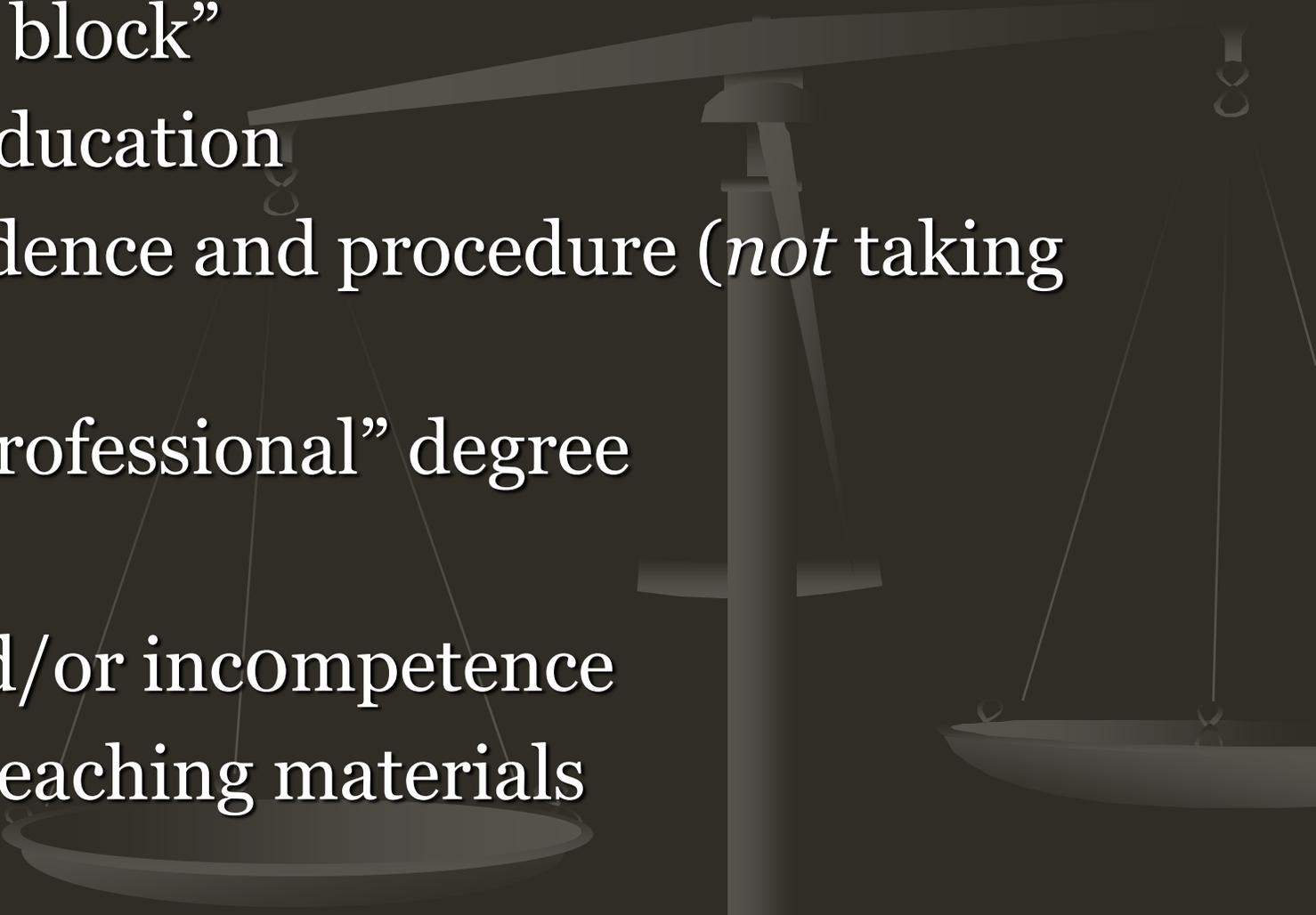
“[I]nstruction for law students in statistical methods or theory appears to be the exception rather than the norm in law schools.... Because attorneys practice law, not statistics, the subcommittee reasoned that it is more important for them to be critical consumers of statistical arguments than to be statisticians in their own right... “[T]he ability to select and utilize expert statistical advice should be cultivated – in clinical or evidence-related courses, if not in an introductory law school course in statistics itself.”

