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Revisiting the History of Scientific Expert Testimony

Tal Golan[†]

INTRODUCTION

This Article provides a broad historical narrative of scientific expert testimony in the adversarial courtroom, from the late eighteenth century to the present. No such narrative exists in the current literature and it would good to have one, considering the growing attention to the topic in the last two decades. This Article identifies four large-scale developments that were involved in the shaping of modern scientific expert testimony as we have come to know it today: the place of the expert in the courtroom; the nature of the expertise deployed; the amount and importance of expert testimony; and the treatment of expert testimony in the courtroom.

The first development was part of the fundamental transformation of the English legal system that took place during the later part of the eighteenth century and came to be known as the Adversarial Revolution. This development changed the position of the expert in the courtroom, shifting it from a neutral court-appointed position to that of a partisan witness, chosen and paid by the parties. The second development also started during the second part of the eighteenth century. It involved changes in the scientific community that began to narrow its focus to the inanimate world and provided first indications of practical utility. Legal historians have paid little attention to this important development, which redefined the legal range of recognized expertise and introduced into the courtroom a new figure—the proto-scientist, who functioned like a skilled professional but cogitated like a natural philosopher. The third development was associated with the Industrial Revolution and with the further development of science. Originating in late eighteenth-

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century England and extending in America well into the late nineteenth century, the Industrial Revolution brought to the courts a rising tide of cases involving technological and scientific argumentation. This development established the newly defined scientific expert witness as a pivotal but also highly problematic figure in the modern courtroom. The fourth development took place during the twentieth century and was driven by the professionalization of science and by society's growing dependence on science. This growing dependence forced the courts to take an active role in managing the deployment of science in the courts, and the professionalization and standardization of twentieth century science offered the courts new means to do so. Consequently, the twentieth-century trial judge turned into an active gatekeeper, charged with the responsibility of screening unreliable scientific evidence away from the jury.

This Article's first five parts are structured around these developments. Part I discusses the emerging role of the partisan expert witness during the Adversarial Revolution. The main argument in this Part is that the newly defined expert witness was not conceived as a premeditated judicial solution to the problems of deploying expertise in the new adversarial courtroom. Instead, the partisan expert witness emerged as a necessary exception, the only source of information the new system could not rationalize under its evolving doctrines. And, as such, it would stay—an incompatible yet indispensable figure in the modern adversarial courtroom.

Part II discusses the changing nature of expert testimony during the late eighteenth century. To that end, it focuses on the 1782 case *Folkes v. Chadd*, a legal episode that became iconic in the legal literature as the origin story for modern expert testimony. A close look demonstrates that *Folkes v. Chadd* showed little judicial concern with the problems awaiting partisan expertise in the modern adversarial courtroom. Instead, the case revolved around a different important problem—the legal status of a nascent species of experts, the proto-scientists, or Newtonian philosophers as they were then styled, who propounded in court theories whose station on the legal continuum between fact and speculation were yet to be settled.

Parts III and IV discuss the nineteenth-century developments of scientific expert testimony in England and America, respectively. They demonstrate that while the volume of scientific expert testimony constantly increased during the

nineteenth century, the respect paid to it by the courts and the public constantly diminished. The main argument here is that by the late nineteenth century the putative problem of scientific expert testimony had already acquired most of the features that today are blithely assumed to be new. These two Parts further suggest that, although first raising its head in English courts, it was in America that the problem of expert testimony reached its fullest expression.

Part V discusses the twentieth-century attempts to control the problem of scientific expert testimony. Much of the current scholarship portrays the controversies surrounding scientific expert testimony as a late twentieth-century development, the result of the difficulties of the courts and the lay jury in handling the growing volume and complexity of modern science. The discussion in Part VI paints a more nuanced picture. Far from being a late twentieth-century pathology, the putative problem of scientific expert testimony has been chronic for over two centuries. Moreover, during the twentieth century, the courts were able to take advantage of the professionalization of science and the standardization of the market of expertise and actually improved their ability to control the performance of science in the courtroom.

I. THE EMERGING ROLE OF THE PARTISAN EXPERT WITNESS

Common law has long acknowledged the importance of scientific advice in cases where the disputed facts were such that the courts lacked sufficient knowledge to draw from them an informed decision. In 1554, an English judge declared:

[I]f matters arise in our law which concern other sciences or faculties, we commonly apply for the aid of that science or faculty which it concerns. Which is an honourable and commendable thing in our law. For thereby it appears that we do not despise all other sciences but our own, but we approve of them and encourage them as things worthy of commendation.¹

Over the centuries the legal system had developed two procedural options to deploy such sciences in the courtroom by experts who, from their special training and experience, could

¹ *Buckley v. Rice Thomas*, 1 Plowden 118, 124, 75 Eng. Rep. 182, 192 (1554) (Saunders, J.).

instruct the court and the jury in regard to the disputed facts.² The first option was to call them as jurors.³ The second was for the court to nominate them as consultants whose advice the court or the jury could adopt as they pleased.⁴

There was also a third option, which was for the parties to call experts as witnesses testifying on their behalf.⁵ However, unlike court experts and expert juries, there was no special procedure that would define such witnesses as experts. Thus, physicians and surgeons testified in criminal, insurance, and will cases; surveyors testified in property cases; linguists testified concerning the meaning of Latin phrases used in contracts; merchants concerning the particular customs and norms of trade; tradesmen concerning the quality of particular goods; ship builders concerning the state and construction of vessels; other artisans concerning their respective subjects of mechanical skill, and so on and so forth.⁶ However, these testifying experts were not clearly differentiated from all other lay witnesses, who often were also allowed to testify to their opinions, especially if it was based on their direct knowledge of the facts of the case. Thus, in the absence of a procedure that would define witnesses as experts or a theory that would restrict lay witnesses from testifying to their opinions, the testifying experts were regarded and treated merely as witnesses.⁷

The theories and practices that differentiated the testifying experts from all other lay witnesses evolved only late in the eighteenth century, as part of a larger transformation of the English legal system that came to be known as the Adversarial Revolution. This so-called revolution was primarily associated with the expanding presence of lawyers in criminal proceedings.⁸ Until the 1700s, lawyers were generally kept out

² J.H. Beuscher, *The Use of Experts by the Courts*, 54 HARV. L. REV. 1105, 1108-10 (1941); Learned Hand, *Historical and Practical Considerations Regarding Expert Testimony*, 15 HARV. L. REV. 40, 40-43 (1902); see also 4 THOMAS ROGER FORBES, *SURGEONS AT THE BAILEY* 26-33 (1985).

³ James C. Oldham, *The Origins of the Special Jury*, 50 U. CHI. L. REV. 137, 173-75 (1983).

⁴ Beuscher, *supra* note 2, at 1109-10.

⁵ Hand, *supra* note 2, at 43-50.

⁶ *Id.*

⁷ 4 JOHN HENRY WIGMORE, *A TREATISE ON THE ANGLO-AMERICAN SYSTEM OF EVIDENCE* § 1917, at 101-03 (2d ed. 1923).

⁸ John H. Langbein, *The Criminal Trial Before the Lawyers*, 45 U. CHI. L. REV. 263, 307-14 (1978).

of criminal trials.⁹ The judges dominated the proceedings, and evidence was mostly adduced by direct in-court altercation between the accuser, the accused, and the witnesses, and by the judge, who examined the parties and the witnesses himself.¹⁰ In this environment, which kept criminal proceedings quick and simple, testimonial constraints had little, if any, meaning.¹¹ Thus, although the common law requirement that regular testimony be limited to personal knowledge based on experience was old, lay witnesses were nevertheless allowed to testify to their opinion or present hearsay evidence. And if an objection was raised, the courts were content with allowing it to go to the weight of the evidence rather than to its admissibility.¹²

By the 1730s, defense counsel began to participate in regular criminal proceedings. Not yet allowed to directly address the jury, they were permitted to gather and adduce evidence and examine and cross-examine witnesses. The reasons for this “most remarkable change” to ever take place in English criminal law (as the noted Victorian judge and legal historian Sir James Fitzjames Stephen called it¹³) are not fully clear. It has been suggested that the appearance of the defense lawyer was, at least partially, a response to the expanding prosecutorial capacities of the Crown.¹⁴ Whatever the reasons were, by the second part of the eighteenth century, according to Stephen, “A practice sprung up . . . by which counsel were allowed to do everything for prisoners accused of felony except addressing the jury.”¹⁵ The active participation of the lawyers slowly reshaped the processes of criminal litigation. Outside the courtroom the lawyers gave new significance to pretrial activities such as preparing records and seeking out witnesses.

⁹ J.M. BEATTIE, *CRIME AND THE COURTS IN ENGLAND* 352-56 (1986); THOMAS ANDREW GREEN, *VERDICT ACCORDING TO CONSCIENCE: PERSPECTIVES ON THE ENGLISH CRIMINAL JURY 1200-1800*, 135-36 (1988); Langbein, *supra* note 8, at 310.

¹⁰ See J.S. COCKBURN, *HISTORY OF ENGLISH ASSIZES 1558-1714*, at 120-21 (1972).

¹¹ Cockburn reports that one judge heard as many as fifty Crown cases a day. *Id.* at 109.

¹² Charles T. McCormick, *Some Observations upon the Opinion Rule and Expert Testimony*, 23 TEX. L. REV. 109, 109-12 (1945); 9 WILLIAM S. HOLDSWORTH, *A HISTORY OF ENGLISH LAW* 211-14 (1926).

¹³ 1 JAMES FITZJAMES STEPHEN, *A HISTORY OF THE CRIMINAL LAW OF ENGLAND* 424 (London, MacMillan 1883).

¹⁴ Stephan Landsman, *The Rise of the Contentious Spirit: Adversary Procedures in Eighteenth Century England*, 75 CORNELL L. REV. 497, 572-80 (1990).

¹⁵ STEPHEN, *supra* note 13, at 424.

Inside the courtroom they increasingly took over the examination of witnesses, developed the techniques of cross-examination to perfection, and even established the right to argue points of law.¹⁶

Looking back, William Best, a leading mid-nineteenth-century authority on legal evidence, wrote that "the necessary consequence of [allowing defense counsel in criminal cases] was that objections to the admissibility of evidence were much more frequently taken, the attention of the judges was more directed to the subject of evidence, their judgments were better considered, and their decisions better remembered."¹⁷ Indeed, still prohibited from speaking directly to the jury, the lawyers mostly fought their battles over the content and the presentation of the evidence before the jury in terms of evidentiary objections.¹⁸ By the end of the eighteenth century these evidentiary battles had produced two powerful legal doctrines: the hearsay doctrine, which attempted to limit testimony to information based solely on personal observation, and the opinion doctrine, which sought to control the form in which witnesses communicated their perceptions to the jury, requiring them not to use inferences where the subject matter is susceptible to factual statements.¹⁹

These two powerful evidentiary doctrines rendered the expert witness into a distinct legal entity. However, they did so indirectly, by curtailing the privileges of all other testimonial sources until only the testifying expert was left as the last but necessary exception to the rules—a witness who did not have to observe the facts of the case personally but nevertheless was allowed to pronounce an opinion on them in court. The expert

¹⁶ Landsman, *supra* note 14, at 539-42, 548-52; John H. Langbein, *Shaping the Eighteenth-Century Criminal Trial: A View from the Ryder Sources*, 50 U. CHI. L. REV. 1, 123-34 (1983); Langbein, *supra* note 8, at 312.

¹⁷ W.M. BEST, A TREATISE ON THE PRINCIPLES OF EVIDENCE AND PRACTICE AS TO PROOFS IN COURTS OF COMMON LAW § 109, at 99 (Phila., T. & J.W. Johnson 1849).

¹⁸ See LAWRENCE M. FRIEDMAN, A HISTORY OF AMERICAN LAW 101-04, 300-01 (3d ed. 2001); see generally T.P. Gallanis, *The Rise of Modern Evidence Law*, 84 IOWA L. REV. 499 (1999); Stephan Landsman, *From Gilbert to Bentham: The Reconceptualization of Evidence Theory*, 36 WAYNE L. REV. 1149 (1990); James Oldham, *Truth-Telling in the Eighteenth-Century English Courtroom*, 12 LAW & HIST. REV. 95 (1994). The prohibition on the defense counsel to address the jury in summation was abolished by legislation only in 1836. See John M. Beattie, *Scales of Justice: Defense Counsel and the English Criminal Trial in the Eighteenth and Nineteenth Centuries*, 9 LAW & HIST. REV. 221, 250-58 (1991).

¹⁹ See Landsman, *supra* note 14, at 572; Gallanis, *supra* note 17, at 530-37; see also Hand, *supra* note 2, at 44-45; John H. Wigmore, *The History of the Hearsay Rule*, 17 HARV. L. REV. 437, 448 (1904).

witness was not conceived therefore as a deliberate judicial solution to the problems of deploying expertise in the new adversarial courtroom. Instead, the expert remained as the only source of information the new system could not rationalize under its evolving doctrines—a freak, if you will, in the new adversarial courtroom.

The new adversarial system not only redefined the role of the expert as a partisan witness but also had a dramatic effect on the deployment of expert testimony in the courtroom. Traditionally, experts, whether as part of the jury or as court advisors, were summoned and controlled by the court, which conferred on these experts a large degree of impartiality. But during the late eighteenth century, as the court gradually assumed a neutral position, as the litigants assumed responsibility for developing their own proof in court and summoned their own experts to represent them before the jury, and as adversarial ideology was given free reign, a demanding problem seemed to emerge: how to ensure that in this adversarial environment the lay jury would still have access to reliable expert guidance when the jury needed it. Surprisingly, though, an analysis of major late eighteenth and early nineteenth-century rulings finds little judicial awareness of this problem. While the judges were certainly busy with the delicate act of balancing the demands of the increasingly defined rules of evidence with the growing supply of expert testimony, they seemed far less concerned that the practice itself of calling experts as partisan witnesses was expanding.

The absence of judicial anxiety about expert testimony is all the more remarkable if we take into account that there was ample judicial dismay about lay witnesses for hire. The late eighteenth century was a period in which the slightest interest in the result of the trial rendered the witness unreliable.²⁰ Persons were not allowed to testify in cases in which they had financial interest.²¹ Husbands and wives were forbidden from testifying for or against each other.²² Even the parties to the lawsuit themselves, by the same reasoning, were not allowed to testify.²³ Why then the expert witness for hire?

²⁰ 1 SIR GEOFFREY GILBERT ET AL., *THE LAW OF EVIDENCE* 105-31 (London, W. Clarke & Sons et al., 6th ed. 1801).

²¹ *Id.* at 106-16.

²² *Id.* at 119-21.

²³ *Id.* at 116-19.

We will return to this question toward the end of the next section.

II. THE CHANGING NATURE OF EXPERTISE

The practice of deploying expertise in the new adversarial courtroom was not the only thing that was changing during the late eighteenth century. A second change, equally important, was in the nature of the expertise deployed in the courtroom. For centuries, experts summoned to give their opinions in the courtroom were men of large and tested experience, who, from their special training and experience, could instruct the court and the jury in regard to the disputed facts. The specialized knowledge these experts brought to the courts was expected to be based on personal and empirical observations, readily traceable to the specific training and experience of the particular expert pronouncing it. Distilled through ages of legal experience and immortalized in the early seventeenth-century writings of Lord Chancellor Francis Bacon, this legal epistemology disdained abstract explanations and stressed the necessity of direct observational data in processes of proof.²⁴

By the late eighteenth century, however, a new culture of expertise began its rise to dominance, which defied this epistemology. This was the culture of science, confident in its ability to discern the hidden laws of nature, however subtle their workings were. At the start of the eighteenth century, this was still a bookish culture that studied nature in general, but by the end of the century it had narrowed its focus to the inanimate world, supplemented books with experiments, borrowed some mathematics, and gave indications of practical utility. Its practitioners, who styled themselves men of science (the word “scientist” was yet to be invented) or Newtonian philosophers (after their great leader, Isaac Newton), may have still theorized like natural philosophers, but they increasingly acted like skilled professionals. They reasoned from first principles but concerned themselves with the observable, the measurable, and the practical. By the end of the eighteenth century, they became central to Britain’s booming economy—revolutionizing agriculture; inventing and improving engines, pumps, and other machinery; designing and overseeing the

²⁴ See FRANCIS BACON, *THE NEW ORGANON* 33-101 (Lisa Jardine & Michael Silverthorne eds., Cambridge Univ. Press 2000) (1620).

construction of waterways, bridges, and harbors.²⁵ It was not long before the courts were asked to consider the status of these new experts in the courtroom.

The matter was laid squarely before the courts in the 1782 civil case of *Folkes v. Chadd*.²⁶ In this celebrated legal episode, several experts were summoned by the litigants to the courtroom to testify before the jury to what in their opinion caused the decay of a certain harbor on the Norfolk coast of England.²⁷ The testimony of one of those experts, a prominent Newtonian philosopher named John Smeaton, was excluded by the trial judge on the ground that his theoretical explanations were “matter of opinion, which could be no foundation for the verdict of the jury.”²⁸ On appeal, Lord Mansfield, Chief Justice of the Royal Court of King’s Bench, found the silencing of the philosopher to be an error and granted a new trial on the ground that Smeaton’s theory “was very proper evidence.”²⁹

Lord Mansfield’s opinion in *Folkes v. Chadd* has served in the legal literature as the principal precedent that shaped the dominant option of using expert knowledge in the modern adversarial courtroom—calling experts to testify before the jury as partisan witnesses. It has been unanimously declared “the foundation of the rules governing expert evidence.”³⁰ James Thayer maintained that it inaugurated the new practice of calling experts as partisan witnesses before the jury.³¹ John Wigmore claimed that it certified experts to pronounce opinion without being personally familiar with the facts of the case.³² And recently, Stephan Landsman considered it “the court’s seal of approval on the whole adversarial apparatus

²⁵ See David P. Miller, *The Usefulness of Natural Philosophy: The Royal Society and the Culture of Practical Utility in the Later Eighteenth Century*, 32 BRIT. J. HIST. SCI. 185, 185-201 (1999); Richard Sorrenson, *Towards a History of the Royal Society in the Eighteenth Century*, 50 NOTES & REC. ROYAL SOC’Y LONDON 29-46 (1996). See generally MARGARET C. JACOB & LARRY STEWART, PRACTICAL MATTER: NEWTON’S SCIENCE IN THE SERVICE OF INDUSTRY AND EMPIRE, 1687-1851 (2005).

²⁶ *Folkes v. Chadd*, 3 Doug. 157, 99 Eng. Rep. 589 (1782).

²⁷ *Id.* Doug. at 157, 99 Eng. Rep. at 589.

²⁸ *Id.* Doug. at 158, 99 Eng. Rep. at 590.

²⁹ *Id.* Doug. at 160, 99 Eng. Rep. at 590.

³⁰ Anthony Kenny, *The Expert in Court*, 99 LAW Q. REV. 197, 199 (1983).

³¹ JAMES BRADLEY THAYER, A SELECTION OF CASES ON EVIDENCE AT THE COMMON LAW 672-73 (1900).

