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Susan S. Silbey

Law and Science

Volume I

Epistemological, Evidentiary and Relational
Engagements

Edited by

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ASHGATE

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Series Preface

The International Library of Essays in Law and Society is designed to provide a broad overview of this important field of interdisciplinary inquiry. Titles in the series will provide access to the best existing scholarship on a wide variety of subjects integral to the understanding of how legal institutions work in and through social arrangements. They collect and synthesize research published in the leading journals of the law and society field. Taken together, these volumes show the richness and complexity of inquiry into law's social life.

Each volume is edited by a recognized expert who has selected a range of scholarship designed to illustrate the most important questions, theoretical approaches, and methods in her/his area of expertise. Each has written an introductory essay which both outlines those questions, approaches, and methods and provides a distinctive analysis of the scholarship presented in the book. Each was asked to identify approximately 20 pieces of work for inclusion in their volume. This has necessitated hard choices since law and society inquiry is vibrant and flourishing.

The International Library of Essays in Law and Society brings together scholars representing different disciplinary traditions and working in different cultural contexts. Since law and society is itself an international field of inquiry it is appropriate that the editors of the volumes in this series come from many different nations and academic contexts. The work of the editors both charts a tradition and opens up new questions. It is my hope that this work will provide a valuable resource for longtime practitioners of law and society scholarship and newcomers to the field.

AUSTIN SARAT

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Introduction

This volume focuses on the relationships between science and law, primarily – but not exclusively – in American society and Western cultures. Along with modern law, modern science shares its roots in the Enlightenment and its ascendance to institutional dominance in the twentieth century. The ascendance of both modern law and science has been achieved in competition against traditional institutions, especially religious interpretations of nature and human relations; their cultural dominion signifies a radical transformation in the sources of human agency and authority. Both law and science are deeply and noticeably marked by formal rationality – that is, systematic ordering through general rules and logical derivations that Max Weber identified as the central characteristics of modern consciousness. Importantly, although law and science have achieved unprecedented hegemony, both claim to recognize and rely for their legitimacy on limits to their own fields of action. In science, the limits are co-extensive with the scientific method of inquiry; in law, the limits reside in procedural technicalities. In both cases, these methodological limits distinguish law and science from faith or metaphysical speculation, nonetheless promising supportable, if not absolutely right, answers to an ever-expanding array of continually perplexing questions.

Modern legality and modern science reconfigure both agency and authority through their commitments to what we might characterize as profound forms of community participation. Both law and science derive their normative and epistemological legitimacy from public processes, particularly processes of rational inquiry. Whether the source of positive law is a democratic or autocratic sovereign, the rule of law derives its authority from the specification of binding rules of evidence and decision, thus constraining how even autocratic governments enact their policies. Beyond procedural technicalities, fundamental legal rights and the acquiescence of the governed can be analogized to the consensus formed among scientists through replicable and revisable procedures assessed through peer review.

This should not be taken to suggest homogeneous consensus concerning scientific facts or theories. In contrast to some popular, idealized accounts, science is not a bounded, value-free, amoral, autonomous enterprise engaged in a self-regulated search for timeless, universal, irrefutable truths. Science is the same as all other human activities: a socially constructed phenomenon – the product of collectively organized human labour and decision-making that involves contest, dispute and struggle. Scientific facts are produced under constraints that vary historically and culturally; thus scientific inquiry is both enabled and constrained by what is already known, by technological capacity and the available material resources, as well as the human capacity for work, imagination, collaboration and communication. Those constraints shape both the content of the science and the process of producing that content. Scientific facts have variable status. Some claims have proved durable and sustainable over long periods of time, generating additionally durable and sustainable observations, and explanations have developed thus constituting what we might think of as a core of scientific knowledge; other scientific facts exist in the making, and are actively challenged. Nonetheless, the process is collective and open to those who pursue the training to speak the languages of

scientific discourse. No ascribed characteristics prevent such membership. For example, see Kuhn (1962); Feyerabend ([1975]1999); and several collections of contemporary science/technology studies such as Jasanoff, Markle, Petersen and Pinch (1995); Biagioli (1999); Restivo (2005).

In both institutions, the decision-making and evidentiary processes seek to restrain human agency by relying on collective cognitive processes. Decisions in law or science can never be the product of one mind nor be beyond human observation and still legitimately claim to be law or science. Finally, at their core, modern law and science constitute themselves not only as public, accessible and collective processes, but just as importantly profess to be morally preferable alternatives that suppress the use of unregulated force in human life. Through their collective cognitive processes, both seek to undermine the use of force through reason or words.