Peter Hawkins and Anne Hawkins, 'Lawyers' Probability Misconceptions and the Implications for Legal Education' (1998) 18 *Legal Studies* 316, 330, 332

“On all of the items [in the authors’ study] the lawyers’ responses were significantly different in statistical from what would be objectively correct... Put more bluntly, their mathematics training had failed to equip the lawyers with the necessary skills and understanding that they needed for making judgments in the face of uncertainty. Clearly, something needs to be done if lawyers are to be effective in this crucial aspect of their professional duties.... Statistical education must be introduced for lawyers.”

Reasons to be not cheerful...

Obstacles to better Education in Maths & Stats

- numerophobia, “math block”
 - doctrinalism in legal education
 - marginalisation of evidence and procedure (*not* taking facts seriously)
 - Law is not merely a “professional” degree
 - curriculum over-load
 - teacher disinterest and/or incompetence
 - absence of accessible teaching materials
- 

Numerophobia

Do you have a fear of numbers?

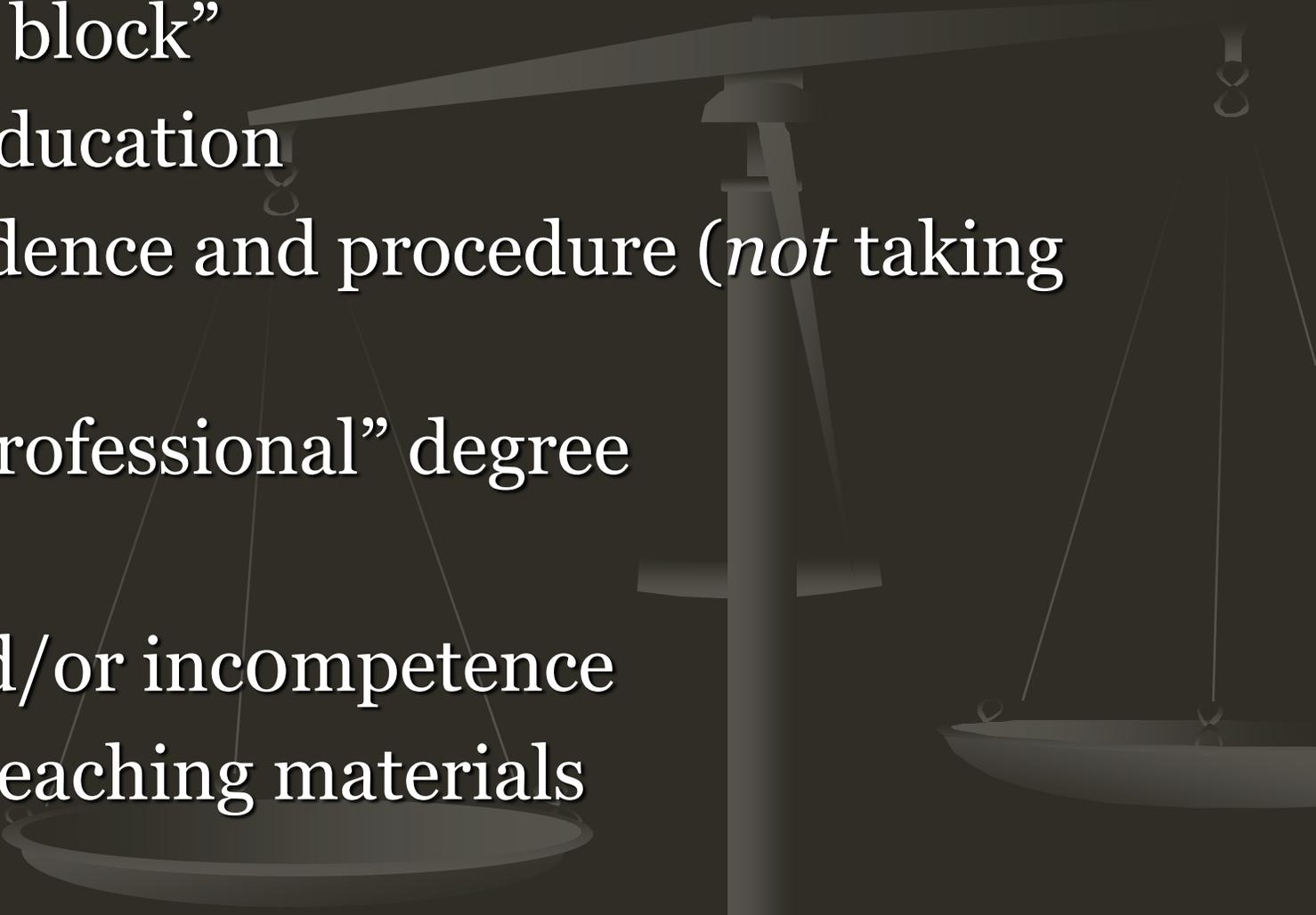


Richard A Posner, 'Philistinism in Law' (1989)
16 *Northern Kentucky Law Review* 415, 423-4