³² 4 WIGMORE, *supra* note 7, § 1917, at 103.

including contending experts, hypothetical questions, and jury evaluation.”³³

What follows below is a close study of *Folkes v. Chadd*. The study confirms that it was indeed a moment of great importance for the deployment of expert testimony, but for reasons other than those so far suggested by historians. In *Folkes v. Chadd*, Lord Mansfield was intent neither on inaugurating a new practice of calling experts as partisan witnesses before the jury nor on solving the difficulties that awaited such practice in the adversarial courtroom. Instead, Mansfield was trying to clarify the legal status of a nascent species of experts—proto-scientists, who presented in court knowledge claims whose legal status was yet to be settled.

A. *Folkes v. Chadd, Round I*

During the eighteenth century a new breed of capitalistic landlords evolved in the northern county of Norfolk, England, anxious to experiment with new methods of farming that would produce ever larger surpluses for sale. By the end of the eighteenth century, Norfolk’s innovative husbandry came to be known worldwide as the Norfolk System and its harbors were shipping more grain than the rest of England combined.³⁴ One of these harbors was the tidal harbor of the town of Wells. Having no river or other inland fresh water source, Wells Harbor had relied for centuries on the strength of the ebbing tide to scour the rich silt that the violent tides and winds of the North Sea constantly deposited at its bottom. Overflowing much of the coast, the tide created a body of water covering thousands of acres. With the ebbing of the sea, much of this water ultimately collected in the main channel of Wells Harbor, providing sufficient scouring to maintain its depth and safety.³⁵

³³ Stephan Landsman, *Of Witches, Madmen, and Products Liability: A Historical Survey of the Use of Expert Testimony*, 13 BEHAV. SCI. & L. 131, 141 (1995); see also Kenny, *supra* note 30, at 199; Stephan Landsman, *One Hundred Years of Rectitude: Medical Witnesses at the Old Bailey, 1717-1817*, 16 LAW & HIST. REV. 445, 491 (1998).

³⁴ NAOMI RICHES, *THE AGRICULTURE REVOLUTION IN NORFOLK* 15-17, 36-42, 150-52 (1967); PAUL WOODMAN BLAKE, *THE NORFOLK WE LIVE IN* 36 (3d ed. 1964); Nathaniel Kent, *Exported Produce of Norfolk*, 22 ANNALS AGRIC. (1784-1815) 35 (1793).

³⁵ DANIEL DEFOE, *A TOUR THROUGH THE WHOLE ISLAND OF GREAT BRITAIN: DIVIDED INTO CIRCUITS OR JOURNIES* 82-84 (London, J. & F. Rivington, 7th ed. 1769); ARTHUR W. PURCHAS, *SOME HISTORY OF WELLS-NEXT-TO-THE-SEA AND DISTRICT* 63 (1965); TIDAL HARBOURS COMMISSION, *FIRST [AND SECOND] REPORT[S] OF THE COMMISSIONERS PRESENTED TO BOTH HOUSES OF PARLIAMENT BY COMMAND OF HER MAJESTY* 444-66 (London, W. Cowes & Sons 1847). See generally M.J. ARMSTRONG, AN

In the 1720s, Wells Harbor began to show signs of decay.³⁶ The parts of the harbor furthest from the sea became increasingly clogged, and by mid-century the quay became inaccessible to shipping and the greater part of the cargo had to be carried to and from the town by lighters. Wells merchants and the ship owners blamed the deterioration of their harbor on some of the local landlords, who embanked and reclaimed from the North Sea significant tracts of land on both sides of the harbor's main channel. These embankments, Wells inhabitants believed, greatly weakened the body of backwater available for scouring their harbor, thereby causing it to choke up.³⁷

Fearing for the loss of their livelihood, Wells' inhabitants tried to save their harbor. They financed the constructions of two artificial sluices that would scour the harbor and keep it open, but to no avail. The conditions of the harbor continued to deteriorate.³⁸ Finally, in 1780, confident that the embankments were the principal cause of its troubles, the Harbor's board of commissioners decided to take legal action against one of the biggest landlords, whose embankment, it felt, was the most harmful to its harbor.³⁹

The trial took place in August 1781, at the summer Assizes in Norwich. The questions put before the jury were whether the said embankment harmed the harbor and whether the harm justified the cutting of the embankments.⁴⁰ The trial lasted two days. During the first day, the commissioners' lawyers marched a long line of traditional experts to the witness stand. Pilots, mariners, and other seamen, who had spent their entire life at the harbor, testified from their personal experience to the rapid deterioration of the harbor following the construction of the said embankment. On the

ESSAY ON THE CONTOUR OF THE COAST OF NORFOLK, BUT MORE PARTICULARLY AS IT RELATES TO THE MARUM-BANKS & SEA-BREACHES SO LOUDLY AND SO JUSTLY COMPLAINED OF! (Norwich, Crouse & Stevenson 1789).

³⁶ JOHN ARMSTRONG, REPORT CONCERNING THE DRAINAGE OF BEDFORD LEVEL AND THE PORT OF KING'S LYNN (1724); THOMAS BADESLADE, THE HISTORY OF THE ANCIENT AND PRESENT STATE OF THE NAVIGATION OF THE PORT OF KING'S-LYN, AND OF CAMBRIDGE, AND THE REST OF THE TRADING-TOWNS IN THOSE PARTS 13-14 (London, J. Roberts 1725).

³⁷ NATHANIEL KENT, GENERAL VIEW OF THE AGRICULTURE OF THE COUNTY OF NORFOLK WITH OBSERVATIONS ON THE MEANS OF IMPROVEMENT 9-10 (London, C. Macrea 1794); CUCHLAINE A.M. KING, BEACHES AND COASTS 274-75 (1959).

³⁸ TAL GOLAN, LAWS OF MEN AND LAWS OF NATURE 9-11 (2004).

³⁹ See *id.* at 11-12 (citing TIDAL HARBOURS COMMISSION, *supra* note 35, at 444).

⁴⁰ *Folkes v. Chadd*, 3 Doug. 157, 157, 99 Eng. Rep. 589, 589 (1782).

second day, it was the landlord's lawyers' turn. They presented only one expert, Robert Mylne, Fellow of the Royal Society and the owner of a thriving London-based architecture-engineering practice.⁴¹

Before the trial, upon the invitation of the landlord, Sir Martin Browne Folkes, Mylne traveled from London to Wells to study its harbor.⁴² He concluded that the troubles of the harbor could not be attributed to Folkes's embankment or to any other embankment. What caused the decay of the harbor were the vast quantities of materials discharged at the immense western estuaries by the six rivers of Ouse, Nene, Witham, Trent, Wharfe, and Swale, and deposited along the north coast of Norfolk by the strong tides and winds of the North Sea.⁴³ The defense experts, Mylne explained to the jury, had been misled by their perceptions. The filling up of the harbor they had witnessed was but a mere link in the temporal chain of causes imperceptible to lay observation, a chain perceptible only to those intimated with the hidden operation of nature.⁴⁴

The authoritative testimony of the famous engineer and Fellow of the Royal Society, who had made a special study of the cause of the trial, made a strong impression on the jurors, who, we are told, "relying on the weight of Mr. Mylne's abilities of knowledge, and not having the least doubt of the truth of his evidence, found a verdict for the Folkes."⁴⁵ Wells' inhabitants were outraged by the arrogance of the metropolitan expert. How could a foreigner to the county, lacking intimate knowledge of the facts of the case, claim, on the basis of the shortest inspection, to recognize forces at work unobserved by their own experienced experts, who had spent their entire life at the harbor? The commissioners' lawyers moved for a new

⁴¹ Robert Mylne owned a thriving private architecture/engineering/surveying practice. His specialty was bridges but his designs were various. Among other things he was appointed architect to St. Paul's Cathedral and chief engineer of the great New River Company that supplied water to London. ALBERT E. RICHARDSON, ROBERT MYLNE: ARCHITECT AND ENGINEER, 1733 TO 1811 (1955).

⁴² *Id.* at 114-16.

⁴³ ROBERT MYLNE, MR. MYLNE'S REPORT, ON HIS SURVEY OF THE HARBOUR, &C. OF WELLS, IN NORFOLK 4 (Apr. 28, 1781).

⁴⁴ *Id.*

⁴⁵ See GOLAN, *supra* note 38, at 23; *Notes of the Ordering for a 2nd Trial, Folkes, Bart & All Agst. Chadd, Esq. & Others*, Norfolk Records Office, MF/RO 504/2, MS 486 [hereinafter *Notes Ordering 2nd Trial*]. This was a standard legal argument for a new trial made by a party who felt cheated by a case falsely made at the trial that it had no reason to expect and therefore could not come prepared to answer. See, e.g., *Hartley v. Buggin*, 3 Doug. 39, 40, 99 Eng. Rep. 527, 528 (1781) (Mansfield, J.).

trial “on the ground that the defendants were surprised by the doctrine and reasoning of Mr. Milne.”⁴⁶

The royal judges of the King’s Bench, who convened to discuss the commissioners’ request, agreed that the commissioners should have had the opportunity to counter Mylne’s performance with their own experts. “[I]n matters of science,” they dictated, “the reasonings of men of science can only be answered by men of science.”⁴⁷ A new trial was therefore granted and was promptly set for the following summer term of the Norfolk assizes in July 1782. To avoid additional surprises in this important litigation, which “has influenced the whole county of Norfolk, and perhaps the whole country may be affected by it,”⁴⁸ the judges directed the parties to exchange between them in writing, before the new trial, the opinions of the experts whom they intended to produce in court “so that both sides might be prepared to answer them.”⁴⁹

B. *The Experts and Their Reports*

The second round of the Wells Harbor litigation, it was clear to all, was going to be decided upon the opinions of men of science. Unwilling to be caught off guard again, the commissioners of Wells Harbor went out and recruited four senior experts—John Grundy, Joseph Nickalls, Thomas Hogard, and Joseph Hodskinson—to represent them in the coming trial. Grundy was an experienced engineer whose specialties included the improvement of river navigation and the drainage of adjacent low lands. Nickalls served as an appointed engineer to the Thames Commissioners, representing their cause in Parliament against loud opposition from promoters of competing canal schemes. Hogard specialized in fen drainage and served as a commissioner for several fen drainage schemes in Lincolnshire. Hodskinson was Vice-President of the Society of Civil Engineering and one of the most respected land-surveyors in England. No doubt, the commissioners of Wells Harbor prepared themselves well for the coming scientific battle.⁵⁰

⁴⁶ *Folkes*, 3 Doug. at 157, 99 Eng. Rep. at 589.

⁴⁷ *Id.* Doug. at 159, 99 Eng. Rep. at 590.

⁴⁸ See GOLAN, *supra* note 38, at 24 (citing *Notes Ordering 2nd Trial*, *supra* note 45, at 67).

⁴⁹ *Folkes*, 3 Doug. at 157.

⁵⁰ See JOHN SMEATON, FRS 25-26 (A.W. Skempton ed., 1981) [hereinafter Skempton, JOHN SMEATON]; GARTH WATSON, *THE SMEATONIANS* 3-21 (1989). See

Sir Martin Browne Folkes added just one more expert to his team. But he chose exceptionally well. His expert was John Smeaton—Fellow of the Royal Society and a civil engineer who was considered the highest authority on harbors in the kingdom.⁵¹ By 1781, Smeaton had been consulted on more than thirty different harbors in England and Scotland.⁵² Furthermore, he was responsible for the recent successful rescue of Ramsgate Harbor, one of England's largest harbors, from the vast amounts of sand that threatened to choke it completely.⁵³ In addition to his flourishing engineering practice, Smeaton also developed a prominent scientific career. Smeaton had contributed fifteen papers to the Royal Society's *Philosophical Transactions*. One of them, describing his experiments with waterwheels and windmills, was awarded the Copley Medal, the society's highest award, thereby establishing Smeaton's reputation as one of the Kingdom's most celebrated natural philosophers.⁵⁴

In March 1782, Smeaton traveled to Wells and spent three days there studying the harbor. Then, he returned to London to study further the history of the harbor, read the evidence produced in the first trial, and write his report.⁵⁵ Like Mylne before him, Smeaton also concluded that the decay of Wells Harbor was caused not by the hand of man but by the hidden hand of nature. "To have a clear and comprehensive view of the cause of [the] decay," Smeaton wrote, "it will be necessary to shew the natural causes by which the port of

generally A.W. Skempton, *The Engineering Works of John Grundy*, in 19 LINCOLNSHIRE HIST. & ARCHAEOLOGY 65 (1984); A.W. Skempton & Esther Clark Wright, *Early Members of the Smeatonian Society of Civil Engineering*, 44 TRANSACTIONS NEWCOMEN SOC'Y 23 (1971-72).

⁵¹ M. Dixon, *Some Account of the Life, Character, and Works, of Mr. John Smeaton, F.R.S.*, in 1 REPORTS OF THE LATE JOHN SMEATON, F.R.S. xv-xxx (London, Longman et al., 2d ed. 1837) [hereinafter SMEATON REPORTS]; see Skempton, JOHN SMEATON, *supra* note 50, at 27-34.

⁵² Among the harbors were Whitehaven, Workington, and Bristol on the west coast; Christchurch, Rye, and Dover on the south; Yarmouth, Lynn, Wisebeach, Scarborough, and Sunderland on the east; and Aberdeen, Dundee, and Dunbar in Scotland. SAMUEL SMILES, LIVES OF THE ENGINEERS, WITH AN ACCOUNT OF THEIR PRINCIPAL WORKS 63-73 (London, John Murray 1861).

⁵³ SMILES, *supra* note 52, at 65-70.

⁵⁴ J. Smeaton, *An Experimental Enquiry Concerning the Natural Powers of Water and Wind to Turn Mills, and other Machines, Depending on a Circular Motion*, in 51 PHILOSOPHICAL TRANSACTIONS, GIVING SOME ACCOUNT OF THE PRESENT UNDERTAKINGS, STUDIES AND LABOURS, OF THE INGENIOUS, IN MANY CONSIDERABLE PARTS OF THE WORLD 100-74 (London, L. Davis & C. Reymers 1760).

⁵⁵ JOHN BARNEY, THE TRIALS OF WELLS HARBOUR 15-16 (2000); Skempton, JOHN SMEATON, *supra* note 50, at 28-29; 3 SMEATON REPORTS, *supra* note 51, at 18.

Wells has been formed.”⁵⁶ Thus, Smeaton commenced with a theoretical discussion concerning the general principles that govern the creation and decay of tidal harbors by the natural forces of the sea and the weather.

There was a time, Smeaton hypothesized, when nothing more than naked sand lay against the bare coast upon which the town of Wells stood. At that stage, the tide flowed and ebbed uniformly as a continuous sheet of water. But as the steady deposition of tidal silt increased the height of the sand, tidal waters were eventually left behind that started to cut gullies on their way back to the sea. As the land steadily increased in height, greater bodies of water were left on it and the gullies increased in number, depth, and size. Eventually, Smeaton wrote:

[I]f all were ultimately collected into one, as has been the case with the channel of Wells Harbor, the scour would be sufficient to maintain a channel through which vessels might be brought from the sea, and thus an useful harbour would be formed, which would increase in depth and utility by the continuance of the forming powers, but yet, only to a certain degree.⁵⁷

With the continual elevation of the coast above the reach of higher and higher tides, a height would eventually be reached from which the process would start to reverse itself. The volume of the water left upon the coast would start to diminish. Deprived of the scouring action of the backwater, first the gullies and finally the main channel would be choked. The true story of Wells Harbor, then, Smeaton recounted in his report, was that

the progressional operation of nature, which originally formed the harbour of Wells and brought it to maturity, has also occasioned it to grow more and more into a state of decay; and will finally close it up, and convert into a firm ground, fit for arable purposes, and those of pasturage, the very spot where ships have rode at anchor⁵⁸

Two weeks after Smeaton’s departure, the Commissioners’ scientific team also arrived to Wells and spent ten days there, inspecting the harbor and its surroundings.⁵⁹ They did not bother themselves with the general laws governing the dynamics of tidal harbors. That would have been

⁵⁶ 2 SMEATON REPORTS, *supra* note 51, at 149.

⁵⁷ *Id.* at 151.

⁵⁸ *Id.* at 157.

⁵⁹ See GOLAN, *supra* note 38, at 26, 32-34.

to play the part of the natural philosopher. They were civil engineers, practical men whose business was to estimate the relative effectiveness of the backwater deprived by Folkes's embankment. To that end, they concerned themselves with the mappings, measurements, and calculations of the current state of the land; its existing areas, enclosed or not; the locations and orientations of the neighboring creeks; the length and the depth of the main channel; the directions of the winds and the tides; etc.⁶⁰

Back in London, Hodskinson promptly delivered a detailed report to his employers. While Smeaton based his report on his dynamic theory of the tidal harbors, Hodskinson grounded his on interviews with the local harbor masters and on observations and measurements his team had made. The interviews convinced him that within local memory not only had the coast not grown in breadth or height, but, on the contrary, the sea had gained in many places along the coast. His copious calculations showed that Folkes's embankment eliminated 214,122 tons of water, about a third of the volume of water previously available for scouring the harbor.⁶¹ Hodskinson concluded:

Upon the whole, I am of opinion that the present bad and ruinous state of the harbor is to be in a great measure, if not wholly, imputed to the [said] embankment . . . and that if the tide of the sea is permitted to flow and reflow in its ancient course and manner . . . , the navigation will be supported and maintained in a safe, useful and commodious state by the natural operation of the tidal waters thereon.⁶²

C. Folkes v. Chadd, *Round II*

The second round of the Wells Harbor litigation began on July 25, 1782, before Henry Gould, Chief Justice of the Royal Court of Common Pleas, and a special jury. Two eminent counsels ran the trial. Leading the legal team for Folkes, unchanged from the previous trial, was Henry Partridge, a well-known barrister with strong Norfolk connections. This time the commissioners of Wells Harbor brought their own heavy legal artillery in the person of George Hardinge,

⁶⁰ See Joseph Hodskinson, *Report on the State and Causes of the Decay of Wells Harbor to the Commissioners for the Preservation of the Harbor of Wells*, in TIDAL HARBOURS COMMISSION, *supra* note 35, at 446-49.

⁶¹ See GOLAN, *supra* note 38, at 32-33.

⁶² Hodskinson, *supra* note 60, at 449.

Barrister of the Middle Temple and solicitor-general to Queen Charlotte.⁶³

The reports of the experts on both sides were made available to the jury a week before the trial. However, when the trial began, Hardinge chose not to call upon his experts to give oral testimony and be cross-examined. Instead, he summoned a long line of mariners and navigators to testify from their personal experience to the rapid deterioration of their harbor. Partridge, on the other hand, planned to repeat his successful strategy and summon his famous scientific expert to the witness stand to persuade the jury that it was nature, not his employer's embankment, that was responsible for Wells Harbor's troubles. However, when Partridge tried to call Smeaton to the stand, Hardinge objected. The illustrious Smeaton, Hardinge contended, should not be permitted to speak to the jury since his testimony concerning the hidden causes of nature "was matter of opinion, which could be no foundation for the verdict of the jury, which was to be built entirely on facts, and not on opinions."⁶⁴

Hardinge's objection was characteristic of the evidentiary battles that flourished in the new adversarial courtroom.⁶⁵ Central to these battles was the opinion doctrine, which sought to restrict witnesses from expressing their opinions where the subject matter was susceptible to factual statements. As John Wigmore summarized the status of the new opinion doctrine at the end of the eighteenth century: "[H]enceforth, the only question can be how far there are to be specific exceptions to it."⁶⁶ It was with this question in mind that Chief Justice Gould addressed Hardinge's objection to Smeaton's testimony.