Yet, despite their purportedly open and available procedures, both science and legality are experienced in popular culture as arcane, impenetrable and often uninterpretable. Removed from the general public as a domain of experts, modern scientific practices challenge the universalism and communism that Merton ([1942]1957) named as 'institutional imperative[s] of science' (cf. Barnes and Dolby, 1970). Legal procedures, despite their widespread representations in popular media and entertainment, often misrepresent legal processes and disillusion even well-educated, intelligent citizens who become easily disabled among legal technicalities. Neither law nor science achieves the transparency to which it aspires.

Of course, law is much older than science – at least modern science as we commonly recognize it. The law is an ancient institution for the collective consideration of matters of concern. In many ways, the law is more like its nearly 6000-year-old self, more similar in function and processes to Hammurabi's code than, for example, the modern nuclear family, the market economy or the nation-state to their historic counterparts. For these 6000 or more years, the law has been attempting to resolve whatever family or economic disputes and controversies have been voluntarily or coercively brought to it, transforming diverse matters of concern into the objects and expectations of daily life. However, the law is a powerful and durable institution not merely because it is long-lived, but also because it has been a common feature of everyday life, if only in the last several hundred years achieving widespread hegemony.

Although science can also trace its lineage for thousands of years, it has become recognizable as science, rather than a matter of everyday life, only in the last several centuries. It would be a mistake, however, to suggest, as earlier generations of historians of science have, that there was a distinctly pre-scientific age pre-dating a revolutionary seventeenth-century transformation into the age of science (Bensuade-Vincent and Stengers, 1996). Although we cannot find, for example, a well-defined territory or field that was chemistry in early history as we can find the family, the economy and the law, we can find traces of practices concerning transformations of matter in diverse materials, such as dyeing cloth, fermenting wine, organizing pharmacopoeias, as well as theorizing about atoms among the ancients. Thus, '[I]f we accept ... today's definition of chemistry as the science of the transformations of matter, ... all the alchemists, perfumers, metallurgists, philosophers, and dye makers who devoted their lives to transformations of one kind or another must be included in the "prehistory" of the discipline' (Bensuade-Vincent and Stengers, 1996, p. 4). With this conception of science,

we might then analogize these early chemists developing dyes from geological and botanical materials to Mesopotamian ‘lawyers’ working with Hammurabi’s code.

Although legal and scientific institutions have these much older, premodern and distinctive roots, contemporary law and science rely primarily on modern sources that draw from common seventeenth-century ground. In *The Gift of Science* (2005), Roger Berkowitz suggests that the tradition of modern law has its roots in Leibniz’s legal writings where positive law emerges as a special kind of science – a science that insists, because moral knowledge is impossible, on a distinction between empirical facts and value preferences. However, Leibniz’s effort to create a legal calculus that would permit resolution of moral quandaries through a series of mathematical calculations was not popularly adopted. Jurists following in his stead eschewed any necessary connection between law and morality as he suggested, but substituted, in place of both transcendent justice and the mathematical calculus, a simple notion of factual, positive law – law as sovereign will. Despite this positivist rejection of a distinctly moral foundation for legal reasoning, power seems, nonetheless, to demand justification. Thus, Berkowitz argues, efforts to legitimate law as constrained sovereign rule turned to procedural and methodological mechanisms concerning the fair and equitable application of rules – what he calls a scientific legal system – for its legitimacy. Procedure and technique replace justice and calculus as the grounds of modern law.

While modern positive law is born, in Berkowitz’s account, of the attempt to fit law to science, science is by no means a steady or dominant motif in modern legal institutions or scholarship. Although questions of scientific evidence and expertise became a recurring irritant for trial and appeals judges during the last decades of the twentieth century, it has been a topic of scholarly interest to only a small, although slowly growing, community of researchers, and remains relatively underexplored. This volume, *Law and Science I: Epistemological, Evidentiary and Relational Engagements*, and its companion volume, *Law and Science II: Regulation of Property, Practices and Products*, bring together some of the best examples of this emergent field of scholarship in the hope of expanding access to this increasingly important field of social action and study.