“Many law students claim to have - they even flaunt - a ‘math block’. This is a disgraceful anachronism for persons who will be practicing law well into the twenty-first century. I am greatly distressed when I see students at the University of Chicago Law School blanch at formulas... that require no more than high-school algebra to understand. No one who is admitted to a decent law school today is incapable of mastering the rudiments of mathematical and scientific reasoning. Law students... should be ashamed of fearing math and science.”

Reasons to be not cheerful...

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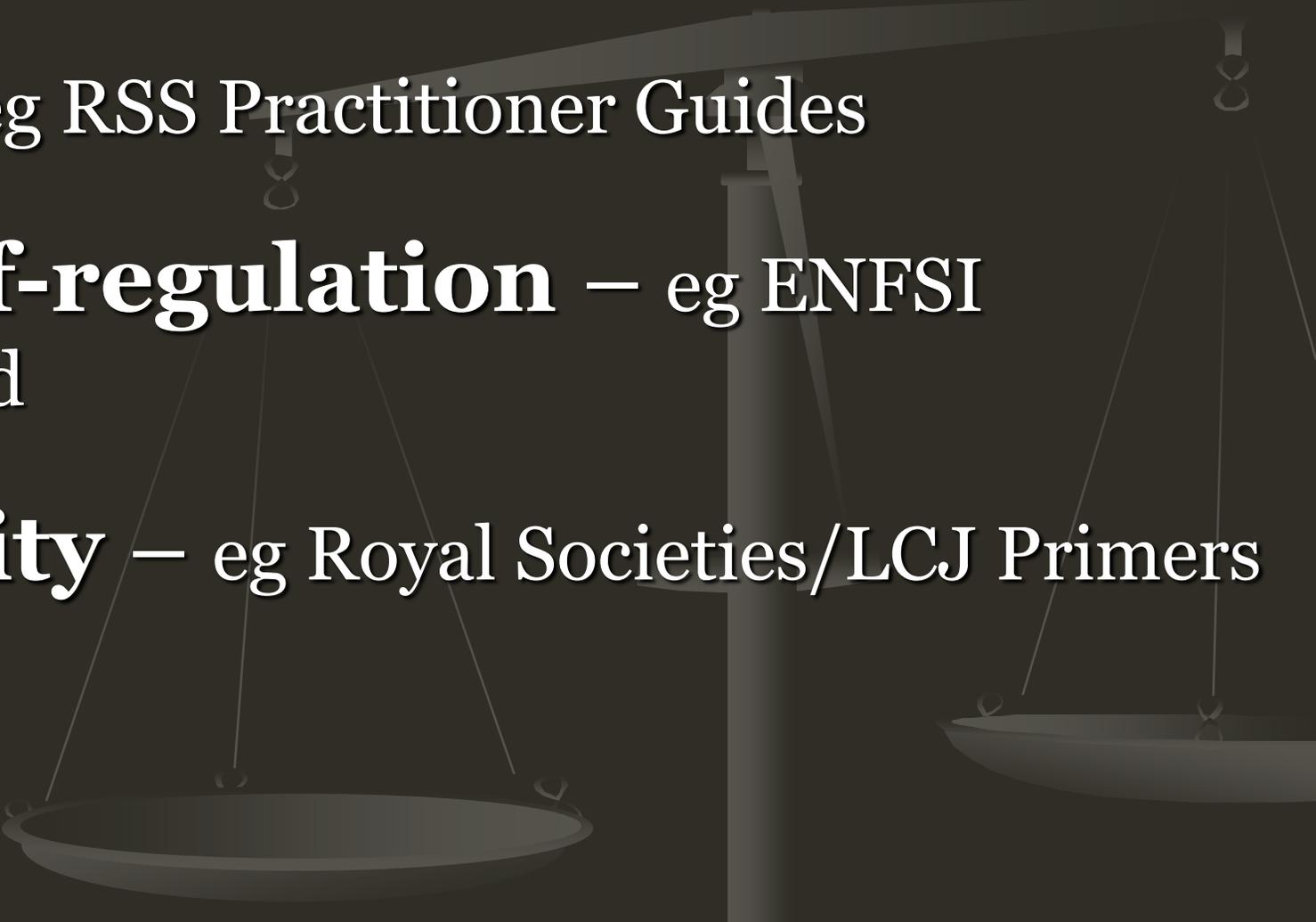
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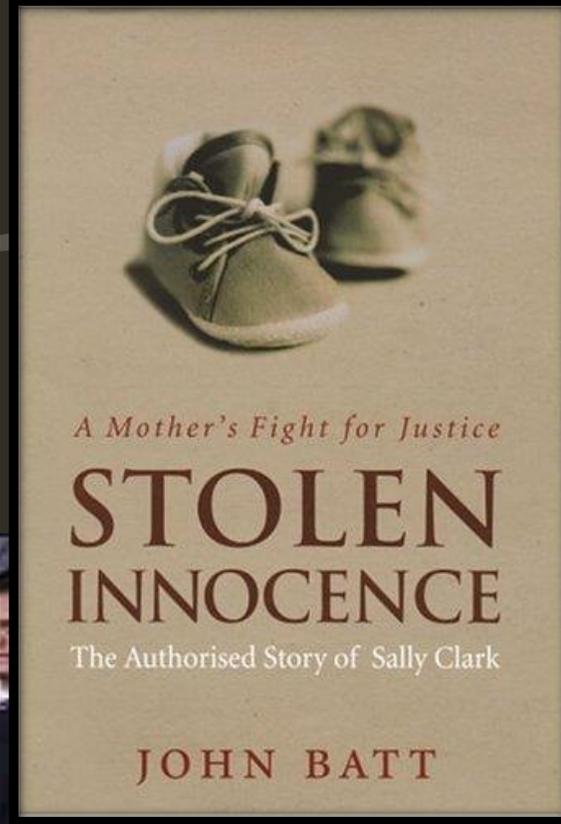
III. Prescription