Smeaton's case seemed straightforward. He was a well-respected expert and the facts of the Wells Harbor case, which he had observed directly, fell well within his field of expertise, thus constituting a proper object for his expert opinion. Nevertheless, the defense counsel, Hardinge, had firm legal

⁶³ See entry for "George Hardinge," in *DICTIONARY OF NATIONAL BIOGRAPHY* (1995).

⁶⁴ *Folkes v. Chadd*, 3 Doug. 157, 158, 99 Eng. Rep. 589, 590 (1782).

⁶⁵ Hand, *supra* note 2, at 37; Landsman, *supra* note 14, at 572.

⁶⁶ Wigmore, *supra* note 19, at 448. Collecting his data from political state trials, Wigmore may have overstated the status of the opinion doctrine in non-political criminal and civil proceedings. In 1782, while no longer embryonic, the opinion doctrine was still subject to the wide discretion of the individual trial judge. See Hand, *supra* note 2, at 45; Landsman, *supra* note 14, at 572; Gallanis, *supra* note 17, at 512-13, 530.

ground to stand upon when he maintained that Smeaton's opinion did not rest on the facts of the case but on speculation that had no place in court. Smeaton, Hardinge argued, transgressed the established legal range of expertise. Expert opinions were supposed to be based on calculations and empirical observations, readily traceable to the particular training and experience of the particular expert pronouncing them. Smeaton, on the other hand, propounded in court a high-minded hypothesis about some natural processes, imperceptible to anyone but himself, which allowed him to shift the blame for the undisputed decay of the harbor from the obvious human hand of his employers to the hidden hand of nature. But what kind of training or experience could have qualified a person like Smeaton in 1782 as an authority on such matters? And what kind of legal reasoning could acknowledge such latent causes as a proper foundation for the verdict of the jury, which was to be built entirely on facts presented before them in court?

Descending from a long legal lineage, the seventy-two-year-old Chief Justice Gould was known for the strictness of his law.⁶⁷ His logic, the logic of the common law, suspected elegantly constructed theories and stressed the importance of empirical data in processes of proof. Yet, Smeaton's evidence was based on a hypothetical natural process that could have taken centuries and could not be measured, tested, or otherwise verified. Thus, Chief Justice Gould accepted Hardinge's argument that Smeaton's evidence indeed "could be no foundation for the verdict of the jury" and did not permit Smeaton to address the jury from the witness stand.⁶⁸ With Smeaton and his imponderable science out of the way, Hardinge won the day as the jury gave a verdict for the commissioners, allowing them to cut the embankment that choked their harbor.⁶⁹ Folkes's lawyers immediately asked for a new trial on the grounds that their expert was improperly silenced.⁷⁰

⁶⁷ See "Gould, Henry," in EDWARD FOSS, *BIOGRAPHIA JURIDICA: A BIOGRAPHICAL DICTIONARY OF THE JUDGES OF ENGLAND FROM THE CONQUEST TO THE PRESENT TIME 1066-1870*, at 308 (London, John Murray 1870).

⁶⁸ *Folkes*, 3 Doug. at 158, 99 Eng. Rep. at 590.

⁶⁹ *Id.*

⁷⁰ See *id.*

D. *Mansfield's Decision*

The request for a third trial was laid before Lord Mansfield, Chief Justice of the King's Bench and probably the most influential judicial figure of the eighteenth century.⁷¹ His famous decision is worthy of a lengthy quotation:

The facts in this case are not disputed. In 1758 the bank was erected, and soon afterwards the harbor went to decay. The question is, to what has this decay been owing? The defendant says, to this bank. Why? Because it prevents the back-water. That is matter of opinion:—the whole case is a question of opinion from the facts agreed upon. Nobody can swear that it was the cause; nobody thought that it would produce this mischief when the bank was erected. The commissioners themselves look on for above twenty years . . . It is a matter of judgment, what has hurt the harbour. The plaintiff says that the bank was not the occasion of it. . . . Mr. Smeaton is called. A confusion now arises from a misapplication of terms. It is objected that Mr. Smeaton is going to speak, not as to facts, but as to opinion. That opinion, however, is deduced from facts which are not disputed—the situation of banks, the course of tides and winds, and the shifting of sands . . . Mr. Smeaton understands the construction of harbours, the causes of their destruction, and how remedied. In matters of science no other witnesses can be called. An instance frequently occurs in actions of unskillfully navigating ships. The question then depends on the evidence of those who understand such matters; and when such questions come before me, I always send for some of the brethren of Trinity House. I cannot believe that where the question is, whether a defect arises from a natural or an artificial cause, the opinions of men of science are not to be received. . . . I have myself received the opinion of Mr. Smeaton respecting mills, as a matter of science. The cause of the decay of the harbor is also a matter of science, and still more so, whether the removal of the bank can be beneficial. Of this, such men as Mr. Smeaton alone can judge. Therefore we are of opinion that his judgment, formed on facts, was very proper evidence.⁷²

Mansfield's decision has long served as the origin story for the rise of partisan expert testimony in the modern Anglo-American legal system. The first report on *Folkes v. Chadd* was published in 1831, as edited by Henry Roscoe, an experienced barrister who based his reports on the records of various leading judges. According to Roscoe, early nineteenth-century courts regarded Mansfield's decision as "the principal case on

⁷¹ See 1 JAMES OLDHAM, *THE MANSFIELD MANUSCRIPTS AND THE GROWTH OF ENGLISH LAW IN THE EIGHTEENTH CENTURY* 3-7 (1992) [hereinafter *THE MANSFIELD MANUSCRIPTS*].

⁷² *Folkes*, 3 Doug. at 158-59, 99 Eng. Rep. at 590.

the admissibility of matter of opinion.”⁷³ Roscoe further elaborated on what was to be learned from Mansfield’s decision: “Professional men, when examined on the subject of their art or science, are of necessity allowed to state their opinions”⁷⁴

The next significant reference to *Folkes v. Chadd* came sixty years later from Professor James Thayer of Harvard Law School. Mansfield’s decision, Thayer explained, represented the onset of judicial recognition in the modern practice of party-called expertise. Introducing *Folkes* in his influential textbook, Thayer wrote that, for a long time, “experts were thought of in the old way, as being helpers of the court But at last the modern conception came in, which regards the expert as testifying, like other witnesses, directly to the jury.”⁷⁵

One difficulty with Thayer’s reading of Mansfield’s decision lies in the fact that the practice of party-called expertise was not novel in 1782. As early as 1678, some of the most eminent physicians in the Kingdom, including future president of the Royal Society Sir Hans Sloan, were called by both sides to testify in a murder case, as to the causes of certain symptoms observed in an autopsy and on the general proposition as to whether a man could die of wounds without a fever.⁷⁶ In the eighteenth century, party-called expertise was also documented in civil proceedings, noticeably in the growing area of patent litigation. The practice was recurrent in the growing textile trade during the 1760s and 1770s.⁷⁷ Tax litigation and nuisance litigation also saw the deployment of party-called expertise with intense adversarial spirit.⁷⁸ Indeed, Lord Mansfield himself had presided over many patent trials and was well familiar with the practice of party-called expertise. In the 1760s, for example, he presided over an

⁷³ See *Folkes*, 3 Doug. at 160 n.(b).

⁷⁴ *Id.*

⁷⁵ THAYER, *supra* note 31, at 673.

⁷⁶ *Rex v. Pembroke*, 6 Howell’s State Trials 1309, 1337-41 (1678); A. Rosenberg, *The Sarah Stout Trial: An Early Example of the Doctor as Medical Expert Witness*, in LEGACIES IN LAW AND MEDICINE 230 (Chester R. Burns ed., 1977).

⁷⁷ R.S. FITTON & A.P. WADSWORTH, *THE STRUTTS AND THE ARKWRIGHTS, 1758-1830: A STUDY OF THE EARLY FACTORY SYSTEM* 41-46, 81-83 (1958).

⁷⁸ See William J. Ashworth, “Between the Trader and the Public”: *British Alcohol Standards and the Proof of Good Governance*, 42 TECH. & CULTURE 27, 37 (2001) (discussing the 1781 excise tax case *Rex v. Steele and Others*); T.C. BARKER & J.R. HARRIS, *A MERSEYSIDE TOWN IN THE INDUSTRIAL REVOLUTION, ST. HELEN’S 1750-1900*, at 227 n.1 (1959) (noting the 1770 indictment for public nuisance of the copper works of Charles Roe and Co.).

important patent case that involved a prominent London optician, Peter Dollond, and a group of other London opticians, in a struggle for patent rights for the design of the refracting telescope.⁷⁹ The case brought to the witness stand a line of experts, who testified to optical principles, previous designs, and trade secrets involved.⁸⁰ In the summer of 1781, concomitantly with the Wells Harbor litigation, Lord Mansfield presided over another important case involving expert testimony—one which revolved around Richard Arkwright's attempt to enforce his monopoly of the carding machine on the textile business. The attempt failed, but a second one succeeded in 1785, largely thanks to the testimony of scientific figures such as William Herschel, Erasmus Darwin, James Watt, and Robert Mylne, who vouched under oath to the validity of the patent's principle and specifications.⁸¹

The practice of party-called expertise was therefore not new in 1782. Still, one could maintain that the adversarial context was novel, and that Mansfield's decision was the first to recognize and legitimate the practice in this new context. However, little in Mansfield's decision could support such claim. In fact, Mansfield's decision displayed a complete disregard to Smeaton's appearance as a partisan witness. If anything, Mansfield's opinion treated Smeaton as if he was a court expert. "When such questions come before me," Mansfield reasoned, "I always send for some brethren of Trinity House."⁸² The Trinity House was a famous club of retired sea captains, and its brethren functioned as arbitrators and official court experts in cases arising out of events on the high seas.⁸³

⁷⁹ Richard Sorrenson, *Dollond & Son's Pursuit of Achromaticity, 1758-1789*, 39 HIST. SCI. 31, 41-43, 41 n.40 (2001), available at <http://www.shpltd.co.uk/sorrenson-dollond.pdf>.

⁸⁰ *Id.* at 41.

⁸¹ See John Hewish, *From Cromford to Chancery Lane: New Light on the Arkwright Patent Trials*, 28 TECH. & CULTURE 80-86 (1987) (citing RICHARD ARKWRIGHT AND CO., THE CASE OF RICHARD ARKWRIGHT AND CO. IN RELATION TO MR ARKWRIGHT'S INVENTION OF AN ENGINE FOR SPINNING COTTON, &C., INTO YARN (London, 1782)); THE TRIAL OF THE CAUSE INSTITUTED BY RICHARD PEPPER ARDEN (London, 1785); RICHARD ARKWRIGHT ESQUIRE V. PETER NIGHTINGALE (London, 1785)); Eric Robinson, *James Watt and the Law of Patents*, 13 TECH. & CULTURE 115-39 (1972). Arkwright's success was short lived. His patent was annulled the following year. Hewish, *supra*.

⁸² *Folkes v. Chadd*, 3 Doug. 157, 159, 99 Eng. Rep. 589, 590 (1782).

⁸³ Like other common law judges, Mansfield used to sit with an admiralty judge. The Trinity House brethren served as court experts in such cases. On occasion Mansfield adopted this practice in the Court of the King's Bench. THE MANSFIELD MANUSCRIPTS, *supra* note 71, at 146 n.377, 395 n.5.

Clearly, the deployment of court-nominated experts is not the precedent one would choose if intent on inaugurating a new practice of calling experts as partisan witnesses selected and paid for by the parties.

John Henry Wigmore, Thayer's student and the leading early twentieth-century authority on evidence, also saw an origin story at the bottom of *Folkes v. Chadd*. Wigmore was aware that the practice of party-called expertise was not new to the period.⁸⁴ He also recognized that expert witnesses were yet to be differentiated from lay witnesses, who were also allowed to testify to their opinions, especially if they were based on an intimate knowledge of the facts of the case.⁸⁵ Wigmore concluded therefore that the distinctiveness of the modern expert witness sprang not from the license to testify to opinion (which was still shared with lay witnesses), but from the exclusive privilege to pronounce an opinion whether or not the expert had observed the facts of the case directly.⁸⁶ It was this distinction, according to Wigmore, which made its first successful appearance in Mansfield's decision in *Folkes v. Chadd*:

Here was a man [Smeaton], who had never seen the place, had no "facts" to add, and was going to give . . . his opinion upon the general question in doubt, the cause of the decay. Why should *he* do this? Why waste time in listening to numbers of such persons when the twelve men in the box have been specially selected for the very purpose of having *their* opinions serve as decisive? There would be only one reason for listening to such outside opinions, namely, that the witness was such a person that the jury would be really aided by his opinion.⁸⁷

Thus, Wigmore claimed, Mansfield's decision epitomized "the general recognition by the end of the 1700s, that there was a class of persons, i.e., those skilled in matters of science, who, though they personally knew nothing about the circumstances of the particular case, might yet, perhaps by way of exception, give their opinion on the matter."⁸⁸

Wigmore, we know, had his facts wrong. Smeaton not only had seen the place, but had also written a detailed report on his findings that had been accepted by the court as primary

⁸⁴ WIGMORE, *supra* note 7, § 1917, at 101-02.

⁸⁵ *Id.* at 102.

⁸⁶ *Id.* at 103.

⁸⁷ *Id.* at 105-06.

⁸⁸ *Id.* at 103.

evidence. But if Mansfield's decision was neither about inaugurating a new practice of calling experts as partisan witnesses before the jury, as Thayer maintained, nor about allowing experts to pronounce opinion without being personally familiar with the facts of the case, as Wigmore maintained, then what was it about? What was the issue that Lord Mansfield tried to winnow from the chaff of the protracted litigation?

Having reconstructed the facts of the case, we are now able to propose an answer to this question. Lord Mansfield, just like Chief Justice Gould before him, was trying to decide the merits of Hardinge's objection, which pitted men of science in the old sense (that is, men of large and tested experience) against men of science in the new sense (that is, Newtonian philosophers), who based their opinions on their privileged knowledge of the imponderable laws of nature. Mansfield's decision delivered therefore the authoritative interpretation of the King's Bench concerning the implications of the nascent opinion doctrine for experts like Smeaton and Mylne, proto-scientists who functioned like skilled professionals but cogitated like natural philosophers.

The Wells Harbor litigation therefore did constitute an important historical moment in the deployment of expert knowledge in the courtroom, but for reasons different from those so far suggested. It was a junction in which the expanding late eighteenth-century cultures of law and science finally crossed paths. The lawyers had been solidifying their control over the production and presentation of evidence in the legal courtroom. Meanwhile, natural philosophy had become a competent branch of applicable knowledge. A noted Newtonian, Smeaton presented a conspicuous example of the growing importance of natural philosophy as a useful pursuit. For example, his experimental studies of waterwheels, the most important source of energy during the early stages of the industrial revolution, revolutionized their design and improved their performance by over thirty percent.⁸⁹ Thus, although late eighteenth-century Englishmen may have still considered the opinions of natural philosophers to be less than facts, they nevertheless were already more than mere opinions. That was also the case concerning the causes behind matters such as the

⁸⁹ Terry S. Reynolds, *Scientific Influences on Technology: The Case of the Overshot Waterwheel, 1752-1754*, 20 *TECH. & CULTURE* 270-95 (1979).

decay of harbors, which had been traditionally a matter for the experience of the craftsmen and artisans who had built them. By 1782, as Mansfield made certain to clarify in his decision, these causes were already a “matter of science [about which] such men as Mr. Smeaton alone can judge.”⁹⁰

Wigmore was therefore right when he considered Mansfield’s decision as illustrating the growing legal recognition by the end of the eighteenth century that there was a new class of witnesses, skilled in matters of science, who could give opinions that were not based directly on the traditional trustworthiness of the senses. However, this lack of positive first-hand evidence was not merely a contingent deficiency occasioned by the experts’ failure to personally inspect the facts of the case. Rather, it was an inevitable consequence of the knowledge these new experts brought to the courts, knowledge that often claimed to be based on the imponderables of nature, which “nothing but the most philosophic eye, by reasoning upon chain of facts, is able to discover.”⁹¹

Hardinge’s objection to Smeaton’s testimony forced the chief justices of the two central royal courts to reflect on the epistemological status of this new style of scientific reasoning and on the status of its bearers in the courtroom. Gould, the conservative, chose to remain within the guarded line delineated by the evolving rules of evidence and excluded Smeaton’s theory for not being clearly reducible to hard and concrete evidence. This formalist approach, which denied the court the services of the most respected expert on the issue upon which the whole litigation turned, made no sense to Mansfield. “I cannot believe,” he remarked, “that when the question is, whether a defect arises from a natural or an artificial cause, the opinions of men of science are not to be received”⁹² Mansfield declared, therefore, that the opinions of men of science were an exception to the opinion doctrine. Unwilling to distinguish one science from the other, Mansfield measured professional reputation instead. If the proposed witness was known as an expert on the matter before the court, Mansfield prescribed, his opinion was proper evidence.⁹³

⁹⁰ *Folkes v. Chadd*, 3 Doug. 157, 160, 99 Eng. Rep. 589, 590 (1782).

⁹¹ 2 JAMES HUTTON, *THEORY OF THE EARTH* 90 (1795).

⁹² *Folkes*, 3 Doug. at 159, 99 Eng. Rep. at 590.

⁹³ *Id.*, Doug. at 160, 99 Eng. Rep. at 590.

Smeaton's appearance as a partisan witness for hire played no part in Mansfield's decision. This disregard was also typical of other leading rulings from the late-eighteenth and early-nineteenth centuries. One is pressed to find in them judicial angst about the growing practice of calling experts as partisan witnesses. One may wonder then: Could it be that the experienced royal judges overlooked the difficulties that might await the deployment of partisan expertise in the new adversarial courtroom? Why did they not try to mold a procedure that would keep expert advice out of the adversarial fire?