Epistemological Engagements

Part I of this volume explores the relationships – similarities and differences, alliances and juxtapositions – between law and science from three disciplinary perspectives: history, philosophy and sociology. Howard Schweber, in his essay ‘Law and the Natural Sciences in Nineteenth-Century American Universities’ (Chapter 1) sets the stage by reporting how legal educators of the early republic drew on the authority of science to legitimate their nascent enterprise. They claimed, Schweber writes, that the study of law was similar to the study of natural sciences. In antebellum America, however, the conception of natural science, as expressed in intellectual and popular discourses of the time, was rife with the same religious commitments and normative constructions of nature that grounded *laissez-faire* conceptions of state and economy. Rather than the positive legal science that Leibniz had struggled to create, American legal science and religion more than a century later expressed a commitment to what Schweber calls ‘Protestant Baconianism’ (p. 4). Although this ideology shared with traditional Baconian and European notions allegiance to empirical induction, it was practised in a more constrained fashion, limited by its avoidance of what was regarded as ‘the extremes

of reason' that fed many European scientific advances. In other words, observational induction was constrained by a refusal to hypothesize, theorize or 'derive axiomatic principles from logical reasoning'. The hallmark of this limited inductivism was 'the survey of forms and their compilation into catalogues' (p. 8) that necessarily demonstrated the principles of a Christian view of life. In a particularly American version of natural law theory, God's plan for human life was discoverable by extensive observation and careful comparison. Legal science, like natural science, was also embarked on this enterprise, a second feature of which was a belief that every field of study informed every other, and could eventually be brought, through analogic reasoning, into a grand synthesis. Whether in law or science, scholars were committed to the goal of human social improvement, legitimating each enterprise as an essential necessary tool for 'industry, refinement, liberty [and] civilization' (Field, 1859, quoted on p. 13), understood as the Christian enterprise. The entire ideological apparatus was grounded in a conception of what was understood as natural theology, the idea that Supreme Intelligence, God, was manifest in material reality, not unlike the contemporary ideology of 'intelligent design'.¹ In science and law, Protestant Christian teaching was the foundation of professional training, scholars believing that religion, law and the study of nature were bound together as one entwined enterprise. By the twentieth century, religion, law and science became more markedly adversarial, the legitimacy and material products of science becoming the subject of, and sometimes the justification for, legal action while simultaneously and systematically eroding the traditional authority of religion. It would be erroneous to say that religion or magic, as Weber claimed, has been entirely eliminated from human life but it has, despite repeated, lively engagement, certainly lost is automatic deference or hegemony.

Hanina and Yemima Ben-Menahem, in 'Law and Science – Reflections' (Chapter 2) consider the similar philosophical dilemmas concerning determinacy in both law and science. Despite aspirations to constrain human agency, arbitrary human action, and unregulated force (Bobbio, 1965), both the judge and the scientist seem to enjoy enormous decisional freedom. The Ben-Menahems' essay explores the issue of determinacy in law and science as a problem of defensible legitimacy because, they claim, '[b]oth the judge and the scientist are called upon to justify their verdicts' (p. 25). This justification 'involves deductive and inductive reasoning – drawing consequences from general laws and applying them to particular cases, as well as projecting from one case, or set of cases, to another' (p. 25). Scientists and jurists disguise the uncertainty of their procedures with a language of determinacy, claiming that the facts or evidence compels conclusions; rather than the judge or the scientist imposing her will on the world, the evidence or data, it is claimed, speaks for itself. The essay analyses the provocative parallel lines of development in scientific and legal philosophies that attempt to manage the decisional indeterminacy. Both fields show a similar continuum of positions with respect to the indeterminacy of decisions. Among legal theories we can observe a continuum of jurisprudential positions ranging from assertions of complete decisional determinacy expressed in legal or scientific positivism through moderating positions that describe limits on decisional freedom in a closed core of settled, determinant rules and a penumbra of unsettled law (see, for example Hart, [1961]1994; Dworkin, 1977, 1986), to realist positions that emphasize the interpretive and historical basis for judicial integrity as the grounds for disciplining decisional indeterminacy. In science, the epistemological debates also range

¹ See http://en.wikipedia.org/wiki/Intelligent_design.