**PRACTICAL INITIATIVES TO PROMOTE
EDUCATION AND IMPROVE (MUTUAL)
COMPREHENSION**

Three Contrasting (Competing or Complementary?) Models

- 1. Education** – eg RSS Practitioner Guides
 - 2. Scientific self-regulation** – eg ENFSI Reporting Standard
 - 3. Legal authority** – eg Royal Societies/LCJ Primers
- 

The tragic case of *Sally Clark*



Letter from the RSS President to the Lord Chancellor regarding the use of statistical evidence in court cases, 23 January 2002

Dear Lord Chancellor,

I am writing to you on behalf of the Royal Statistical Society to express the Society's concern about some aspects of the presentation of statistical evidence in criminal trials.

You will be aware of the considerable public attention aroused by the recent conviction, confirmed on appeal, of Sally Clark for the murder of her two infants.... The case of *R v. Sally Clark* is one example of a medical expert witness making a serious statistical error. Although the Court of Appeal judgment implied a view that the error was unlikely to have had a profound effect on the outcome of the case, it would be better that the error had not occurred at all. Although many scientists have some familiarity with statistical methods, statistics remains a specialised area. The Society urges you to take steps to ensure that statistical evidence is presented only by appropriately qualified statistical experts, as would be the case for any other form of expert evidence.

R v Clark, CA Trans 1999/07495/Y3

2 October 2000, [139], [144], [167]

“[I]t is common ground, we believe, that the statistical justification for squaring exists only where the risk of a single SIDS death in a family that has already had a SIDS death is the same as the chance of a single SIDS death in a family that has not previously suffered one. The existence of arguments against squaring was known to the jury at the trial.... Professor Meadow’s opinion was based on his expert assessment of the medical and circumstantial evidence, *not* on the statistical material. Most of his examination in chief was concerned with the medical issues.... The context is a substantial trial properly concentrating on the medical issues and the circumstantial evidence, including the parents’ evidence and their credibility. The contrary argument seeks to put the passage [in the judge’s summing up] into context. **The trial was not about statistics.** The summing-up was detailed (170 pages approximately), careful and fair. Only two or three pages, in scattered passages, dealt with statistics.”