The answer, I would like to suggest, is that late eighteenth-century judges counted upon men of science to give, by ties of honor, unbiased opinions on matters beyond the ken of the jurors. The scientific community had long adopted the gentlemanly code of honor as a necessary condition for the reliability of the scientific discourse. Gentlemen were bound to credit the word of their fellows. The status of the gentleman—his economic independence, the freedom of his actions, the moral discipline he imposed upon himself—guaranteed the credibility of his word.⁹⁴ This social contract worked both ways. Nothing ruined gentlemanly status quicker than dishonesty. John Locke gave notice in his 1690 guide to the education of English gentlemen:

[T]wenty faults are sooner to be forgiven, than the straining of truth, to cover any one by an excuse. . . . [Lying was] a quality so wholly inconsistent with the name and character of a gentleman, that nobody of any credit can bear the imputation of a lye; a mark that is judged the utmost disgrace, which debases a man to the lowest degree of a shameful manners, and ranks him with the most contemptible part of mankind, and the abhorred rascality, and it is not to endure by anyone, who would converse with people of condition, or have any esteem or reputation in the world.⁹⁵

It was noted that among the seventeenth-century members of the Royal Society, "the far greater Number are Gentlemen, free and unconfine'd."⁹⁶ During the eighteenth century, the Royal

⁹⁴ See generally PHILIP MASON, *THE ENGLISH GENTLEMAN: THE RISE AND FALL OF AN IDEAL* (1982); SIMON RAVEN, *THE ENGLISH GENTLEMAN* (1961); Peter Dear, *Totius in Verba: Rhetoric and Authority in the Early Royal Society*, 76 *ISIS* 145 (1985).

⁹⁵ JOHN LOCKE, *SOME THOUGHTS CONCERNING EDUCATION* §§ 131, 139 (1692) (paragraph break omitted) (quoted in STEVEN SHAPIN, *A SOCIAL HISTORY OF TRUTH: CIVILITY AND SCIENCE IN SEVENTEENTH-CENTURY ENGLAND* 74 (1995)).

⁹⁶ THOMAS SPRAT, *THE HISTORY OF THE ROYAL SOCIETY OF LONDON FOR THE IMPROVING OF NATURAL KNOWLEDGE* 67 (J. Knapton et al. eds., 3d ed. 1722).

Society continued to strengthen its status as a body of disinterested gentlemen who impartially investigated nature and toil for no end but the improvement of public good.⁹⁷ The royal judges therefore were not worried about the behavior of these new experts and trusted that their testimony would correspond to their true opinions.⁹⁸

In retrospect, one can only appreciate the irony in this late eighteenth-century judicial leniency towards the new partisan role men of science took as witnesses in the modern adversarial courtroom. This leniency seems to carry the mark of the aloofness of the eighteenth-century judiciary, who dominated the courtroom to such an extent that they could not imagine it otherwise—that a time may come when their judicial powers would no longer suffice to control the play of partisan expertise in the courtroom. They were soon proven wrong. The tremendous nineteenth-century expansion of science and technology into industry and other public sectors quickly established the scientific expert as a pivotal figure in the courtroom and turned partisan expert testimony into an acrimonious and persistent thorn in the side of the common law. We will attend to these developments in the next two sections.

III. THE DEVELOPMENT OF SCIENTIFIC EXPERT TESTIMONY IN ENGLAND DURING THE NINETEENTH CENTURY

The 1782 contest of expertise over the implications of the tide for Wells Harbor and Lord Mansfield's subsequent decision to allow opinion testimony given by men of science to lay anchor in the courtroom were signs of the time—the time of the Industrial Revolution and the rising tide it brought of legal cases involving technological and scientific argumentation. Thus, during the early nineteenth century, among the crowd of experts who were allowed into the witness stand, besides the traditional figures of the physician, the merchant, and the sea captain, we find the growing presence of men of science—chemists, microscopists, geologists, engineers, mechanists, etc.

⁹⁷ See generally Miller, *supra* note 25.

⁹⁸ The circumstances of *Folkes v. Chadd* provided a good example of this judicial trust. Mylne and Smeaton were elite members of the Royal Society. Lord Mansfield had previously benefited from their expert services and respected them enormously. Clearly, he was not worried that they would testify dishonorably. They were men of honor and their integrity guaranteed the truthfulness of their stories. See GOLAN, *supra* note 38, at 51; *Notes Ordering 2nd Trial*, *supra* note 45, at 67.

These experts untangled for the court and the jury the complexities of the growing number of cases involving science, in fields ranging from insurance, mining, and energy to toxicology, patents, and even regulation. They appraised the disputed claims with their experimental techniques and offered their knowledge of the principles of nature, which the jurors then could apply to the facts at issue before them.⁹⁹

The growing judicial recognition of this special class of witnesses was not all good news for this rising species of experts. It may have underlined the experts' growing importance to the judicial process, but at the same time it perpetuated their marginalization within this process. Moving across professional and institutional boundaries, from the exclusivity of their lecture theaters, private laboratories, and societies to the public courtroom, men of science hoped to represent laws that were not controlled by human whim. Instead, they found themselves manipulated as mere tools in the hands of the lawyers. As members of the jury or as advisors to the court, they were independent and active participants in the legal decision-making process. As witnesses, they found themselves isolated in the witness box, away from the decision-making processes. Browbeaten and set against each other, they found their standard strategies for generating credibility and agreement unfitted for the adversarial heat of the courtroom. The result was a continuous parade of leading men of science zealously contradicting each other from the witness stand—a parade that started to cast serious doubts on their integrity and on their science in the eyes of the legal profession and the public.

A. Severn, King and Co. v. Imperial Insurance Co.

All this was clearly on display during a large insurance litigation in the early nineteenth century.¹⁰⁰ The case was a fire damage claim made in 1820 by the owners of a large sugar factory in London against four insurance companies. Shortly before the fire, the factory introduced a new process that pumped hot whale oil through copper coils immersed in the

⁹⁹ For detailed analyses of many of these cases, see GOLAN, *supra* note 38, at 52-106.

¹⁰⁰ The ensuing description of this case is drawn largely from June Z. Fullmer, *Technology, Chemistry, and the Law in Early Nineteenth-Century England*, 21 *TECH. & CULTURE* 1 (1980), and from the *London Times*; see also GOLAN, *supra* note 38, at 54-70.

sugar pans to boil the sugar solution. The insurance companies argued that the new process, the use of which had not been reported to them, introduced an increased risk of fire that voided the terms of their policies. The ensuing litigation revolved therefore around the little known characteristics of whale oil and its behavior under frequent application of intense heat.

Both sides of the litigation built their strategies upon scientific expert evidence. Virtually every notable chemist and chemical technologist in the kingdom was recruited by one of the parties. The scientific team for the sugar factory included the likes of John Dalton, President of the Manchester Literary and Philosophical Society and the author of the first useful atomic theory of matter; William Brande, Secretary of the Royal Society and Sir Humphry Davy's successor as professor of chemistry at the Royal Institution; Thomas Thomson, a professor of chemistry at the University of Glasgow, editor of *Annals of Philosophy*, and the author of the influential *System of Chemistry*; as well as many other top men of science. One by one, the members of this dream team stepped onto the witness stand and swore for the plaintiffs that the new process was infinitely less dangerous than the old process, in which the sugar solution was heated over open fire.¹⁰¹

The insurance companies put together a scientific team no less formidable. It included the likes of Michael Faraday, chemical operator at the Royal Institution; Arthur Aikin, Secretary to the Society for the Encouragement of the Arts and the author of the *Dictionary of Chemistry*; Richard Phillips, professor of chemistry at the Royal Military College and chairman of the London Chemical Society, and many more. These experts testified under oath that the new heating process was extremely dangerous because the repeated heating and cooling altered the nature of the whale oil, making it increasingly volatile and producing highly flammable gases apt to explode.¹⁰²

Both teams of experts made sure to back up their opinions with results from experiments, many of them performed especially for the trial. Alas, the experimental results presented by the two sides were completely contradictory. While the plaintiff's experts described smooth

¹⁰¹ See GOLAN, *supra* note 38, at 56-59.

¹⁰² See *id.* at 59-62.

operation under all conditions, the defense experts described gusts of fire, combustive vapors, and sudden explosions. Charging the jury, the presiding judge, Chief Justice Lord Dallas, could not hide his utter frustration:

[T]hey [the jurors] had heard the evidence, he [Dallas] would not say of the most intelligent, but of as intelligent men in chymical and scientific pursuits as were to be found in this country or in Europe. He had himself read the works of some of them, had derived pleasure from their labours, and entertained the greatest respect for their talents and information. But they had, nevertheless, left the Court in a state of utter uncertainty; and the two days during which the results of their experiments had been brought into comparison, were days, not of triumph, but of humiliation to science.¹⁰³

Dallas advised the jury to throw “the contradictory results of experiment” out the window, and stated his disgust from the partisanship that had been displayed during the trial.¹⁰⁴ “It must be a matter of general regret,” he said, “to find the respectable witnesses to whom he was alluding drawn up, not on one side, and for the maintenance of the same truths, but, as it were, in martial and hostile array against each other.”¹⁰⁵

The jury found a full verdict for the factory owners and the Imperial Insurance Company moved for a new trial on the ground that the verdict went against the weight of the evidence.¹⁰⁶ Discussing the appeal, the judges of the Court of Common Pleas approved the request but decided to delay the new trial “till one of the other causes [that is, the suits against the other three insurance companies] should also have been tried, and the result of certain proposed experiments affecting the point in dispute be made known.”¹⁰⁷ The judges, it seems, were hoping that further investigation would allow the chemists to clarify their evidence and offer the jury a better basis on which to draw an informed conclusion in this important litigation, which involved not only large sums of money but also the general practice and principles by which fire insurance was regulated.

The stakes were therefore raised for the next trial, against the Phoenix Insurance Company. All parties were well aware that the results would affect not only the renewed trial

¹⁰³ *Court of Common Pleas*, TIMES (London), Apr. 14, 1820, at 3.

¹⁰⁴ *Id.*

¹⁰⁵ *Id.*

¹⁰⁶ Fullmer, *supra* note 100, at 18.

¹⁰⁷ *See* *Severn v. Olive*, 3 Brod. & B. 72, 72, 23 Eng. Rep. 1209, 1209 (1821).

of the first case, but also two other suits still waiting in the wings. Both parties recruited therefore even larger crowds of scientific experts and doubled their efforts to produce convincing experimental data. Alas, the experts and their evidence remained as contradictory as they were in the first trial. Chief Justice Lord Dallas, again, did not hide his distress in his charge to the jury:

A vast body of evidence had been laid before the jury; medical men, chymical men, eminent men in every department of science, had been examined in the course of the trial; but what was the lamentable result? The jury had heard of opinion opposed to opinion, judgment to judgment, theory to theory, and what was still more extraordinary, they had seen the same experiments producing opposite results. Who should decide this mighty controversy? He [Dallas] professed himself unable to give an opinion. He was not unacquainted with scientific subjects, but the little he knew only convinced him how much was beyond the reach of his knowledge . . . This he would say of science in its present state, that all that belonged to the theory was doubtful, and that all that rested on experiment was new.¹⁰⁸

The jury, again, gave full verdict for the plaintiffs, and the insurance companies were directed to honor their policies and compensate the factory owners for their trial costs. However, the insurance company refused to pay the cost of the plaintiffs' experts. Legal precedent entitled only professional men to be compensated for their time and efforts, and the insurance companies argued that the plaintiffs' experts did not fall within this category, but belonged instead to the legal category of "men of skill," which included artisan-like experts (mechanics, navigators, etc.), who were not entitled to be compensated for their troubles and time.¹⁰⁹

A third legal round took place, therefore, which revolved around the professional status of the scientific experts involved in the trial. The standard was set by the two established professions—medicine and law—upper-class oriented vocations defined by highly formal and specialized trainings. Alas, the welter of experts produced in the trial professed none of these traits. Socially they were faceless; intellectually they had just been proved incoherent; and their expertise was not based on any regulated training but rather self-taught. Thus, it was not without a gleeful undertone of score settling that Chief Justice

¹⁰⁸ *Court of Common Pleas*, TIMES (London), Dec. 19, at 3.

¹⁰⁹ *Severn*, 3 Brod. & B. at 73-75, 23 Eng. Rep. at 1210-11.

Dallas refused to recognize them as professionals. It took chemistry another sixty-five years to reverse this perception.¹¹⁰

B. Gillespie v. Russell

The courts may have been unwilling for most of the nineteenth century to recognize men of science as professionals and compensate them accordingly, but there were plenty of others who were ready to pay them for their services in court.¹¹¹ Thus, the presence of scientific experts in the courtroom continued to grow, and with it the embarrassing display of disarrayed definitions, inconsistent experimental results, and contradictory opinions. Such cases disturbed the courts deeply.¹¹² The royal judges were not naive. They were ready to tolerate, to a certain degree, the difference of opinion among the scientific experts. Whether a fever that raged in a certain neighborhood was or was not caused by the fumes of a factory in the vicinity was a matter which admitted no demonstration and was considered therefore to be a speculation admitted as evidence only out of a necessity because no one else was qualified to give a better opinion. Experimental evidence was a different story, however. It was considered to be among the surest species of evidence, and the judges found it exceedingly difficult to accept the fact that similar experimental procedures were constantly producing antithetical results when conducted by opposed experts. Such conflicting experimental results, they believed, represented the partisanship of the men of science who produced them, and since these men were highly paid for their services, their conduct was seen as the prostitution of their science, of selling its credibility to the highest bidder.

Thus, as the century advanced and the legal use of scientific expertise grew exponentially, the court began to develop a skeptical view not only toward the opinions of the scientific experts but also toward their data—not because nature could lie, but because its representatives could. Indeed, by mid-century the judiciary no longer expected further scientific investigations to clarify the issues before the court.

¹¹⁰ Fuller, *supra* note 100 at 24-25; COLIN A. RUSSEL, EDWARD FRANKLAND: CHEMISTRY, CONTROVERSY AND CONSPIRACY IN VICTORIAN ENGLAND 445-57 (1996).

¹¹¹ See GOLAN, *supra* note 38, at 81.

¹¹² For examples from numerous cases, see GOLAN, *supra* note 38, at 52-106.

Gillespie v. Russell, heard in 1853 in Edinburgh's Court of Session, provides an example of this change in legal mood.¹¹³

In 1850, William Gillespie, a Scottish landowner, sold James Russell and Co., a firm of iron masters, the rights to mine coal from his land for the fixed royalty of 13 shillings and 6 pence per ton.¹¹⁴ Later that year, James Young, an industrial chemist from Manchester, patented a revolutionary process that allowed for the first time the profitable distillation of paraffin oil from coal by low-temperature pyrolysis.¹¹⁵ Finding that a certain mineral of the Scottish lowlands, known as Boghead coal, yielded particularly high quantities of paraffin oil, Young established a large oil production facility in Bathgate, Scotland, next to Gillespie's estate, where the Boghead coal was mined. Realizing in retrospect the unexpected value of the Boghead coal, Gillespie attempted to exclude it from the lease on the grounds that it was not truly coal but shale.¹¹⁶ After a set of inconclusive negotiations, Gillespie sued Russell and Co. for mining a mineral not included in their lease.¹¹⁷

The case constituted a direct attack on Young's profitable patent. If the famous Boghead coal was found not to be a coal, anyone could use it in Young's new process without infringing upon Young's patent. The financial stakes were huge and both parties assembled unprecedented crowds of mining experts, geologists, chemists, and microscopists to debate the true identity of said mineral. Alas, although the chemists agreed that the great element in coal was carbon, they disagreed on how to measure it. All experts concurred that since that coal was of organic origin, the classification of the mineral in question could be reduced to the microscopic examination of its organic content. But while one set of microscopists swore that they saw vegetable tissue in the substance, the other set was equally sure that there was none. Lord President of the Court of Session, Duncan McNeil, was exasperated: "I do not care what you call it. I do not care about theories of the formation of coal—I do not care about what

¹¹³ *Gillespie v. Russell*, 3 S.C. 1 (1854).

¹¹⁴ For more information surrounding this case, see GOLAN, *supra* note 38, at 89-92.

¹¹⁵ See James Young, *Improvements in the Treatment of Certain Bituminous Mineral Substances, and in Obtaining Products Therefrom*, 9 CHEMICAL NEWS 249-50 (1864).

¹¹⁶ *Gillespie*, 3 S.C. at 1-2.

¹¹⁷ *Id.*

chemists choose to call it.”¹¹⁸ Whatever it was, he reasoned, Gillespie agreed to lease it. Thus, the verdict was given for the defendant.¹¹⁹

Gillespie moved for a new trial on the grounds that the scientific evidence was so contradictory that a new trial was essential to the justice of the case, and that a new experimental investigation be ordered to clarify the science involved.¹²⁰ Recall the similar request made thirty years earlier, in the 1820 insurance case of *Severn, King and Co. v. Imperial Insurance Co.*¹²¹ There, the Court of Common Pleas not only ordered a new trial, but also decided to postpone it until further experimentation would be able to reduce the discrepancies among the scientific witnesses. By the 1850s, however, the Court of Session no longer entertained such high hopes. “[T]hey [the scientists] all agreed upon the theory, but they all disagreed on what they look at with their own eyes. . . .,” mocked the Lord President, “My opinion is, that they would differ in the result to the end of time.”¹²² Lord Rutherford, a second judge, iterated:

Are we sure that they will be ever agreed? Are we going to get better microscopes and better eyes? Shall this branch of science, not only new in its name, but in its scientific terms, become new in a much more remarkable feature—in the unanimity of its professors? I cannot expect that. I do not anticipate it.¹²³

The request for a new trial was flatly rejected.¹²⁴

C. *The Disillusionment with Scientific Expert Testimony*

Ironically, the process of disillusionment the legal system was going through in its relations with science was not the result of some sort of philosophical relativism or skepticism. On the contrary, it was the result of hard-dying positivism that saw in the scientific method the best passage to truth. One of the most authoritative legal texts of the nineteenth century, written by Chief Justice and legal historian James Fitzjames Stephen, serves as an example of this deep

¹¹⁸ *Id.* at 13.

¹¹⁹ *Id.* at 12.

¹²⁰ *Id.* at 1.

¹²¹ See *supra* Part III.A.

¹²² *Gillespie*, 3 S.C. at 12.

¹²³ *Id.* at 15. For a related litigation in North America in 1851-1852, see 1 PAUL LUCIER, SCIENTISTS AND SWINDLERS: COAL, OIL, AND SCIENTIFIC CONSULTING IN AMERICAN INDUSTRIAL REVOLUTION, 1830-1870, at 69-121 (1994).