along a continuum, where those who acknowledge indeterminacy and moderate determinacy focus on refutation rather than confirmation (which they claim is impossible) as the heart of scientific method, while positions analogous to the legal realists look to the instrumentalism and technological capacities of science or extreme scepticism. Rather than emphasize the distinctions between the fields – for example, law as normative, science as descriptive, law as human action, science as exploration of nature – the Ben-Menahems emphasize the connected problems of legitimacy and authority that derive from both science's and law's incomplete determinacy and the interestingly similar philosophical paradigms that have developed to simultaneously describe and justify their dominant authority in contemporary societies. The authors offer a provocative hypothetical problem to ground a pragmatic understanding of judicial authority that also applies to science. They conclude that the rule of law is a rule of men [*sic*], not law, and by implication science is a social construction, because it is the processes of justification, rather than simply securing the right answer, that matter to us. We look to, and assess, the quality of judging, and the quality of science, by the form of and integrity of its evidentiary and argumentative integrity. In other words, right answers are determined by the processes of justification.

If Schweber observes the historic origins of the shared authority of legal and scientific scholarship in nineteenth-century America, and the Ben-Menahems explore the problem of indeterminacy in both law and science, Bruno Latour, in his essay 'Scientific Objects and Legal Objectivity' (Chapter 3), gives us a closely observed account of a particular legal institution, the French Conseil d'Etat, and the ways in which it performs its authority in comparison to the ways in which modern scientists perform their authority. He does so, he says, not as a matter of establishing confederated epistemological relationships between science and law, as the previous two essays suggest, but as an effort to juxtapose two kinds of laboratories – places of work and reason. Rather than focus, as the first two essays do, on what lawyers and scientists say – discourses that are core components of these institutions – Latour relies on ethnographic inquiry that pays close attention to 'places, forms of life, conditions of speech, and to all those minor details which together, little by little, by minor brushstrokes' constitute the object of study (p. 44). Here, in Latour's essay, those objects of inquiry are scientific objects and legal objectivity, the essay's title. In both cases, Latour maintains, in concord with both Schweber and the Ben-Menahems, 'facts, contrary to the old adage, obviously do not "speak for themselves"' (p. 52). How they are made to speak differs, however, in the Conseil d'Etat and in the laboratory. Ironically, while the laboratory creates facts about matter, and the court about lives, the scientists appear more passionate, varied in their methods and materials, and assertive and deferential to the claims that have already been lodged. They wait for history to judge them. The *conseillers* tend to work individually – one is unlikely to see a group hovering over a specimen as one does in laboratories. Their materials are relatively uniform – paper files, more paper files and yet more paper files, organized in tiers horizontally and vertically in the Ariane database. For scientists, history and the next experiment will confirm or refute the aggressively argued claims of the scientific text whereas the measured voices of the court's decision will have an immediate effect – the claimant's life will change materially, emotionally and sometimes biologically. Latour's essay expends most of its energy delineating the ways in which the court produces its authority through a performance of detachment markedly at odds with the passionate engagement of the scientists. Thus, whilst the facts require an authoritative voice, the scientists perform grand opera while

the court arranges the sheets of music. For the public performance, the scientists borrow the procedures that lawyers invent in order to produce 'their fragile ethos of disinterest' (p. 76). The lawyers, he concludes, lack objects for their interest and sustain 'the production of a mental state', object-less disinterest, justifying their capacity for judgement by 'appealing to incontrovertible facts' (p. 77). Ironically, that which is about transient, sometimes ephemeral, human action and emotion – the law – exudes 'a homeostatic quality which is produced by the obligation to keep the fragile tissue of rules and texts intact' while that which is about objects and things – science – engages 'with turbulent or violent history of innovation and controversy, a history that is continually being renewed' (p. 83).

Science in Court

In the small, but growing contemporary literature describing the ways in which science intersects with law, the largest portion of the research often adopts what scholars sometimes call a 'law-first' perspective (Sarat and Kearns, 1993), examining the role of science when it enters formal legal arenas and settings. This law-first approach often assumes the institutional autonomy of law, focusing on scientific questions and processes as problems which the law needs to manage or resolve as objects in the world, or as threats to the integrity of legal processes. This law-first perspective regularly conceals, because it rarely questions, the ways in which legality itself is formed by these engagements, constituted in legal settings as well as in situations external to formal legal institutions. It also overlooks the ways in which legality penetrates and constitutes extra-legal settings, such as neighbourhoods, factories, schools and laboratories, so that its expressions and shape are not confined entirely within the formal institutional arenas. In this familiar approach, law and science constitute two separate, separable, bounded institutions that periodically lock horns rather than fields of engagement in which scientific and legal methods, knowledge and expertise are co-produced. Without assuming the autonomy of law, or of science, Part II nonetheless begins from a law-first orientation, exploring the evidentiary problems that science poses for trial and appeals courts.