***R v Clark (No 2)* [2003] EWCA 1020, [178], [180]**

“The figure of 1 in 73 million was disputed by Professor Berry in his evidence who pointed to the obvious dangers of simply multiplying the risk of one such recurrence by the same figure to obtain the chance of two such deaths. Quite what impact all this evidence will have had on the jury will never be known but we rather suspect that with the graphic reference by Professor Meadow to the chances of backing long odds winners of the Grand National year after year it may have had a major effect on their thinking notwithstanding the efforts of the trial judge to down play it... Thus it seems likely that if this matter had been fully argued before us we would, in all probability, have considered that the statistical evidence provided a quite distinct basis upon which the appeal had to be allowed.”

Royal Statistical Society/Nuffield Practitioner Guides #1-#4

Communicating and Interpreting Statistical Evidence
in the Administration of Criminal Justice

1. Fundamentals of Probability and Statistical Evidence in Criminal Proceedings

Guidance for Judges, Lawyers, Forensic Scientists and Expert Witnesses

Colin Aitken, Paul Roberts, Graham Jackson

ROYAL
STATISTICAL
SOCIETY

Communicating and Interpreting Statistical Evidence
in the Administration of Criminal Justice

2. Assessing the probative value of DNA evidence

Guidance for Judges, Lawyers, Forensic Scientists and Expert Witnesses

Roberto Puch-Soll
Paul Roberts
Susan Pop
Colin Aitken

ROYAL
STATISTICAL
SOCIETY

Communicating and Interpreting Statistical Evidence
in the Administration of Criminal Justice

3. The Logic of Forensic Proof: Inferential Reasoning in Criminal Evidence and Forensic Science

Guidance for Judges, Lawyers, Forensic Scientists and Expert Witnesses

Paul Roberts and Colin Aitken

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STATISTICAL
SOCIETY
DATA | EVIDENCE | DECISIONS

Communicating and Interpreting Statistical Evidence
in the Administration of Criminal Justice

4. Case Assessment and Interpretation of Expert Evidence

Guidance for Judges, Lawyers, Forensic Scientists and Expert Witnesses

Graham Jackson, Colin Aitken and Paul Roberts

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<http://www.rss.org.uk/statsandlaw>

Influencing Change

- + Data manifesto
- + Education
- + Statistical literacy
- + Official and national statistics
- + Higher education
- + Data for democracy
- Stats and the law
 - Practitioner guides**
 - Statistics and Law Section
- International development
- + Parliament Counts campaign
- Our research

Home » [Influencing Change](#) » [Statistics and the law](#) » Practitioner guides

Practitioner guides

The guides look at communicating and interpreting statistical evidence in the administration of criminal justice. They are intended to assist judges, lawyers, forensic scientists and other expert witnesses in coping with the demands of modern criminal litigation.

The four practitioner guides are:

- Guide 1 – [‘Fundamentals of probability and statistical evidence in criminal proceedings’](#) (PDF), November 2010
- Guide 2 – [‘Assessing the probative value of DNA evidence’](#) (PDF), March 2012
- Guide 3 – [‘The logic of forensic proof: inferential reasoning in criminal evidence and forensic science’](#) (PDF), May 2014
- Guide 4 – [‘Case assessment and interpretation of expert evidence’](#) (PDF), January 2015

Responsibility for the content of the guides rests with the authors, a multidisciplinary team comprising a statistician (Colin Aitken), an academic lawyer (Paul Roberts), and two forensic scientists (Graham Jackson and Roberto Puch-Solis). Their colleagues on our Statistics and the Law Working Group, other advisers and commentators should not be assumed to endorse all, or any particular part, of the text.

The guides are endorsed by the Royal Statistical Society and were produced in association with us. This work was supported financially by the Nuffield Foundation.



ENFSI GUIDELINE FOR EVALUATIVE REPORTING IN FORENSIC SCIENCE

Strengthening the Evaluation of Forensic Results across Europe (STEOFRAE)

European Network of
Forensic Science Institutes



“The reporting of the value of scientific findings shall conform to four requirements: Balance, Logic, Robustness and Transparency. These requirements are met by following the principles of forensic evaluation. The framework set out in this document describes the mechanism by which these requirements are met in formulating evaluative reports... The conclusion shall be expressed either by a value of the likelihood ratio and/or using a verbal scale related to the value of the likelihood ratio. The verbal equivalents shall express a degree of support for one of the propositions relative to the alternative. The choice of the reported verbal equivalent is based on the likelihood ratio and not the reverse.”