¹²⁴ *Gillespie*, 3 S.C. at 15.

irony. According to Sir James, the quest for both legal truths and truths about the physical world “rest upon the same foundations . . . the same great assumptions—the general uniformity of Nature, and the general trustworthiness of the senses.”¹²⁵ Still, scientific knowledge was much closer to certainty:

In physical inquiries the relevant facts are usually established by testimony open to no doubt, because they relate to simple facts which do not affect the passions, which are observed by trained observers, who are exposed to detection if they make mistakes, and who could not tell the effect of misrepresentation if they were disposed to be fraudulent.¹²⁶

No wonder, then, that Stephen too interpreted the constant spectacle of leading scientists contradicting each other from the witness stand, not as legitimate debates but as a sign of moral decadence. “As to want of will to speak the truth, the causes of it are infinitely various,” and in this matter, he concluded, “The case of experts is as strong a one as can be mentioned. No one expects an expert, except in the rarest possible cases, to be quite candid. Most of them—are all but avowedly advocates, and speak for the side which calls them.”¹²⁷

The growing scientific controversies in court have resulted therefore in widespread judicial and public indignation. In 1862, the conservative *Saturday Review* commented:

It is a fact that in all matters which require to be investigated through the evidence of expert witnesses, the same remarkable discrepancies show themselves. Hardly a single patent case is ever tried in which men of the highest scientific eminence do not appear to contradict one another flatly on the newness of the invention, or of some of its parts or stages, and the commonest disputes concerning architects’ and engineering bills are constantly calling forth similar conflicts of skilled testimony. Even in criminal cases, where the point to be decided is whether a particular poison was administered, or whether a death was caused in a particular way, the evidence of the experts is generally more contradictory than would be supposed from the nature of the inquiry; and, in short, judges and lawyers are rapidly coming to the conclusion that skilled testimony, which ought

¹²⁵ JAMES FITZJAMES STEPHEN, *A GENERAL VIEW OF THE CRIMINAL LAW OF ENGLAND* 189 (London, MacMillan & Co., 2d ed. 1890).

¹²⁶ *Id.* at 190.

¹²⁷ *Id.* at 198-99.

to be the most decisive and convincing of them all, is of all the most suspicious and unsatisfactory.¹²⁸

Yet the *Review* admitted, “To suppose that courts can do without such evidence would indeed be a stolid and ignorant prejudice, for expert witnesses can supply materials for judgments not to be obtained from any other source.”¹²⁹ Still, “[t]here is no doubt that a system has been growing up of late years under which men of special knowledge are consulted under such circumstances as to render their opinions almost worthless.”¹³⁰

The growing public mistrust of science, and even more so of the integrity of the scientists, in such an important domain as the legal system, deeply troubled the scientific community. The evil done by the scandals in court, scientific leaders emphasized again and again, was great not only to the administration of justice, but also to the public image of the Victorian scientific community, which was toiling hard on its professional status and seeking to expand its influence into the public domains of education, industry, health, administration, and culture in general. The reform of expert testimony therefore became one of the hottest topics in the meetings of the various scientific and legal societies, and many proposals were put forward to remedy the situation.¹³¹

Almost all scientific commentators agreed that the disagreements among the scientific witnesses did not reflect uncertainties within the body of scientific knowledge itself.¹³² Most of them argued that the disagreements were largely created by the improper adversarial procedures by which the legal system processed scientific knowledge. Others were ready to concede that scientific opinions may legitimately differ. But even they did not believe that the judge, let alone the lay jury, could reliably assess these differences. Each pundit had his own reform proposal, but they all seemed to agree on at least one of two central elements—that the courts should be allowed to call their own independent scientific witnesses, and to

¹²⁸ Editorial, *Expert Witnesses*, SATURDAY REV., Jan. 11, 1862, at 32.

¹²⁹ *Id.*

¹³⁰ *Id.*

¹³¹ For a comprehensive discussion of the Victorian debates on expert testimony, see GOLAN, *supra* note 38, at 107-43; see also Christopher Hamlin, *Scientific Method and Expert Witnessing: Victorian Perspective on a Modern Problem*, 16 SOC. STUD. SCI. 485 (1986).

¹³² GOLAN, *supra* note 38, at 108-33 (recounting the proposals and responses of numerous contemporaneous commentators).

appoint, at least in civil cases, scientific assessors who would sit next to the judge and advise him on technical matters.¹³³

However, even those in the legal profession who empathized with the frustrated scientific community pointed out that the reforms proposed by the scientific community ran against the fundamental postulates of the adversarial legal system.¹³⁴ Getting rid of the jury ran against the fundamental political right to a trial by a jury of one's peers. And allowing the court to call in assessors or witnesses independent of the parties ran against two other equally fundamental postulates—the right of the parties to control the evidence in court and the neutrality of the court. The reform suggestions were therefore rejected by the legal profession, who cautioned that “the remedy should not be worse than the disease.”¹³⁵

The legal profession also resisted the scientific attempts to monopolize expertise by drawing a line between scientific and non-scientific men. “A man who acquired a particular kind of knowledge by long training,” insisted Thomas Webster, a leading authority on Patent Law, who played a central role in many attempts to reform Patent Law, “was just as much a scientific man in his particular art as the man who contributed to those wonderful discoveries of science at which we all so much rejoice.”¹³⁶ Thus, it was wrong to speak of scientific men as a class to the exclusion of such skilled witnesses.

With no resolution in sight, the legal and scientific fraternities grew belligerent. The legal profession remained disturbed by the scientific partisanship displayed in the courtroom, while the scientific community remained frustrated by the awkward position it occupied in the courtroom. Still, the deadlock did not stop the increasing deployment of expert testimony in the courts. The growing scope and accuracy of scientific knowledge, as well as the constantly enlarging application of its principles to the business of everyday life, had inevitably expanded the uses of experts and tended to make the

¹³³ *Id.* at 120; *see, e.g.*, Committee of Scientific Evidence in Courts of Law, *Report of the Committee, in 36TH MEETING OF THE BRITISH ASS'N FOR THE ADVANCEMENT OF SCIENCE* 456, 456-57 (London, John Murray 1867).

¹³⁴ *See, e.g.*, William Odling, *Science in the Courts of Law*, 7 J. SOC'Y ARTS 167 (1860).

¹³⁵ CHEMICAL NEWS, Oct. 11, 1862, at 190.

¹³⁶ Robert Angus Smith, *Science in the Courts of Law*, J. SOC'Y ARTS, Jan. 20, 1860, at 144 (1860). Thomas Webster wrote the standard textbook on patent law for his day, THOMAS WEBSTER, *REPORTS AND NOTES OF CASES ON LETTERS PATENT FOR INVENTIONS* (London, Thomas Blenkarn 1844).

courts more and more dependent upon their advice. Still, the increasing tendency of lawyers to fortify their cases by the testimony of experts did not reflect appreciation for its excellence, but rather, the requirements of the rising culture of Victorian professionalism. The result was an ironic schism that was clearly emerging during the second half of the nineteenth century—the same increasingly indispensable expert opinions that were treated in everyday life as safe and reliable under the mere good faith of social and business reputation were considered unsafe and unreliable when given in court under oath.

IV. THE DEVELOPMENT OF SCIENTIFIC EXPERT TESTIMONY DURING THE NINETEENTH CENTURY IN THE UNITED STATES

The sale of expert advice did not become widespread in America until the middle decades of the nineteenth century. Once it did, though, the deployment of expert testimony in American courts of law grew quickly, and with it all its familiar woes. The American legal system observed the same adversarial procedures of the common law, while the American scientific community advertised the same high expectations from the scientific method, as did its English counterpart. These two features ensured that in spite of the significant differences in the institutional and social dynamics of the legal and scientific communities between the two countries, the problem of expert testimony would develop in nineteenth-century America along the same basic pattern displayed in England. Thus, as in England, the growing deployment of men of science in divergent areas of litigation turned the American courts into a lucrative arena for scientific activity.¹³⁷ And, as in

¹³⁷ For a list of cases in which scientific experts had made court appearances at the time, see 2 FRANCIS WHARTON, A COMMENTARY ON THE LAW OF EVIDENCE IN CIVIL ISSUES §§ 434-451, at 394-421 (Phila., Kay & Bro., 3d ed. 1888). For examples of the use of expert testimony in specific types of cases, see also, e.g., KENNETH ALLEN DE VILLE, MEDICAL MALPRACTICE IN NINETEENTH-CENTURY AMERICA: ORIGINS AND LEGACY (1990) (medical malpractice); J. LAWSON, *Farmers and Agriculturalists*, in THE LAW OF EXPERT AND OPINION EVIDENCE REDUCED TO RULES 13-25 (St. Louis, F.H. Thomas 1883) (agriculture); J. LAWSON, *Insurers and Insurance*, in *id.* 26-51 (insurance); MITCHELL OKUN, FAIR PLAY IN THE MARKETPLACE: THE FIRST BATTLE FOR PURE FOOD AND DRUGS (1986) (food and drug adulteration); Arthur S. Browne, *Patent Litigation from the Expert's Standpoint*, 25 REP. ANN. MEETING A.B.A. 670-74 (1902) (patents); CLARK C. SPENCE, *We Must Overwhelm Them with Testimony*, in MINING ENGINEERS & THE AMERICAN WEST 195-230 (1970) (mining). See also A. Hayward, *The*

England, this arena soon put on public display the curious spectacle of leading scientists disagreeing with each other from the witness stand, a view that served to cast doubts on the integrity of the experts and their science.¹³⁸

A. *The Declining Credibility of Scientific Experts*

By 1870, a study on expert testimony was already able to report in detail on an “unmistakable tendency on the part of eminent judges and jurists to attach less and less importance to testimony of this nature,” explaining this result by “the surprising facility with which scientific gentlemen will swear to the most opposite opinions upon matters falling within their domain.”¹³⁹ Many shared this bleak view. “[W]hoever has read the reports of trials or been present at them, in which experts are seen arrayed against each other, prostituting at times the science which they professed to represent,” wrote U.S. Supreme Court Chief Justice Morrison Remick Waite in 1874, “need not be told, that the subject of expert testimony as now understood, is one of no ordinary importance.”¹⁴⁰

Like their English colleagues, American men of science were much concerned with the damage that the scandals in court were inflicting on the public image and credibility of their emerging community, and, like their English colleagues, they were bitter about the adversarial legal machinery that placed them in the awkward position of partisan witnesses.¹⁴¹ “[N]o class connected with the administration of justice is more frequently misunderstood, or abused,” complained Charles Himes, a professor of physics and chemistry at Dickinson University.¹⁴² The improper position of science in court seemed to have turned the scientific witness into a legal annoyance:

Handwriting of Junius: A Review, TIMES (London), May 22, 1871, reprinted in THE EVIDENCE OF HANDWRITING (Cambridge, Riverside Press 1874).

¹³⁸ See J. SNOWDEN BELL, THE USE AND ABUSE OF EXPERT TESTIMONY 28-34 (Phila., Rees Welsh & Co. 1879); EVAN B. LEWIS, THE LAW OF EXPERT TESTIMONY 5-12 (Phila., Rees Welsh & Co. 1894).

¹³⁹ *Expert Testimony*, 5 AM. L. REV. 227, 228 (1871).

¹⁴⁰ Morrison R. Waite, *Testimony of Experts*, 8 W. JURIST 129, 134-35 (1874).

¹⁴¹ See CLEMENS HERSCHEL, ON THE BEST MANNER OF MAKING USE OF THE SERVICES OF EXPERTS IN THE CONDUCT OF JUDICIAL INQUIRIES 5-7, 11-14 (Boston, Comm. of the Bar Ass'n of Boston 1886), edited version reprinted in Clemens Herschel, 22 AM. L. REV. 571-77 (1887); Rossiter Johnson, *Expert Testimony*, 138 N. AM. REV. 602, 602-06 (1884); J. Trowbridge, *The Imperiled Dignity of Science and the Law*, ATLANTIC MONTHLY, Oct. 1896, at 491.

¹⁴² Chas. F. Himes, *The Scientific Expert in Forensic Procedure*, 85 J. FRANKLIN INST. 407, 412 (1893).

[A] sort of intractable, incompatible, inharmonious factor, disturbing the otherwise smooth current of legal procedure; too important or necessary to be ruled out, too intelligent and disciplined mentally to yield without reason to ordinary rules and regulations of the court . . . and at the same time possessing an undoubted influence with a jury that it is difficult to restrict by the established rules and maxims of legal procedures.¹⁴³

Both the English and the American legal systems were well aware of the need to protect the credulous jury from charlatans. Still, neither system was able to lay down a precise rule for determining who was and who was not a competent expert. The only legal criterion was 800 years old: those persons are qualified to speak as experts who possess special training and experience in the subject in question. Everything beyond this point remained purely a matter of discretion with the presiding judge, who had to decide in each case afresh whether the particular person offered as an expert witness would be admitted or not. In most cases, it was very hard for the judge to satisfy himself as to the qualifications of the persons offered as experts. Scientific titles and diplomas, and professional reputation, carried little judicial meaning during the nineteenth century, and preliminary examinations were impossible to make. The judges therefore were continually forced to decide on the spur of the moment, and often on the most difficult subjects, upon the credibility of the persons offered as experts. Unable to discriminate with any reasonable degree of accuracy between experts and charlatans, the actual practice of the courts came to be to admit almost everybody presented as experts, leaving it for cross-examination to expose quackery, and for the jury to be the judge of the ensuing battles between expert witnesses and lawyers.¹⁴⁴

No one, of course, trusted the jury to be able to do this job properly. As one distinguished psychologist of the day pointed out:

[T]he average jury is unable to pass judgment on, or even to comprehend in any adequate way, many of the questions submitted to it—such as motives and capacity of the mind, the power of control, the analysis of conduct, and the conditions and influences which have been dominant in certain acts; the application of the law, and

¹⁴³ *Id.* at 411-12.

¹⁴⁴ WILLIAM BEST, A TREATISE ON THE PRINCIPLES OF EVIDENCE AND PRACTICES AS TO PROOFS IN COURTS OF COMMON LAW §§ 495-496, at 589-93 (London, S. Sweet, 2d ed. 1854); Harold L. Korn, *Law, Fact, and Science in the Courts*, 66 COLUM. L. REV. 1080, 1084-85 (1966).

the distinctions of responsibility and accountability; the distinctions of science as to the meaning of certain facts, or the recognition and discrimination of facts from the mass of statements.¹⁴⁵

Here, however, came into play two critical differences between the English and the American situations. While the English legal system recognized the jury as the final adjudicator on the facts of the case, it nevertheless granted its judges the freedom to take part in the questioning of the witnesses, advise the counsels in the framing of their questions, and comment fully on the weight of the evidence and the credibility of the witnesses in their charge to the jury. The authoritative royal judges did not hesitate to use these legal instruments to control the usage of expert testimony in their court and to guide the jury in its assessment of the scientific witnesses and their evidence. In addition, from the mid 1860s onward, the English courts began to divert cases that involved scientific expertise from jury trials to the juryless Chancery Court. At first it was mainly patent trials, but in 1875 a parliamentary bill was passed that officially granted trial judges unfettered discretion in all civil actions to order a trial without a jury in any matter requiring scientific evidence that, in their opinion, could not be handled by the jury.¹⁴⁶

The American court lacked access to these two instruments. The eighteenth-century English notion of the institution of the jury as a mainstay of liberty was adopted with added zeal in the American colonies, and the fact that many judges were laymen with no special claim to legal competence only added to the prominence of the jury. The Jacksonian faith in the ability of the common man and the enduring political philosophy that supported maximizing citizen participation in government kept this enthusiasm alive throughout most of the nineteenth century to an extent unfamiliar in England.¹⁴⁷ Consequently, the early nineteenth-century American juries did pretty much as they pleased. The

¹⁴⁵ T.D. Crothers, *A Psychological Study of Jurors*, 60 ALB. L.J. 341, 342 (1899).

¹⁴⁶ R.M. Jackson, *The Incidence of Jury Trial During the Past Century*, 1 MOD. L. REV. 132, 139-40 (1937); W.R. CORNISH & G. DE N. CLARK, *LAW AND SOCIETY IN ENGLAND 1750-1950*, at 20 (1989).

¹⁴⁷ The Seventh Amendment to the American Constitution provides as follows: "In Suits at common law, where the value in controversy shall exceed twenty dollars, the right of trial by a jury shall be preserved, and no fact tried by jury, shall be otherwise re-examined in any Court of the United States, than according to the rules of the common law." U.S. CONST. amend. VII.

second half of the century saw a growing pressure by the bar and the business community to instill more predictability and rationality in the operation of the jury, but the pressure also bred popular fears of undue influence. The result was a practical compromise that was attained by a sharpening of the law/fact dichotomy and the corresponding spheres of judge and jury. On the one hand, the power of the jury to determine the law, especially in civil cases, was eroded. On the other hand, fears of undue influence on the jury were eased by legislative and constitutional restrictions on the power of the American courts in charging juries.¹⁴⁸ By 1889, in twenty-one out of the forty-nine U.S. states and territories, judges were expressly forbidden by statute or constitutional provision to charge the jury on questions of fact.¹⁴⁹ And in about half of the remaining twenty-eight states and territories, the courts had voluntarily adopted the same restriction.¹⁵⁰ Only in federal courts and a minority of state courts were judges allowed to comment on the weight of the evidence in their charge to the jury.¹⁵¹

American men of science decried the absence of a judicial hand that would guide the jury in its difficult task of assessing the scientific evidence of the case. "If it be necessary to give juries authoritative instruction on points of law, how can it be less necessary that they should be similarly instructed in matters involving scientific knowledge?" wondered *Scientific American* in 1872.¹⁵²

Is it any wonder that the public is beginning to mistrust the value of this kind of [scientific] evidence? Such mistrust is based upon good grounds enough. As now presented to juries, the testimony of the both competent and incompetent witnesses, only serves to muddle their intellects, and to complicate rather than make plain the facts.¹⁵³

¹⁴⁸ Irwin A. Horowitz & Thomas E. Willging, *Changing Views of Jury Power: The Nullification Debate, 1787-1988*, 15 LAW & HUM. BEHAV. 165, 168, 170, 180 (1991) (citing FRIEDMAN, *supra* note 17; MOLLY SELVIN & LARRY PICUS, THE DEBATE OVER JURY PERFORMANCE: OBSERVATIONS FROM A RECENT ASBESTOS CASE (1987)); Mark DeWolfe Howe, *Juries as Judges of Criminal Law*, 52 HARV. L. REV. 582, 584-89 (1939); Glenn D. Peters, *Invading the Province of the Jury*, 2 IND. L.J. 539, 539-45 (1927); Note, *The Changing Role of the Jury in the Nineteenth Century*, 74 YALE L.J. 170-74, 187-92 (1964); J.B.F., *Legislation, Changes in the Jury*, 17 VA. L. REV. 497, 499 (1931).

¹⁴⁹ Edson R. Sunderland, *The Inefficiency of the American Jury*, 13 MICH. L. REV. 302, 307-08 (1915).

¹⁵⁰ *Id.* at 308.

¹⁵¹ *Id.* at 309.

¹⁵² Editorial, *Science in the Courts*, SCI. AM., Mar. 9, 1872, at 167.

¹⁵³ *Id.*

The nineteenth-century American scientific community lacked the organization, status, and political resources needed to challenge the legal system and its procedures.¹⁵⁴ Most attempts to reform the legal procedures of expert testimony were initiated by members of the medical and the legal professions.¹⁵⁵ The reform of expert testimony became one of the hottest topics in the meetings of the various bar associations that mushroomed in late nineteenth-century America, and many bills were drafted to remedy the evils of expert testimony.¹⁵⁶ For the selection of experts it was suggested that they be chosen by the court, either reserving or denying the right of the parties to call additional witnesses; that the selection of the courts be unassisted or made from an official list chosen in some other manner; that the official list be either permanent or special for each case.¹⁵⁷ In regard to the examination of witnesses, it was recommended that the examination be by the court, with or without the right of the parties to cross-examine, or that there be no examination at all and that the expert would submit a report.¹⁵⁸ In regard to decisions when experts disagree, it was recommended that a jury of experts be selected or that an expert sit with the judge during the trial to advise him.¹⁵⁹ Alas, the American legislature and judiciary seemed even more reluctant than their English counterparts to dissent from the legal axioms of the adversary system. Most reforms bills did not pass the legislative stage, and the few that did were promptly held unconstitutional.¹⁶⁰

¹⁵⁴ See generally S.G. KOHLSTEDT, *THE FORMATION OF THE AMERICAN SCIENTIFIC COMMUNITY: THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE, 1848-1860* (1976).