Looking at science as an independent variable perturbing legal processes, research tends to focus on the technical assistance that science offers for establishing social and physical facts (see, for example, Faigman, Kaye, Saks and Sanders, 1997; Faigman, 1999; Jasanoff, 1990, 1995; Goldberg, 1994; Lempert, 1988; Lempert and Sanders, 1986; Monahan and Walker, 1994; Saks and Baron, 1980). In this endeavour, science is distinctly secondary to legal norms and methods – a tool in service of legal decision-making. In one of their canonical statements concerning this engagement, Laurens Walker and John Monahan, 'Social Frameworks: A New Use of Social Science in Law' (Chapter 4), summarize the traditional uses of social science and propose a new category of scientific knowledge as resources for those who try the facts. In a 1942 paper and subsequently in his administrative law texts, Kenneth Culp Davis (1942, 1972) distinguished between adjudicative and legislative facts.² Social science is useful, Davis argued, in determining whether an existing rule of law should be altered on the basis of accumulated social science research on how that rule has been working in

² 'The cardinal distinction which more than any other governs the use of extra-record facts by courts and agencies is the distinction between legislative and adjudicative facts' (Davis, 1972, p. 296).

practice – that is, on its consequences. Social science research might also be helpful, he continued, in determining facts at the heart of a legal dispute, such as whether consumers recognize an unlicensed copy of a trademarked product as a copy or mistake it for the original. Survey data can provide evidence about consumer response to the two products. Walker and Monahan, however, suggest a third use for social science data in court, namely, that social science research can, and is, used to provide expert information concerning forms of evidence presented at trial – for example, on the reliability of eye-witness testimony, predictions of dangerousness, or the probability of recidivism for a particular type of offence. Social science provides context, Walker and Monahan argue, for the jury's or judge's interpretation and assessment of related testimony. Using social science to establish social framework is similar to establishing a legislative fact in that both rely on claims of generality. The research bears on 'issues at trial only as those issues [are] particular instances of larger empirical relationships that [have] been uncovered' (p. 97). However, using social science research to establish social framework also bears similarities to the use of science to establish adjudicative facts because they are 'introduced solely to help resolve factual issues disputed by the immediate parties to the case, issues whose resolution had no substantive significance beyond the case at hand' (p. 98). Because establishing social framework is neither exactly like establishing a legislative or adjudicative fact, Walker and Monahan suggest that changes in procedure are necessary to distinguish this use and to properly assess the empirical and legal merits of the research.

In general, however, the legal process is less, or not all, interested in the scientific methods, but only at the conclusions, and continues to have difficulty dealing with the epistemology and dialogic nature of scientific inquiry. Jessica Riskin, in her essay 'The Lawyer and the Lightning Rod' (Chapter 5), recounts the history of a French trial in 1783 during which a young defence lawyer seeking to making a name for himself, Maximilien Robespierre, defends a homeowner, one Charles Dominique de Vissery de Bois-Valé, an elderly lawyer and amateur *physicien* of Arras. Vissery had put on the chimney of his house a lightning rod whose tail trailed down along the wall of his neighbour's house. At issue in the case was the deference that judges should pay to scientific expertise concerning the lightning rod and its tail. Because, as Riskin recounts, '[l]aw and physics in 1780s France shared a common, contradictory dogma [that] general truths are founded in particular facts' and 'because of their irreducible particularity', Robespierre was able to convince the court that it could accept the scientist's testimony concerning the safety of the lightning rod by insisting that the court need not defer to scientific testimony, but need only consult the empirical facts themselves: 'The virtues of the lightning rod were fully proven by "experience" ... A magistrate's duty to the people ... was to consult, not the experts, but the facts' of experience (p. 152). With this argument that exploited the empiricist dogma fashionable at the time, Robespierre sidestepped the challenge to judicial authority and secured for himself an enviable reputation. The argument that Robespierre developed in this case, Riskin notes, he would make with mounting authority 'throughout the tumult of the following decade' (p. 160). Within the decade, that argument would become institutionalized as Robespierre led the Jacobin-dominated National Convention to abolish experts from French officialdom.