STEP ADVANCED CERTIFICATE IN UK TAX FOR INTERNATIONAL CLIENTS

Covers the extensive changes introduced by the 2008 and 2013 Finance Acts

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Boffins offer primers for courtroom science

12 April 2016 | By Monidipa Fouzder

Topics: Courts business

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Easy-to-understand guides on scientific evidence could be introduced in courts as part of joint efforts to explore common interests between lawyers and scientists.

The lord chief justice, Royal Society and Royal Society of Edinburgh have announced a joint project to develop a series of 'primers' on scientific topics, designed to assist judges, legal teams and juries when handling scientific evidence.

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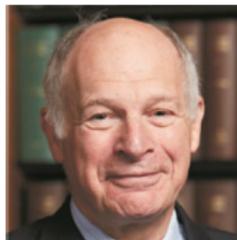
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WORLD VIEW

A personal take on events

SUPREME COURT



Stop needless dispute of science in the courts

Primers on various scientific topics could be used across trials to avoid wasting time on debating basic points, argues David Neuberger.

Testimony from expert witnesses — and I have heard a lot in my career as a judge — is a long-standing and important feature of legal proceedings. The scientists, engineers, inventors and technologists who offer their opinions in court are encouraged to agree on basic points before a trial begins. But they often do not agree as much as we hope. That tends to lengthen the time taken to cross-examine them, and contributes to justice being an expensive, drawn-out and stressful experience for all involved.

Better would be for courts to have a set of scientifically agreed principles that lay out the consensus opinion on some topics, and where there is reasonable doubt on others. Judges typically get such a primer when trying a patent dispute. Both sides allow their expert witnesses jointly to present points on which they agree, and which will not be disputed. This effectively sets a baseline for the ensuing arguments, which can still diverge significantly. These primers are useful, but only for specific cases. When the case they were prepared for is settled, the primer normally becomes redundant.

It's not realistic for primers to be prepared individually for every case, but perhaps they could be created for topics that recur — and that are argued about each time. Scientific issues arise in a substantial number of cases, certainly enough to justify a primer that could be applied to many of them. These could be broken down into four themes. For example, forensic-science primers could detail how crime-scene samples can be matched to DNA profiles and how mixed profiles can be disentangled. Pure-science primers could explain how computer memories can be accessed and interpreted, and good-practice primers could lay out appropriate medical treatments and techniques. Scientific-method

that formal cross-examination risks the court favouring a more-fluent witness or a cleverer cross-examiner rather than the best evidence. One possibility, already being adopted as an alternative to cross-examination in some civil litigation, involves so-called concurrent evidence (or 'hot-tubbing' as it is colloquially known), in which the experts and lawyers sit around a table and discuss the issues at a relatively informal, if structured, meeting that is chaired and led by the judge. The scientific primers that I have suggested build on this approach.

How could they be prepared? It would require identifying areas of expertise in which a primer would be helpful and feasible, and then getting a group of acknowledged experts to formulate the guidance in that area. It would also, I think, be necessary for the group to monitor the primer, to take into account both how it is working and what advances are being made in the area.

This would involve the legal and scientific communities working closely together, which is already starting to happen. As part of broader discussions, I and other senior judges are talking to scientists and officials at the Royal Societies of London and Edinburgh on how they could help us to prepare primers. We hope to announce some progress soon.

The law has much to learn from science, in terms of both scientific thinking and discoveries and inventions. Scientific thinking is inevitably different from legal thinking — the idea of what constitutes proof and the role of common sense are two examples of divergence. But, given the importance of experience, logic and humanity in both spheres, legal and scientific thought have much in common as well.

As for scientific advances, they interrelate with law both specifically (patents, for example) and generally (DNA evidence). And as scientific

**PRIMERS WOULD
SAVE MONEY
AND TIME
BECAUSE THE ISSUES
THEY DETAIL WOULD
NOT REALISTICALLY
BE OPEN TO
CHALLENGE.**



IV. Conclusions

**SWEETENING THE PILL (WITHOUT KILLING
THE PATIENT)**

A Modest Prescription

- Education is a two-way street; beating lawyers with the statistics stick is misguided and counterproductive
- Interdisciplinary collaboration is essential (but interdisciplinarity is hard work)
- Don't underestimate pragmatic institutional obstacles and challenges
- Details matter! (eg in styles of education and regulation)
- Be prepared for the long-haul: there are signs of genuine progress, but changing cultures is the work of lifetimes...



Thank-you for listening!

Any questions?