¹⁵⁵ One of the first reform bills was a joint effort of the American Academy of Arts and Sciences, the Suffolk District Medical Society, the Boston Society for Medical Observation, and the Boston Society for medical Sciences. The bill was written by Judge Emory Washburn who headed the committee of the Academy of Arts and Sciences. See Editorial, 90 BOS. MED. & SURGICAL J. 387-88 (Apr. 16, 1874). For a wider look on the efforts of the medical community, see JAMES C. MOHR, *DOCTORS AND THE LAW: MEDICAL JURISPRUDENCE IN NINETEENTH-CENTURY AMERICA* 95, 100-05 (1993).

¹⁵⁶ For a long list of related commentary, see "Evidence, Expert" in INDEX TO STATE BAR ASSOCIATION REPORTS AND PROCEEDINGS 176-77 (Dennis A. Dooley ed., 1942).

¹⁵⁷ See, e.g., A.M. Kidd, *The Proposed Expert Evidence Bill*, 3 CAL. L. REV. 216, 223 (1915).

¹⁵⁸ See *id.* at 224.

¹⁵⁹ See William L. Foster, *Expert Testimony: Prevalent Complaints and Proposed Remedies*, 11 HARV. L. REV. 169, 180-84 (1897).

¹⁶⁰ Gustav A. Endlich, *Proposed Changes in the Law of Expert Testimony*, 1898 PA. BAR PROCEEDINGS 189-221; Foster, *supra* note 159, at 182-83; Hand, *supra*

B. *The Failure of the Law of Evidence*

Unable to check either the selection of the experts or to guide the jury's assessment of their evidence, nineteenth-century American courts concentrated their efforts on the law of evidence, in an attempt to check the growing problem by regulating the processes through which the experts communicated their information in court.

One major legal doctrine sought to protect the credulous jury from being uncritically influenced by the expert's view by preventing the expert from giving his opinion upon the "ultimate issue," that is, the precise factual issue before the jury.¹⁶¹ To permit that, it was held, would put the expert in place of the jury and invade their province.¹⁶² Rational as it may sound, the application of this doctrine created great confusion and led to absurd consequences. In theory, it made irrelevancy a ground for admission, and relevancy for exclusion. In practice, the "ultimate issue" was often exactly what the expert testimony was all about. The doctrine seemed, therefore, to exclude expert evidence exactly where it was most needed. Consequently, the courts developed various ways to bypass the rule and allow the witnesses to give their opinion on the ultimate issue.¹⁶³

The most popular procedure was to allow an expert to state in general terms whether a certain cause may have produced the result under consideration, and leave it to the jury to decide whether it did produce it or not. To enable this, a second evidentiary doctrine came into play. Under the "hypothetical question" doctrine, the expert's testimony was given in the form of answers to hypothetically framed questions.¹⁶⁴ These questions specified a set of factual premises, already submitted in evidence, and the expert was asked to draw his conclusion from them, assuming that they were true. This cumbersome technique was justified on triple grounds: to enable experts to apply their general knowledge to facts that were not within their personal knowledge; to allow juries to

note 2, at 55, 56-58; Note, *Appointment of Expert Witnesses by the Court*, 24 HARV. L. REV. 483, 483-84 (1911).

¹⁶¹ Charles T. McCormick, *Expert Testimony as an "Invasion of the Province of the Jury,"* 26 IOWA L. REV. 819, 820 (1941).

¹⁶² *Id.* at 825-39; see also CHARLES T. MCCORMICK, HANDBOOK OF THE LAW OF EVIDENCE § 14, at 26 (1954) [hereinafter MCCORMICK, HANDBOOK].

¹⁶³ MCCORMICK, HANDBOOK *supra* note 161, at 120.

¹⁶⁴ McCormick, *supra* note 161, at 820-25

hear the factual premises upon which expert opinions were based; and to allow experts to give their opinions on ultimate issues without “invading” the province of the jury. Juries were then instructed to credit the opinions only if they believed the underlying premises.¹⁶⁵

Sound in theory, the technique broke down in practice. If counsel was required to recite all the relevant facts, the question became intolerably lengthy; if allowed to select the facts, as most courts did, it prompted one-sided hypotheses. Designed and controlled by the interested parties, the hypothetical question became a means to manipulate the facts of the case rather than to clarify them for the jury. “It was a strange irony,” Wigmore noted in 1904, that “the hypothetical question, which is one of the few truly scientific features of the rules of Evidence, should have become that feature which does most to disgust men of science with the law of Evidence.”¹⁶⁶

Even the old and powerful hearsay doctrine turned out to be problematic in the context of expert testimony. The caution of the courts in admitting opinions not based on observation of the particular facts of the case, and the fear of misleading the jurors by reading to them scientific statements they were hardly competent to assess, had led many courts to exclude what many considered the most natural source of scientific information—standard textbooks, reports, etc. The exclusion of these written documents was justified by the hearsay doctrine on the premise that they were statements not made under oath or that their author was not available for cross-examination. As with other doctrines, the courts slowly devised ways to work around this one, too. Some courts permitted the use of scientific treatises, but only to discredit an expert. Others allowed experts to “refresh their memory” by reading from standard works. Others even allowed publications of exact science, assuming their statements to be of ascertained facts rather than of opinion, and excluded other treatises, especially medical works.¹⁶⁷ Confusion and inconsistency, again, were rampant.

¹⁶⁵ See MCCORMICK, HANDBOOK, *supra* note 162, § 14, at 31; 2 JOHN H. WIGMORE, A TREATISE ON THE SYSTEM OF EVIDENCE IN TRIALS AT COMMON LAW §§ 672-686, at 766-81 (1904); Mason Ladd, *Expert Testimony*, 5 VAND. L. REV. 414, 425-27 (1952).

¹⁶⁶ McCormick, *supra* note 12, at 129 (quoting 3 WIGMORE, A TREATISE ON THE ANGLO-AMERICAN SYSTEM OF EVIDENCE § 686 (3d ed. 1940)).

¹⁶⁷ See John Henry Wigmore, *Scientific Books in Evidence*, 26 AM. L. REV. 390, 390-403 (1892); Warren M. Dana, *Admission of Learned Treatises in Evidence*, WIS. L.

By the end of the nineteenth century, it was clear that the American law of evidence had failed to control the problem of expert testimony. Designed to be the crown of modern American jurisprudence, a corpus of legal procedures as rational as Euclidean geometry, the law of evidence had turned instead into a highly complicated and technical domain, sagging to the point of collapse under the burden of its own distinctions, exceptions, and exclusionary duties.¹⁶⁸ In 1898, James Thayer called it a "piece of illogical, but by no means irrational, patchwork; not at all to be admired, nor easily to be found intelligible,"¹⁶⁹ and by 1904, his famous pupil, John Henry Wigmore, needed four thick volumes to cover it.¹⁷⁰ "There is a full realization now," concluded the *Chicago Legal News* in 1909, after a long historical review of expert testimony, "that in the present practice we have carried a branch of procedure out to the utter defeat of its object, to an absurdity; and that the result has been a wide-spread disgust with methods of legal administration."¹⁷¹

Thus, although first raising its head in the English courts, it was in America that the problem of expert testimony reached its fullest expression. The diversion in England of technical litigation away from jury trials and the efforts of the authoritative royal judges seemed to have kept the thriving business of expert testimony under relative check. The last decades of the nineteenth century saw the bitter English debates concerning the problems of expert testimony subsiding. Across the Atlantic, however, things went from bad to worse. Unable to check either the selection of the experts or their evidence in court, or the jury's assessment of this evidence, late nineteenth-century American courts saw the problem of scientific expert testimony reach a crisis.¹⁷²

REV. 455, 455-62 (1945); JOHN D. LAWSON, *THE LAW OF EXPERT AND OPINION EVIDENCE REDUCED TO RULES* 169-94 (St. Louis, F.H. Thomas 1883); HENRY WADE ROGERS, *THE LAW OF EXPERT TESTIMONY* 166-86 (St. Louis, William H. Stevenson 1883).

¹⁶⁸ James B. Thayer, *The Present and Future of the Law of Evidence*, 12 HARV. L. REV. 71, 72-74 (1898).

¹⁶⁹ *Id.* at 72.

¹⁷⁰ See WIGMORE, *supra* note 165. Thayer's son later reminisced how a famous judge, J.H. Choate, asked him to tell his father that his famous *Preliminary Treatise on Evidence at the Common Law* (1898) was a good book, "but it is a pity he did not publish it while there was still such a thing in existence as the law of evidence." Ezra Ripley Thayer, *Observations on the Law of Evidence*, 13 MICH. L. REV. 355, 364 (1915).

¹⁷¹ Bond, *Expert Witness*, 42 CHI. LEGAL NEWS 115 (1909).

¹⁷² Much research is still needed on the developments in England. Clearly, despite the relatively greater judicial control and latitude, the problem of scientific expert testimony has continued to simmer in English courts throughout the twentieth

The grim legal mood was captured by Judge Gustav Endlich in his 1896 address on expert testimony before the prestigious Law Academy of Philadelphia:

Indeed, it is difficult to conceive of language within the bounds of decent and temperate criticism, which ought to be regarded as excessively severe in commenting upon the expert testimony nuisance as it has, of late years, been infesting our courts. In the way of wasting the public time, in the way of burdening litigants with expense, and in the way of beclouding the real issues to be tried and effecting miscarriages of justice, it has grown to the proportions of an offensive scandal. Instead of being an aid in the administration of the law, it has become a positive hindrance to it. Instead of assisting in the approximation of the truth, it has become the means of obscuring it. . . . [E]xpert testimony is to-day discredited and rightly discredited by the courts, and ridiculed and rightly ridiculed by the hard common sense of the people.¹⁷³

This outlook was shared by many, in and out of the legal profession. Invited to speak on expert testimony before the New Hampshire Medical Society at its 1897 annual meeting, Judge William Foster chose to open his address with a joke popular within legal circles: "There are three kinds of liars,—the common liar, the [damned] liar, and the scientific expert."¹⁷⁴ Foster assures his scientific audience:

This characterization . . . is bestowed . . . not only by defeated lawyers and their enraged clients, but also by eminent members of the legal profession, both lawyers and judges, as well as by worthy and respectable members of the general public outside of the professions involved. It is the voice of the people and of the press, as well as that of the bench and the bar. It is the fashion.¹⁷⁵

V. DEVELOPMENTS DURING THE TWENTIETH CENTURY IN THE UNITED STATES

As Endlich's and Foster's choice of words made clear, the feeling by the end of the nineteenth century was that the problem of expert testimony had reached rock bottom.¹⁷⁶ The

century. See generally SCIENCE AND TECHNOLOGY IN THE EYE OF THE LAW (A.M. Muir Wood ed., 2000); HARRY WOOLF, ACCESS TO JUSTICE: FINAL REPORT (1996); E. Erzinclioglu, *British Forensic Science in the Dock*, NATURE 859-60 (1998).

¹⁷³ GUSTAV ENDLICH, EXPERT TESTIMONY: WHAT IS TO BE DONE WITH IT? 5, 12-13 (Phila. 1896).

¹⁷⁴ See Foster, *supra* note 159, at 169.

¹⁷⁵ *Id.*

¹⁷⁶ Judicial complaints about scientific expert testimony could be compiled almost at will. For one of the more extensive compilations, see L.G. Kinne, *Expert*

debate over its causes and solution had been picking up steam for almost half a century, and the remedies suggested, as another judge put it, were “as numerous as prescriptions for the cure of rheumatism and generally about as useful.”¹⁷⁷ The disease was spreading fast, however, and the pressure for a remedy, any kind of a remedy, was mounting. Something eventually had to give way in the sacred triangulation of the adversarial system: either the political postulate of the lay jury, the traditional right of the parties to furnish all evidence, or the neutral position of the court.

In 1905, Michigan made the first attempt to accomplish such a reform by an act of the legislature. It passed a statute that embodied the most popular reform suggestion—that of allowing the court to nominate its own experts. The statute contained the mildest possible version of such a reform. It did not preclude the parties from using their own witnesses but provided in criminal cases for the additional appointment by the court of no more than three disinterested persons, whose identity should not be made public, to investigate issues involving expert knowledge and testify to their findings at the trial. Nevertheless, the Michigan Supreme Court held the statute unconstitutional.¹⁷⁸ The court considered it no part of the duties of the court to select witnesses.¹⁷⁹ Such activity, it pointed out, transferred the power of choosing witnesses from the prosecutor, an administrative officer, to a member of the judicial department, in violation of the provision of the state constitution for a separation of powers.¹⁸⁰ The court considered the statute a violation also of the fundamental right of the accused to a fair and impartial trial. The official sanction of judicial appointment, the court pointed out, would give the court experts an “extraordinary certificate of candor, ability, and truthfulness, while the other testimony in the case must be judged by the jury by ordinary standards.”¹⁸¹ Declaring the legislation in question unconstitutional, the court expressed the opinion that the only available remedy for the acknowledged evils at which the statute aimed would have to

Testimony—Its Origin, Value, Dangers and Proper Place in Jurisprudence, 4 AM. LAW. 201, 201-04 (1896); see also Learned Hand's famous piece on the topic, *supra* note 2.

¹⁷⁷ Kidd, *supra* note 159, at 217.

¹⁷⁸ *People v. Dickerson* 129 N.W. 199, 199-201 (Mich. 1910).

¹⁷⁹ *Id.* at 200-01.

¹⁸⁰ *Id.* at 201.

¹⁸¹ *Id.*

be found in a "livelier sense of responsibility to the public for the proper and decent administration of justice."¹⁸²

The decision dealt a serious blow to those who had been advocating reform of expert testimony by means of statutory enactment. Taking their cue from the Michigan Supreme Court, and accepting that the experts should remain party-chosen and the jury still be considered the final trier of facts, early twentieth-century American legal scholars concentrated their attention on improving the standards of admissibility for the party-chosen expert.¹⁸³ Their renewed hopes of succeeding where their predecessors had so miserably failed hinged on a clear change in the market of scientific expertise, created by the rising professional culture in America. By the second decade of the twentieth century, the individual expert who developed and marketed his or her own expertise had already been replaced by a community of experts who shared, and were defined by, common standards of competence and ethics. A wide range of expertise, from the scientific and technological fields of the chemists, physicists, and engineers, to architects, surveyors, actuaries, realtors, insurers, and accountants, came to be dominated by professional associations of practitioners. These associations developed codes of ethics, standards of education, training and practice, and defined minimum qualifications of certification either through their own examinations or through those of the various state boards of examiners.¹⁸⁴

By the second decade of the twentieth century, one can find legal scholars pondering the ways in which the courts could take advantage of this standardized market of expertise to check the problem of expert testimony. "The remedy is not in the enactment of any new statute," wrote one scholar in 1910.¹⁸⁵ "No act of the legislature will make witnesses learned or honest. The reform must come from the professions themselves."¹⁸⁶ It was not clear exactly how such a reform should be carried out. "There is . . . the logical possibility that no remedy exists, or that any proposed remedy brings in its

¹⁸² *Id.*; see also Note, *supra* note 160, at 483-84.

¹⁸³ *E.g.*, Lee M. Friedman, *Expert Testimony: Its Abuse and Reformation*, 19 YALE L.J. 247, 252-57 (1910).

¹⁸⁴ THOMAS L. HASKELL, *THE AUTHORITY OF EXPERTS: STUDIES IN HISTORY AND THEORY* 180-225 (1984).

¹⁸⁵ Friedman, *supra* note 183, at 252.

¹⁸⁶ *Id.*

train new evils worse than the disease which it cures,” claimed another commentator in 1915.¹⁸⁷ One thing was clear, though. “In the selection of experts no solution can be considered satisfactory that does not provide for the selection by the profession involved.”¹⁸⁸ Eight years later, in 1923, the Court of Appeals for the District of Columbia came up with the first effective formulation of such a solution.¹⁸⁹

A. *The General Acceptance Standard*

The decision was occasioned by the newly invented and highly publicized lie-detector technology. In 1922, a young African-American named James Frye was accused of murder in Washington, D.C.¹⁹⁰ Frye pleaded not guilty, and his lawyer offered one of the inventors of the lie detector, William Marston, as an expert witness to testify to the results of a test performed on the defendant, which allegedly proved his truthfulness.¹⁹¹ The trial judge, Walter Irvin McCoy of the Supreme Court of the District of Columbia, refused to admit Marston and his sensational test in evidence.¹⁹² As far as he was concerned, McCoy proclaimed, such tests were inadmissible until “there is an infallible instrument for ascertaining whether a person is speaking the truth or not. . . ., [but] I shall be dead by that time, probably, and it will bother some other judge, not me.”¹⁹³ Frye was found guilty, and his lawyer appealed on the ground that the scientific expert and his evidence were improperly excluded.¹⁹⁴

The Court of Appeals for the District of Columbia likewise was not going to allow the sensational lie-detector test into the court. Still, being an appellate court, it needed to furnish a better rationale for its exclusion than McCoy’s peculiar infallibility standard. This was not an easy task, however. In 1923, there was no special rule for the admissibility of scientific evidence. Like every other type of evidence, scientific evidence was mainly evaluated according to

¹⁸⁷ Kidd, *supra* note 159, at 218, 223.

¹⁸⁸ Friedman, *supra* note 183, at 252; Kidd, *supra* note 159, at 218, 223.

¹⁸⁹ Frye v. United States, 293 F. 1013, 1014 (D.C. Cir. 1923).

¹⁹⁰ See WILLIAM MOULTON MARSTON, LIE DETECTOR TEST 70-72 (1938).

¹⁹¹ See *id.* at 71-72.

¹⁹² See James E. Starrs, *A Still-Life Watercolor: Frye v. United States*, 27 J. FORENSIC SCI. 684, 691 (1982).

¹⁹³ *Id.* at 694.

¹⁹⁴ *Frye*, 293 F. at 1014.

the traditional evidentiary criteria: the “logical relevancy” of the evidence and its helpfulness to the trier of fact, and the qualifications of the witness.¹⁹⁵ Neither criterion offered the Court of Appeals for the District of Columbia much reason to exclude the lie detector. The logical relevance of the test and its potential helpfulness to the jury were obvious. So were the credentials of the test inventor, William Marston. He was a lawyer, a member of the Massachusetts Bar, and a well-published research psychologist, who possessed special training and extensive practical experience in the subject in question.¹⁹⁶ Thus qualified, the weight of legal precedent of expert testimony was clearly for admissibility.¹⁹⁷

Unable to exclude Dr. Marston and his deception test on the basis of the existing admissibility rules, the *Frye* court put forward an innovative rationale that shifted the focus of the admissibility process from the expert’s credentials to the particular scientific knowledge he proposed to the court.