When researchers look at how science enters legal disputes and the evidentiary quality of scientific data, they also focus specifically on the role of scientists as expert witnesses – emissaries from the scientific community to the halls of justice. Jones (1994) has described the emergence of the expert witness out of specialist juries and court experts, who were common

in late medieval and early modern British courts. This practice of court-appointed oracles was slowly transformed into the contemporary practice of using scientists as witnesses – expert, but partisan, actors in the adversarial process (Jones, 1994). Tal Golan, in ‘The History of Scientific Expert Testimony in the English Courtroom’ (Chapter 6) constructs a narrative about the introduction of the expert witness as a specific element of the larger transformation of the English legal system that legal historians call the ‘Adversarial Revolution’. This label is associated with the increasing appearance of lawyers in criminal proceedings in the mid-eighteenth century. The new adversarial system not only created the role of the expert witness, but also restrained the court’s control of the witness. When the judge assumed a neutral position as umpire of the proceedings, the lawyers were given increasing degrees of freedom to summon their own witnesses. In these early years, Golan tells us, judges were not particularly concerned with the possible partisanship of the witnesses. By the late eighteenth century, however, ‘the slightest interest in the result of the trial rendered the witnesses unreliable’, and ‘[e]ven the parties to the lawsuit themselves, by the same reasoning, were not allowed to testify’ (p. 174). Golan attributes the continuing practice of calling expert witnesses, despite the concern about interest, to the growing respect and deployment of expertise in general during the century, a phenomenon well recognized in contemporary social histories. With the rapid expansion of industry and science in the nineteenth century, more and more courts sought out the advice of scientists. With this increasing participation of scientists, however, ‘the legal profession learned that the promised scientific ladder to the summit of truth could not always bear the weight of adversarial proceedings’ (p. 176). The problem of conflicting expert testimonies became the vexed concern we observe today.

Contemporary legal procedures and standards, in contrast to revolutionary France and nineteenth-century Britain, regularly include scientific testimony but sometimes push scientists to modes of participation and discourse that stretch, if not clearly violate, norms of scientific integrity. Scientific data are often more probabilistic and less determined than legal decision-makers want for the purpose of establishing legally relevant and irrefutable facts. Issues concerning scientific proof have been central in debates concerning, for example, the reliability and interpretation of evidence from DNA ‘fingerprinting’ (Lynch, Cole, McNally and Jordan, forthcoming), battered women’s syndrome (Faigman, 1986, 1987), insanity pleas, rape trauma (Frazier and Borgida, 1988; Economou, 1991), silicon implants, the death penalty (Sarat, 2001, 2005) and the toxicity of certain chemical wastes. In this volume, essays by Nicole Rafter, Jennifer Mnookin, Simon Cole and Joseph Dumit relate the histories of scientific theories and technologies that have played important roles in the evolving evidentiary conundrums. Each of these techniques has relied, in one form or another, on a process of visualization to establish irrefutable truth. Despite the old chestnut that ‘seeing is believing’, each of these authors deconstructs claims to visual transparency and thus uncontested legal relevance, revealing visual evidence’s status as human artifice rather than ‘natural’ expression.

In ‘Seeing and Believing: Images of Heredity in Biological Theories of Crime’ (Chapter 10) Nicole Rafter suggests that there is a direct lineage from nineteenth-century biological theories of hereditary criminality to contemporary concerns about DNA typing. She argues that, from phrenology and visual representations of skull shape to genealogical trees of degenerate or feeble-minded families, images have been key to what she calls ‘biocriminality’, the effort to locate the sources of deviant behaviour in the biological constitution of the person. The visual displays ambush us, she says, compelling acceptance of a reality that we

cannot otherwise access yet keenly desire to embrace. If early theories of biocriminality were deployed to mobilize more a stringent response to cleanse society of this invading degeneracy, contemporary theories of biocriminality are more often invoked to exonerate the accused. Although alluring and possibly bewitching, the DNA images are unlikely, Rafter suggests, to transform theories of legal culpability because they do not come packed with those older, appealing theories of inheritance, and the complexity of the imagery invites resistance as much as seduction. In 'Objective Brains, Prejudicial Images' (Chapter 13) Joseph Dumit fears that when brain scans constructed through computerized tomography (CT) and positron emission tomography (PET) enter courtrooms and popular culture, they are understood not as mathematically constructed illustrations, but as images of the criminal mind. Because non-experts find them difficult to interpret, he fears that they will not be understood as the stylized representations of statistical correlations that they are, but as straightforward, objective pictures of madness.