Just when a scientific principle or discovery crosses the line between the experimental and demonstrable stages is difficult to define. Somewhere in this twilight zone the evidential force of the principle must be recognized, and while courts will go a long way in admitting expert testimony deduced from a well-recognized scientific principle or discovery, the thing from which the deduction is made must be sufficiently established to have gained general acceptance in the particular field in which it belongs. We think that the systolic blood pressure deception test has not yet gained such standing scientific recognition among physiological and psychological authorities as would justify the courts in admitting expert testimony deduced from the discovery, development, and experiments thus far made. The judgment is affirmed.¹⁹⁸

Proposing to look for a general acceptance in the particular field to which the expertise belonged, *Frye* offered a potent point of departure from the traditional deadlock of scientific expert testimony. The jury was still considered the final trier of facts, and the experts would still be party-chosen; but the

¹⁹⁵ See MCCORMICK, HANDBOOK, *supra* note 162, at 489; JAMES BRADLEY THAYER, A PRELIMINARY TREATISE ON EVIDENCE AT THE COMMON LAW 266 (Boston, Little, Brown, and Co. 1898); Herman L. Trautman, *Logical or Legal Relevance—A Conflict in Theory*, 5 VAND. L. REV. 385, 385, 392 (1952).

¹⁹⁶ KEN ALDER, THE LIE DETECTORS: THE HISTORY OF AN AMERICAN OBSESSION 39-40, 48-51 (2007).

¹⁹⁷ See BEST, *supra* note 144, at §§ 513-515, at 867-88; THAYER, *supra* note 195, at 195-97; David L. Faigman et al., *Check Your Crystal Ball at the Courthouse Door, Please: Exploring the Past, Understanding the Present and Worrying About the Future of Scientific Evidence*, 15 CARDOZO L. REV. 1799, 1803-04 (1994).

¹⁹⁸ *Frye*, 293 F. at 1014.

judicial ability to control the market of scientific expert testimony was significantly extended from the realm of the expert to the realm of expertise.¹⁹⁹

A century and a half earlier, in 1782, George Hardinge, barrister of the Middle Temple, suggested a similar rationale in *Folkes v. Chadd*.²⁰⁰ John Smeaton was a worthy expert, Hardinge argued, but he propounded in court a theory whose scientific status was yet unsettled. Hence, his evidence should be excluded. Lord Mansfield rejected the proposed distinction between the expert and his expertise. Mansfield's decision, maintaining that it was not for the court to qualify the expert's opinion, shaped the nineteenth-century practice of expert testimony.²⁰¹ If a person was qualified as an expert, his or her expert opinion came along; it was the job of the cross-examiner to expose the weaknesses of the testimony and for the jury to weigh it.²⁰² A century and a half later, the *Frye* court reintroduced Hardinge's exclusionary logic into the rules of evidence; being an expert was no longer enough.²⁰³

The *Frye* opinion portrayed scientific knowledge as an evolutionary process that had to advance from the experimental to a demonstrable stage before it could be accepted in the court. This resonated admirably with the pragmatic vision of American professional culture that conceived of expert knowledge as a communal product that could be objectively evaluated, independently from the individual expert.²⁰⁴ In a similar fashion, the search for general acceptance within the relevant scientific community accorded well with the dominant progressive views of the age, which conceived of law as an organic part of greater society and emphasized the role of coordinated expertise in the joint attempt to run society

¹⁹⁹ Wigmore offered a similar but less demanding formulation in a new section, entitled "Scientific Experimental Tests by Psychologists," that he added to the 1923 edition of his famous treatise on evidence: "All that should be required as a condition is the preliminary testimony of a scientist that the proposed test is an accepted one in his profession and that it has a reasonable measure of precision in its indications." 2 WIGMORE, *supra* note 7, § 990, at 419.

²⁰⁰ See *supra* text accompanying notes 63-67.

²⁰¹ See THAYER, *supra* note 31, at 672-73; 4 WIGMORE, *supra* note 7, § 1917, at 102-04.

²⁰² See MCCORMICK, HANDBOOK, *supra* note 162, at 363-64.

²⁰³ See *Frye*, 293 F. at 1014; Black et al., *Science and the Law in the Wake of Daubert: A New Search for Scientific Knowledge*, 72 TEX. L. REV. 715, 725-27 (1994).

²⁰⁴ Arthur O. Lovejoy, *The Thirteen Pragmatisms*, 5 J. PHIL. PSYCH. & SCI. METHODS 1-12, 29-39 (1908); H.S. THAYER, MEANING AND ACTION: A CRITICAL HISTORY OF PRAGMATISM 50-66 (1968).

efficiently and uniformly.²⁰⁵ Still, originating in an extreme case and containing no precedential citations, the decision of the Court of Appeals for the District of Columbia remained at first an isolated solution to a particular problem. During the following three decades, the courts remained content with applying the requirement for general acceptance only to exorcize from criminal trials evidence derived from various lie-detection and truth serum schemes.²⁰⁶ It was only in the post-World War II years that the courts began to apply the general acceptance requirement as an exclusive test in a constantly broadening range of novel scientific evidence.²⁰⁷

The growing adoption of *Frye* signaled the onset of a new judicial trend towards ever-greater judicial scrutiny of scientific evidence. The expansion of this judicial role during the second part of the twentieth century can be described in terms of both the scope of the cases to which it has been applied and the depth of the judicial scrutiny of the scientific evidence. Thus, by the early 1950s, *Frye* was already addressed in the legal literature as the leading criterion for the admissibility of novel types of scientific evidence in criminal trials.²⁰⁸ In the 1960s, the U.S. Supreme Court restricted the acquisition of evidence in criminal cases via traditional interrogation techniques.²⁰⁹ Perhaps in response, crime laboratories flooded the courts with innovative scientific technologies, and trial judges started to use *Frye* as a ready-made tool to decide the reliability of evidence derived from new techniques such as voice prints, neutron activation analysis, gunshot residue tests, bite mark comparisons, scanning electron microscopic analysis,

²⁰⁵ See generally Roscoe Pound, *The Scope and Purpose of Sociological Jurisprudence* (pts. 1-3), 24 HARV. L. REV. 591 (1911), 25 HARV. L. REV. 140, 489 (1911-1912).

²⁰⁶ See FOURTEENTH ANNUAL REPORT OF THE JUDICIAL COUNCIL OF THE STATE OF NEW YORK 264-65 (1948); Charlotte L. Smallwood, Comment, *Evidence: Lie-Detector: Discussion and Proposals*, 29 CORNELL L. Q. 535, 535-38 (1944). Courts cited *Frye* only five times prior to World War II; each case but one involved lie detectors. See SHEPARD'S FEDERAL CITATIONS.

²⁰⁷ After World War II, the case was only cited 6 times before 1950, 20 times during the 1950s, 21 times during the 1960s, 100 times during the 1970s, 470 times during the 1980s, and 350 times in the early 1990s. See Black et al., *supra* note 203, at 722 n.30.

²⁰⁸ See, e.g., MCCORMICK, HANDBOOK, *supra* note 162, at 363; Felver A. Rowell, Jr., Comment, *Admissibility of Evidence Obtained by Scientific Devices and Analysis*, 6 ARK. L. REV. 181, 181 (1952).

²⁰⁹ See, e.g., *Mapp v. Ohio*, 367 U.S. 643 (1961); *Miranda v. Arizona*, 384 U.S. 436 (1966); *United States v. Wade*, 388 U.S. 218 (1967); *Stovall v. Deno*, 388 U.S. 293 (1967).

truth sera, and numerous others.²¹⁰ By the 1970s, *Frye*'s general acceptance standard had become "not only the majority view . . . [but] the almost universal view" in the majority of criminal courts that considered the admissibility of new scientific evidence.²¹¹ By the end of the 1980s, the judiciary expanded its use from criminal to civil proceedings.²¹² Finally, by the 1990s, as the judiciary grew confident in their ability to measure the proffered expert evidence, the courts moved from deferring to the judgment of the scientific community to independently finding out things for themselves.²¹³

The expanding judicial dominion over scientific expert testimony met with increased criticism.²¹⁴ The earliest critics considered judicial screening of the scientific evidence as an unnecessary procedure that deprived the jurors of their right to decide for themselves what facts are valuable.²¹⁵ As the use of *Frye* multiplied, so did its critics—complaining that the general acceptance criterion was too vague, too narrow, and too slow.²¹⁶ The courts responded by setting forth supporting rationales. Their main argument was that *Frye* finally provided the courts with a uniform "method for ensuring the reliability of the

²¹⁰ Paul C. Giannelli, *The Admissibility of Novel Scientific Evidence: Frye v. United States, A Half-Century Later*, 80 COLUM. L. REV. 1197, 1198-1200; Edward J. Imwinkelried, *A New Era in the Revolution of Scientific Evidence—A Primer on Evaluating the Weight of Scientific Evidence*, 23 WM. & MARY L. REV. 261, 261-63 (1982).

²¹¹ Edward J. Imwinkelried, *The Standard for Admitting Scientific Evidence: A Critique from the Perspective of Juror Psychology*, 28 VILL. L. REV. 554, 556 (1983). By the mid-1970s approximately forty-five states followed the *Frye* standard. *Id.* at 557.

²¹² *Sterling v. Velsicol Chem. Corp.*, 855 F.2d 1188, 1208 (6th Cir. 1988). The Sixth Circuit did not cite *Frye*; nevertheless it excluded "clinical ecology" evidence for not being generally accepted in the relevant scientific community. The Fifth Circuit applied *Frye* soon after, in 1991, in *Christophersen v. Allied-Signal Corp.*, 939 F.2d 1106, 1115-16 (5th Cir. 1991). Tellingly, both of these were toxic tort cases.

²¹³ See the so-called Daubert trilogy: *Daubert v. Merrell Dow Pharm., Inc.*, 509 U.S. 579 (1993); *General Elec. Co. v. Joiner*, 522 U.S. 136 (1997); *Kumho Tire Co., Ltd. v. Carmichael*, 526 U.S. 137 (1999).

²¹⁴ David E. Bernstein, *Frye, Frye, Again: The Past, Present, and Future of the General Acceptance Test*, 41 JURIMETRICS J. 385, 396-400 (2001); Giannelli, *supra* note 210, at 1197 n.59; Imwinkelried, *supra* note 210, at 264-67; John D. Borders, Jr., Note, *Fit to Be Fried: Frye v. United States and the Admissibility of Novel Scientific Evidence*, 77 KY. L.J. 849, 860-62 (1989).

²¹⁵ Professor McCormick criticized the general acceptance test and argued that it "is a proper condition upon the court's taking judicial notice of scientific facts, but not a criterion for the admissibility of scientific evidence." MCCORMICK, HANDBOOK, *supra* note 162, at 363.

²¹⁶ Giannelli, *supra* note 209, at 1226 n.59; Imwinkelried, *supra* note 210, at 265; Frederic I. Lederer, *Resolving the Frye Dilemma—A Reliability Approach*, 26 JURIMETRICS J. 240, 241 (1986).

scientific evidence.”²¹⁷ However, in practice, “the thing from which the deduction is made” has meant different things to different courts at different times. The ambiguities inherent in determining the particular field to which new scientific evidence belongs, and in deciding how to measure its “general acceptance,” left ample room for discretion. Consequently, *Frye* ended up having not one but many general acceptance criteria, which the courts seemed to apply in a selective manner, according to their own views about the reliability of the particular forensic technique before them.²¹⁸

Meanwhile, a new twist entered the plot. In 1975, the rules that federal judges must follow were finally codified. Completely disregarding *Frye*, the newly enacted *Federal Rules of Evidence* (“FRE”) prescribed no special test to ensure the reliability of scientific evidence, new or old. Instead, casting the widest net possible, the FRE provided:

If scientific, technical, or other specialized knowledge will assist the trier of fact to understand the evidence or to determine a fact in issue, a witness qualified as an expert by knowledge, skill, experience, training, or education, may testify thereto in the form of opinion or otherwise.²¹⁹

Having left open the question of how one defines “scientific, technical, or other specialized knowledge,” the FRE was generally interpreted as prescribing a more flexible judicial consideration of scientific evidence in order to create the opportunity for more types of scientific evidence to be used in court.²²⁰ On the other hand, since the FRE did not state an explicit intent to abandon the *Frye* rule, some federal and almost all state courts remained committed to the “general

²¹⁷ Giannelli, *supra* note 209, at 1207.

²¹⁸ *Id.* at 1210-11, 1221; *see also* MCCORMICK, HANDBOOK, *supra* note 162, at 363-64; Black et al., *supra* note 203, at 724; Ronald N. Boyce, *Judicial Recognition of Scientific Evidence in Criminal Cases*, 8 UTAH L. REV. 313, 314-15 (1964); John William Strong, *Questions Affecting the Admissibility of Scientific Evidence*, 1970 U. ILL. L.J. 1, 14; DAVID W. LOUISELL & CHRISTOPHER B. MUELLER, *FEDERAL EVIDENCE* 820-26 (1977).

²¹⁹ FED. R. EVID. 702 (1975).

²²⁰ According to the U.S. Supreme Court, the general approach of the Federal Rules of Evidence was “of relaxing the traditional barriers to opinion testimony.” The Court referred to *Frye*’s as an “austere standard, absent from and incompatible with, the Federal Rules of Evidence.” *Daubert*, 509 U.S. at 589. According to Judge Weinstein, “The Rules were designed to depend primarily upon lawyer-adversaries and sensible triers of fact to evaluate conflicts.” Jack B. Weinstein, *Rule 702 of the Federal Rules of Evidence Is Sound; It Should Not Be Amended*, 138 F.R.D. 631, 631 (1991) (quoted in *Daubert*, 509 U.S. at 589).

acceptance” criterion as an absolute prerequisite to the admissibility of scientific evidence.²²¹

The debate concerning the proper judicial attitude and standard for the admissibility of scientific evidence intensified during the late 1980s and early 1990s, heated by growing fears of a mass tort litigation explosion.²²² Until the 1970s, judicial scrutiny of scientific evidence took place almost exclusively in criminal cases, where life and liberty are on the line.²²³ However, the 1970s saw the rise of tort law as a new major arena for scientific evidence. Dangerous drugs, industrial defects, environmental pollutants, and a host of other technological breakdowns have all become the subject of prolonged civil litigation with ever-escalating financial stakes.²²⁴ In the great majority of these cases, the central legal questions were of risk and causation, which invariably turned upon scientific evidence and put on display, again, the all-too-familiar sight of leading scientific experts producing from the witness stand conflicting data and contradictory conclusions.²²⁵

The customary complaints soon followed, and the warning was sounded that America’s courts were being swamped by “junk science,” produced by an unholy alliance between unscrupulous experts and opportunistic attorneys.²²⁶ The judges were urged to raise the bar and rely on the conservative interpretation of *Frye* in order to protect the credulous jury from pseudoscientific experts, and the deep-pocketed corporations from greedy lawyers.²²⁷ Others objected. The *Frye* test, they argued, sanctions a stifling and repressive scientific orthodoxy that could prevent the courts from learning

²²¹ Giannelli, *supra* note 209, at 1228-31.

²²² See generally PETER W. HUBER, *GALILEO’S REVENGE: JUNK SCIENCE IN THE COURTROOM* (1991).

²²³ Bernstein, *supra* note 214, at 389-90.

²²⁴ See generally MARCIA ANGELL, *SCIENCE ON TRIAL: THE CLASH OF MEDICAL EVIDENCE AND THE LAW IN THE BREAST IMPLANT CASE* (1996); JOSEPH SANDERS, *BENEDICTIN ON TRIAL: A STUDY OF MASS TORT LITIGATION* (1998); PETER H. SCHUCK, *AGENT ORANGE ON TRIAL: MASS TOXIC DISASTERS IN THE COURTS* (1987). But see Michael Saks, *Do We Really Know Anything About the Behavior of the Tort Litigation System, and Why Not?*, 140 U. PENN. L. REV. 1147, 1149 (1992) (examining tort litigation data from the mid-1970s to 1991).

²²⁵ For a plethora of examples, see HUBER, *supra* note 222; PHANTOM RISK: SCIENTIFIC INFERENCE AND THE LAW (Kenneth R. Foster et al., eds. 1993).

²²⁶ HUBER, *supra* note 222, 17-20; PRESIDENT’S COUNCIL ON COMPETITIVENESS, *AGENDA FOR CIVIL JUSTICE REFORM IN AMERICA* 4 (1991); CARNEGIE COMMITTEE ON SCIENCE, TECHNOLOGY AND GOVERNMENT, *SCIENCE AND TECHNOLOGY IN JUDICIAL DECISION MAKING* 11 (1993).

²²⁷ HUBER, *supra* note 222, at 200-01.

of authentic scientific innovations and citizens from seeking justice.²²⁸ Hence, they urged the court to adopt the relaxed admissibility requirements of the FRE.²²⁹ In short, the two-centuries-old debate between the Goulds, who maintain that the law should exclude from the courtroom certain expert opinions for not being scientific enough, and the Mansfields, who maintain that the law has no means to give preference to one kind of science over another, was back with renewed vigor.

B. Daubert in Historical Perspective

The conflict came to a head in 1993, when a civil suit by two minors, Jason Daubert and Eric Schuller, and their parents, against the giant pharmaceutical corporation Merrell Dow was decided by the Supreme Court. Daubert and Schuller were born with serious birth defects and blamed them on Merrell Dow's Bendectin, a popular anti-nausea drug their mothers took during their pregnancies.²³⁰ To prove a causal link between the drug and the birth defects, Daubert's lawyers offered eight well-credentialed experts, who based their conclusion that Bendectin can cause birth defects on: animal studies that found links between Bendectin and malformation; chemical analysis which pointed to structural similarities between Bendectin and other substances known to cause birth defects; and re-analysis of previously published epidemiological data that found a link between the drug and birth defects.²³¹ The federal judge was not impressed, finding that the animal studies and the chemical analysis insufficient to show causation.²³² The meta-analysis of the epidemiological data, he further pointed out, was created especially for the trial and was neither published nor subjected to peer-review.²³³ Thus, it could not be considered to be generally accepted under *Frye*.

²²⁸ See, e.g., Michael S. Jacobs, *Testing the Assumptions Underlying the Debate About Scientific Evidence: A Closer Look at Juror "Incompetence" and Scientific "Objectivity,"* 25 CONN. L. REV. 1083, 1085 (1993); Sheila Jasanoff, *What Judges Should Know About the Sociology of Science*, 77 JUDICATURE 77, 82 (1993).

²²⁹ See, e.g., Mark McCormick, *Scientific Evidence: Defining a New Approach to Admissibility*, 67 IOWA L. REV. 879, 908-15.