Of course, images and photographs were not always – and should not now be – regarded as an objective, straightforward unvarnished record of something that existed in another time or place. All visual evidence is artifice that requires interpretive skill (Silbey, 2004). Jennifer Mnookin, 'The Image of Truth: Photographic Evidence and the Power of Analogy' (Chapter 8) rehearses the legal journey of the photograph as visual evidence and the limitations of judges' analogic reasoning for coping with new technologies. At first, the photograph was plagued by a Janus-like reception, embraced as both an artistic rendering and as a form of machine-made truth – a vehicle for capturing and storing otherwise ephemeral phenomenon. Judges responded to photography by declaring the new technology to be analogous to other forms of representation, such as diagrams, drawing, and maps. As such, the photos were regarded as demonstrative evidence – that is, merely illustrative of testimony and not independent evidence by themselves. By seeming to constrain the truth-telling capacity of the photographs by denying them independent evidentiary status, 'not officially proof but nonetheless compelling' (p. 279), the judges inadvertently created an opening for a vigorous expansion of visual evidence. Both mechanically made images and other kinds of visual depictions – what Mnookin calls the culture of construction – grew in both frequency and significance. Mnookin offers this narrative as a possible origin tale for that problematic category of 'demonstrative evidence' that occupies an uneasy 'boundary between illustration and proof' (p. 284).

Looking at the ways in which a profession established the credibility of its expert evidence, Simon Cole, in 'What Counts for Identity? The Historical Origins of the Methodology of Latent Fingerprint Identification' (Chapter 9) describes the epistemological tensions that have characterized fingerprint identification. Lacking a recognizable scientific foundation and thus unable to sustain a rhetoric of science for 'dactylocoscopy', early professional latent fingerprint examiners (LFPEs) concentrated their efforts on practical techniques that seemed to work, eventually achieving widespread and secure legal acceptance very early in the twentieth century. Cole suggests, however, that the conservative rules of practice that formed the basis for their authority and credibility may prove vulnerable to a contemporary resurgence of interest in establishing scientific foundations for forensic evidence. Can latent fingerprint examiners establish the scientific grounds for their work? To date, this remains an open question, and Cole is quite sceptical.

In a parallel study, 'Speaking for the Dead; Forensic Pathologists and Criminal Justice in the United States' (Chapter 7), Julie Johnson-McGrath focuses her attention on the

institutional and professional competitions that shaped the practice and credibility of forensic pathologists. Facing opposition from the medical profession when they sought to control entry to the speciality, from the legal profession when they sought to control presentations of medical evidence, and from the local political machinery when they sought to control the coroner's office, forensic pathologists slowly triumphed in each of these struggles. They successfully established scientific and legal credibility for their work by, inadvertently it seems, sacrificing prestige and social status. By securing control over the forensic evidence through the coroner's office, the pathologists rid themselves, in large part, of the taint of political patronage, although they failed to secure the prestige that should have accompanied the establishment of professional standards. The lawyers borrowed the rhetoric and employed the forensic pathologists' expertise in the courts, whilst relegating them to more incidental, technical roles. More often regarded as failed doctors than research scientists, forensic pathologists, before the onset of the blitz of high-tech TV crime shows, lived in the shadows of their more powerful professional competitors.

In some areas debates concerning the interpretability and reliability of scientific evidence have subsided, so much so that the use of technically complex scientific evidence has become a routine feature of the legal process. For example, in trademark litigation, as mentioned above, social science surveys have become a necessary part of the burden of proof, enjoying a status close to legal precedent (Monahan and Walker, 1991; see also Bernacchi, 1978; Evans and Gunn, 1989; Lipton, 1987, 1988). In twenty-first century criminal trials DNA fingerprinting has also become a standard aspect of the material evidence. In 'The Evidence Does Not Speak for Itself: Expert Witnesses and the Organization of DNA-Typing Companies' (Chapter 12) Arthur Daemrich describes how the credibility of DNA evidence had to overcome several hurdles concerning the biological theories, the representation and interpretation of the statistical data, and the mechanics of producing the evidentiary samples from the scene of the crime through the laboratory to the courtroom. Credibility in the court could not rely on the professional reputation of forensic pathologists because the work was outsourced; nor could it rely on assertions of laboratory skill alone because the evidence was a commercial product – a marketed commodity crafted by profit-making organizations. The credibility of DNA was institutionalized by interweaving, like DNA itself, multiple sources of integrity, scientific authority, corporate practices and the persona of the expert witness (p. 741).

The general picture that emerges from this body of research is that, as science has been imported into the courtroom and thus subjected to different linguistic and interpretive conventions, burdens of proof, rules of evidence and authority structures, its distinctive claims to knowledge and impartiality have been challenged and perhaps even eroded. Carol Smart (1989) has argued, for instance, that rather than scientific disciplinary knowledge colonizing law as some critics have feared, science has been swallowed up by the legal, becoming something unrecognizable to itself. Perhaps this is because the probabilistic and statistical reasoning at the heart of much modern science generates frequent misunderstandings (Kahneman and Tversky, 1982; see also Chiorazzi, 1983; Faigman and Baglioni, 1988; Rubinfeld, 1985; Rubinfeld and Steiner, 1983). Some observers question the ability of legal actors, in particular juries, to understand and interpret expert testimony independent of its reliability (see, for example, Cutler, Dexter and Penrod, 1989; Diamond and Casper, 1992; Frazier and Borgida, 1988). Indeed, some researchers have claimed that the increased reliance on scientific testimony that is difficult to interpret and understand creates openings for 'junk

science' or a pseudo-science that has been undertaken specifically to produce results desired by, and supporting, particular litigants (see also Faigman, 1992; Foster, Bernstein and Huber, 1993; Schuck, 1993).

Michael Lynch and Ruth McNally, in 'Science, Common Sense and the Common Law: Courtroom Inquiries and the Public Understanding of Science' (Chapter 11), provide an analysis of the kinds of incommensurable data presented in trial courts and the efforts in some recent British trials to create commensurability between common sense and scientific evidence through Bayesian statistics. This analysis reveals a set of interestingly collated problems between legal considerations of scientific evidence and science and technology (STS) scholars' investigations of scientific practices. Where judges are concerned about juror's interpretations of science, the STS scholars are concerned about the public understanding of science, the boundaries constructed between science and non-science (Gieryn, 1999) and the trust placed in numbers (Porter, 1995). Following Lynch and McNally's account of the problem with regard to several criminal trials in Britain, Gary Edmond, in his essay 'Judicial Representations of Scientific Evidence' (Chapter 14) offers a more comprehensive doctrinal analysis of efforts to manage the proliferation of scientific evidence through new rules of civil procedure. Edmond emphasizes the paradoxical treatment by judges simultaneously celebrating and criticizing scientific expertise. Scientific evidence rarely, if ever, speaks for itself, and when judges speak for science, Edmond claims, they enact and display their enormous discretionary authority. The discussion is meant to question normative and idealized conceptions of science that exaggerate the boundaries between science and other social activities. Edmond argues that idealized images of science operate more as representational and legitimating practices than as prescriptive guides for judges when determining reliable or preferable evidence. He suggests, in conclusion, that the tensions between science and law might more productively raise questions about judicial methods and discretion than about scientific procedure and expertise.

Finally, there are extensive discussions in the law reviews that summarize the doctrinal status of scientific evidence in court. Unfortunately, space limitations preclude their incorporation in this volume. Readers are advised to check out papers by Faigman, Saks and others. For example, 'Check Your Crystal Ball at the Courthouse Door, Please' by David Faigman, Elise Porter and Michael Saks (1994) offers a brief summary of the relevant American legal doctrine, as well as advice on how to mediate the clash between science and law. Using the kind of schematic model of science that the STS scholars (see Lynch and McNally, Chapter 11) critique, Faigman, Porter and Saks describe three kinds of scientific knowledge – general theory, empirical tests or applications of the theoretical framework, and case-specific applications – each of which may be assessed differently. Relying on doctrine embodied in *Frye v. US*³ and *Daubert v. Merrill Dow*⁴, they suggest that, when assessing scientific evidence, the test of 'general acceptance' required by *Daubert* is most useful 'only to evaluate the scientific theory that underlies the technique that underlies the testimony' (p. 1828) – that is, whether there is general acceptance within the scientific community on the most general theoretical basis for the science presented. With regard to the application of the scientific theory, the court said that judges should assess only general applicability – that

³ 293 F. 1013, DC Cir. 1923.

⁴ 113 S. Ct 2786, 1993.