²³⁰ *Daubert v. Merrell Dow Pharm., Inc.*, 727 F. Supp. 570, 571 (1989), *aff'd*, 951 F.2d 1128, 1128 (9th Cir. 1991), *vacated*, 509 U.S. 579 (1993).

²³¹ *Id.* at 573.

²³² *Id.* at 575.

²³³ *Id.*

Consequently, the judge granted summary judgment to Merrell Dow and threw the case out before it could reach a jury.²³⁴

Daubert's lawyers appealed all the way to the Supreme Court, arguing that the FRE supersedes *Frye* and that according to the FRE, it is for a jury, not a judge, to determine the persuasiveness of scientific evidence. The Court agreed with the petitioners that *Frye* was superseded by the FRE, but rejected their let-it-all-in interpretation of the FRE. Instead, the Supreme Court read the FRE as requiring that the trial judge ensure that any scientific evidence admitted into the courtroom be reliable. Addressing the main question left open by the FRE—how one recognizes valid scientific knowledge—the Supreme Court acknowledged that ready-made formulae, such as the “general acceptance” criterion, failed to provide the desired answer.²³⁵ Nevertheless, the Court emphasized that an answer must be provided, and if a general formula could not be furnished, then it was the responsibility of trial judges to make their own inquiries in each and every case in order to provide it.²³⁶ To that end, the Supreme Court took a courageous dip into the murky waters of modern philosophy of science and came up with a flexible recipe of four non-exclusive factors that could be used by the trial judge in determining the quality of the scientific evidence proposed: testability, peer review, standardization, and general acceptance.²³⁷

Emphasizing the need for independent judicial inquiry into the reliability of all scientific evidence, *Daubert* has been widely celebrated as a breakthrough in the attitude of the courts towards scientific evidence. The decision was labeled the “death of *Frye*.”²³⁸ The seventy years since *Frye* were declared to have been “seven decades of hiding from science,”²³⁹ and *Daubert*'s new set of criteria was hailed as an attempt “to deal substantively with the problem of expert testimony in the

²³⁴ *Id.* at 576.

²³⁵ *Daubert*, 509 U.S. at 593-94.

²³⁶ *Id.* at 594-97.

²³⁷ *Id.* at 592-94. The petitioners won the Supreme Court battle but lost the war. The Ninth Circuit reconsidered the evidence and affirmed its exclusion again, this time under the new *Daubert* criteria. *Daubert v. Merrell Dow Pharm., Inc.*, 43 F.3d 1311, 1322 (9th Cir. 1995). For a detailed analysis of the *Daubert* decision and its criteria, see KENNETH R. FOSTER & PETER W. HUBER, JUDGING SCIENCE: SCIENTIFIC KNOWLEDGE AND THE FEDERAL COURTS 4-16 (1997).

²³⁸ Note the title of the symposium published in *Scientific Evidence After the Death of Frye: Daubert and Its Implications for Toxic Tort, Pharmaceutical, and product Liability Cases*, 15 CARDOZO L. REV. 1959 (1994).

²³⁹ Black et al., *supra* note 203, at 722.

courts.”²⁴⁰ However, a perspective beyond seven decades allows us to see *Daubert* more as the offspring of *Frye* rather than its killer. True, *Daubert* displaced *Frye*, but it also inherited *Frye*’s exclusionary logic. No longer a passive umpire who watches over the rules of the game, the twentieth-century trial judge has become an active player, a gatekeeper charged with the responsibility for screening unreliable scientific evidence. First formulated by the *Frye* court, albeit in a milder form, this exclusionary spirit has since come to dominate American legal thought, and the *Daubert* decision only served to affirm it more vigorously. Its admissibility criteria may be different, but its mindset followed, and put the final stamp on, the twentieth-century trend toward ever-greater judicial scrutiny of scientific evidence.

VI. DISCUSSION

What can we learn from this concise history of scientific expert testimony? First and foremost, that scientific expert testimony in common law courts has a long and rich history. This simple lesson is particularly important in the context of the current tendency to present the malaise of science in the courts as a sign of our time, the result of the growing volume and complexity of late twentieth-century science.²⁴¹ As this Article makes clear, this widely held assumption is flat wrong. Far from being new, the putative problems of scientific expert testimony in common law courts have existed since science was first introduced into the adversarial courtroom. The difficulties of fitting science within adversarial procedures; the reluctance of courts to mold a procedure that would shield science from the adversarial fire; the chronic inability of courts to bridge the gap between scientific experts and lay jurors; the failure of the legal and scientific professions to regulate the market of expertise; the resultant fear of a credulous jury bewitched in the name of science by charlatans and opportunists—none of these predicaments was new to the twentieth century.²⁴²

Not only the problems but also the debate over their meaning and the ways to resolve them had by the late-nineteenth century all of the features that today are blithely

²⁴⁰ ANGELL, *supra* note 224, at 127.

²⁴¹ See Development in the Law, *Confronting the New Challenges of Scientific Evidence*, 108 HARV. L. REV. 1481, 1484-85 (1995).

²⁴² See *supra* Parts I-IV.

assumed to be new.²⁴³ Almost every twentieth-century reform proposal can be traced back to the nineteenth century, including self-regulation,²⁴⁴ court-appointed experts,²⁴⁵ pre-approved experts lists,²⁴⁶ scientific tribunals,²⁴⁷ and expert juries.²⁴⁸ All these reform proposals fell flat. Not surprisingly, then, the feeling by the late twentieth century was remarkably similar to that which prevailed a century earlier: the problem of expert testimony had reached rock bottom.²⁴⁹

Legal scholarship has not been entirely oblivious of the problematic history of science in the courts.²⁵⁰ Still, the relevance and significance of this history have been undermined by at least two arguments. The first holds that experts who served as witnesses in the courts in the eighteenth and nineteenth centuries, and even in the early twentieth century, were not really scientists but experience-based experts.²⁵¹ This argument is, again, wrong. Prominent scientific experts made regular appearances in courts of law throughout the nineteenth century,²⁵² if not earlier.²⁵³ Furthermore, one could argue that in these earlier centuries law and science actually enjoyed closer, if not better, relations. Indeed, in the nineteenth century, which offered scientists very limited career opportunities, the legal system stood out as an exceptional and most lucrative market for scientific expertise—so much so that, while writing about the spectrum of Victorian science patronage, one historian of science could not help but wonder why it was that “on more than one occasion it would seem . . .

²⁴³ See *supra* Part III.C. For more on the nineteenth-century reform proposals, see GOLAN, *supra* note 38, at 107-43.

²⁴⁴ Edward K. Cheng, *Same Old, Same Old: Scientific Evidence Past and Present*, 104 MICH. L. REV. 1387, 1399-400 (2006).

²⁴⁵ *Id.* at 1393-96; see also Joe S. Cecil & Thomas E. Willging, *Court-Appointed Experts*, in REFERENCE MANUAL ON SCIENTIFIC EVIDENCE 525, 529-73 (1st ed. 1994).

²⁴⁶ Cheng, *supra* note 244, at 1395-96.

²⁴⁷ *Id.* at 1396-99; see generally Arthur Kantrowitz, *Proposal for an Institution for Scientific Judgment*, 153 SCIENCE 763 (1967); James A. Martin, *The Proposed “Science Court,”* 75 MICH. L. REV. 1058 (1977).

²⁴⁸ Cheng, *supra* note 244, at 1396-98.

²⁴⁹ See, e.g., HUBER, *supra* note 222, at 3-5.

²⁵⁰ See, e.g., Hand, *supra* note 2. For examples of historians’ accounts focusing on medical expert testimony, see MOHR, *supra* note 155; Landsman, *supra* note 33 (both articles); see also Hamlin, *supra* note 131.

²⁵¹ See, e.g., Lee Loevinger, *Science as Evidence*, 35 JURIMETRICS J. 153, 154 (1995) (“[M]any experts who served as witnesses in the courts in earlier centuries, and even in the twentieth century prior to *Frye*, were not scientists.”).

²⁵² See *supra* Parts III, IV.

²⁵³ See *supra* Part II.

that all the chemists in London were being shared by aggrieved parties in a patent action."²⁵⁴ In the 1850s, for example, August Hofmann, a major figure in the field of organic chemistry and a leading consultant to the artificial dye industry, was able to pull in a yearly income of eight to nine thousand pounds from his court appearances.²⁵⁵ Hofmann made this lofty income in patent litigation, which became a most profitable sideline activity for many leading men of science on both sides of the Atlantic.²⁵⁶

It would be a mistake, however, to subsume the evolving relations between law and science under monetary interests alone. Early nineteenth-century scientists dreamt of becoming "true amicus curia . . . a terror to the guilty and a joy to the innocent."²⁵⁷ But what had seemed in the early part of the nineteenth century as a central civil function of science had become by the end of the century a source of discontent. The courts were growing increasingly weary and wary of the conflicting scientific testimony, and the scientific community was growing increasingly bitter with the courts' deployment of its services. Far from being irrelevant, then, the history of nineteenth-century scientific expert testimony tells a dramatic story: what had started as a great promise of cooperation between law and science ended with mutual disenchantment. Instead of bringing these two powerful fraternities closer, forensic science pulled them further apart.²⁵⁸

A second assumption that served to discount the historical depth of the problems of science in the courts is that the growing volume and complexity of science made it increasingly harder for the judicial system to manage late

²⁵⁴ William H. Brock, *The Spectrum of Science Patronage*, in *THE PATRONAGE OF SCIENCE IN THE NINETEENTH CENTURY* 173, 187 (G.L'E. Turner ed., 1976).

²⁵⁵ *Id.* at 5.

²⁵⁶ See GOLAN, *supra* note 38, at 81-96. For scientific experts appearing in American courts, see RALPH K. ANDRIST, *STEAMBOATS ON THE MISSISSIPPI* (1962) (steamboat explosions); DE VILLE, *supra* note 137 (malpractice cases); LAWSON, *supra* note 137 (agricultural cases); LUCIER, *supra* note 123 (patent cases); Paul Lucier, *Court and Controversy: Patenting Science in the Nineteenth Century*, 29 BRIT. J. HIST. SCI. 139 (1996) (same); Okun, *supra* note 137 (food and drug adulteration); Fred Quivik, *Smoke and Tailings: An Environmental History of Copper Smelting Technologies in Montana, 1880-1930* (1998) (Ph.D. dissertation, Univ. of Pa.) (pollution cases); Spence, *supra* note 137 (mining cases).

²⁵⁷ William J. Lewis, *Forensic Microscopy, or the Microscope in Its Legal Relations*, PROC. AM. SOC'Y MICROSCOPISTS, Sept. 1889, at 5.

²⁵⁸ See generally ENDLICH, *supra* note 173; Foster, *supra* note 159; *Science in the Courts*, *supra* note 152; HERSCHEL, *supra* note 141; Himes, *supra* note 142.

twentieth-century science-rich cases.²⁵⁹ However, this widely held assumption has never been corroborated by comparative historical studies.²⁶⁰ Moreover, it is not clear why we should even assume that present-day judges and jurors would find it harder to handle the scientific evidence presented before them in court. Is DNA profiling really more complicated than fingerprinting or nineteenth-century blood tests? Is the science involved in testing new pharmaceuticals drugs harder to comprehend than the nineteenth-century science involved in patenting artificial dyes? Many historians and philosophers of science would answer in the negative. Science, they teach, advances not by sheer accumulation of details and complexities, but by devising new theories with superior organizational and predictive powers, which are not necessarily more complex.²⁶¹

Even if we concede that modern science did grow more complex (certainly it grew richer and far more specialized), we can still point to other developments that actually made science more accessible to laypersons. Scientific language, literature, and training have all been systematized, and its credentials, equipment, and procedures standardized. The presentation of scientific evidence in court has also been improved by visual technologies such as medical imaging and computer animation and simulation. Finally, lay understanding of science has greatly improved during the twentieth century, following the vast increase in the availability of modern education. All this supports the notion that a present-day factfinder should find it easier, not harder, to handle the scientific evidence presented in court. Indeed, during the last two decades, courts have consistently pronounced their confidence in the ability of lay judges to do just that—to critically evaluate the scientific

²⁵⁹ See, e.g., CARNEGIE COMMISSION ON SCIENCE, TECHNOLOGY, AND GOVERNMENT, *supra* note 226, at 1.

²⁶⁰ My own historical studies do not support this assumption. See GOLAN, *supra* note 38, at 211-64.

²⁶¹ No philosopher has explicitly discussed this aspect of complexity in any detail. However, many philosophers have described scientific progress as responding to notions such as simplicity, organizational strength, and predictive power. This implies that complexity may actually decrease at any given developmental step, or at least that it would not necessarily increase. See generally THOMAS KUHN, THE STRUCTURE OF SCIENTIFIC REVOLUTIONS 43-51 (1970); LARRY LAUDAN, PROGRESS AND ITS PROBLEMS: TOWARDS A THEORY OF SCIENTIFIC GROWTH (1977); see also PIERRE MAURICE MARIE DUHEM, THE AIM AND STRUCTURE OF PHYSICAL THEORY (Philip P. Wiener trans., 1954).

evidence presented to them.²⁶² But if a lay judge can do so on her own, why not twelve lay jurors in their combined wisdom?

The question remains: if the problems of scientific testimony were neither new to twentieth-century courts nor necessarily harder to manage, then what did change during this period? What has driven the unmistakable trend toward ever-greater judicial scrutiny of scientific evidence? Further research is needed before a convincing answer can be provided. Still, any answer would have to take into account the history outlined here. The early twentieth-century judicial attitude, I suggest, was a direct response to the late nineteenth-century crisis of scientific expert testimony. Unable to check either the selection of the experts or their evidence in court, or the jury's assessment of this evidence, the nineteenth-century courts were forced to admit almost everybody presented as experts, leaving juries to assess the ensuing battles between expert witnesses and lawyers.²⁶³ That changed in the early twentieth century with the professionalization of American scientists and the standardization of science education, literature, and practices. These developments provided the American legal system for the first time with the means to control the performance of scientific experts in the courtroom—by measuring the proffered individual expertise against the field's own standards. First offered by the *Frye* court, this rationale flourished during the middle decades of the twentieth century, thereby inculcating the exclusionary judicial attitude toward scientific evidence, which reached its high-water mark at the end of the century with the *Daubert* opinion.

The rise of mass tort litigation during the last quarter of the twentieth century helped to extend the new judicial gate-keeping role from criminal to civil proceedings.²⁶⁴ The extraordinarily complicated nature of this new species of lawsuit forced trial judges to become even more active players in the litigation process, and to develop new rules and procedures with an eye toward both economic consequences as

²⁶² The *Daubert* trilogy declares so directly. See, e.g., *Daubert v. Merrell Dow Pharm., Inc.*, 509 U.S. 579, 593 (1993).

²⁶³ See *supra* text accompanying notes 145-160. Whatever its failings, this arrangement was nevertheless justified as a necessary trade-off that provided the best "free-market" mechanism of proof testing and the best protection from the abuse of executive power. See, e.g., *Choate on Trial by Jury; New York Lawyer Addresses the American Bar Association*, N.Y. TIMES, Aug. 19, 1898, at 5.

²⁶⁴ See SCHUCK, *supra* note 224, at 3-15; Bernstein, *supra* note 214, at 385-86, 389-90.

well as broad social and political implications.²⁶⁵ The far-reaching effects of this litigation legitimated a new judicial role, less arbitral and more managerial in kind.²⁶⁶ Furthermore, the unprecedented financial risks for the defendants in mass tort cases induced powerful economic players to put their weight behind the long-stalling campaign for reform of legal procedures for handling expert testimony.²⁶⁷ The results were quick to show, and in the early 1990s the two-century-old debate was red-hot again.²⁶⁸ Having never addressed the problems of science in the courts, the U.S. Supreme Court found it necessary to do so three times during the 1990s, each time in the context of a product liability case.²⁶⁹ The important outcome of this series of Supreme Court opinions was not the oft-discussed four-prong *Daubert* test, but rather the further enhancement of the judicial gate-keeping role and its extension to civil proceedings.²⁷⁰

Finally, one should note that the growing judicial scrutiny of scientific evidence has not been driven by the loss of judicial faith in science.²⁷¹ On the contrary, despite the problematic history of science in the courtroom, the legal profession has never wavered in its trust in the scientific method.²⁷² During the nineteenth century, this steadfast belief

²⁶⁵ SCHUCK, *supra* note 224, at 5-7.

²⁶⁶ Sheila Jasanoff, *Science and the Statistical Victim: Modernizing Knowledge in Breast Implant Litigation*, 32 SOC. STUD. SCI., 37, 38-40 (2002).

²⁶⁷ See, e.g., the twenty-two amicus briefs filed in *Daubert* (links to the briefs available at <http://www.westlaw.com>). The unusually large number of briefs included a large cohort of major commercial interest groups such as the American Insurance Association, the American Tort Reform Association, the Chamber of Commerce of the United States, the Pharmaceutical Manufacturers Association, the Product Liability Advisory Council, the Defense Research Institute, Inc., and the Washington Legal Foundation. The scientific community was represented by a host of academies, societies, colleges, and journals such as the National Academy of Sciences; the American Medical Association; the American Association for the Advancement of Science; the *New England Journal of Medicine*; the *Annals of Internal Medicine*; the College of Legal Medicine; a group of eighteen scientists, scholars, and teachers of science (including six Nobel laureates); and another group of prominent physicians, scientists, and historians of science (including the late Stephen Jay Gould).

²⁶⁸ See generally CARNEGIE COMMITTEE ON SCIENCE, TECHNOLOGY AND GOVERNMENT, *supra* note 226; HUBER, *supra* note 222; PRESIDENT'S COUNCIL ON COMPETITIVENESS, *supra* note 226; SCHUCK, *supra* note 224; Saks, *supra* note 224.

²⁶⁹ *Daubert v. Merrell Dow Pharm., Inc.*, 509 U.S. 579; *General Electric Co. v. Joiner*, 522 U.S. 136 (1997); *Kumho Tire Co. v. Carmichael*, 526 U.S. 137 (1999).

²⁷⁰ See Cheng, *supra* note 244, at 1401.

²⁷¹ See Jennifer Mnookin, *Science at the Bar*, 92 AM. SCIENTIST (Nov.-Dec. 2004), available at <http://www.americanscientist.org/BookReviewTypeDetail/assetid/37203>.

²⁷² See *supra* text accompanying notes 125-127.

induced the judiciary to interpret conflicting expert testimony not as legitimate debate, but as a sign of moral decadence.²⁷³ During the twentieth century, it pushed the judiciary even further into scientific territory to exorcise charlatanism and differentiate good science from bad. Consequently, at the beginning of the twenty-first century, lay judges find themselves deeper than ever in the strange land of biostatistics, confidence levels, meta-analysis, and falsifiability, charged with the difficult task of weighing the merit of highly specialized scientific claims. How well the lay judges can meet these challenges and whether their gate-keeping role will lead to better adjudication are questions that will bear careful watching.

²⁷³ GOLAN, *supra* note 38, at 107-43; Hamlin, *supra* note 131, at 490-501.