The History of Scientific Expert Testimony in the English Courtroom*

The Argument

This paper provides a historical perspective to one of the liveliest debates in common law courts today — the one over scientific expert testimony. Arguing against the current tendency to present the problem of expert testimony as a late twentieth-century predicament which threatens to spin out of control, the paper shows that the phenomena of conflicting scientific testimonies have been perennial for at least two centuries, and intensely debated in both the legal and the scientific communities for at least 150 years.

1. Introduction

The problem of scientific expert testimony is one of the most serious concerns in common law courts today.1 Underlying this concern is the widespread belief shared by scientists, lawyers, policy makers, and scholars that there is an increase of "junk science," produced in the courts by opportunistic scientific expert witnesses at the behest of unscrupulous attorneys, and that it presents a dramatic new problem that demands immediate redress (Huber 1991; Angell 1996; Erzinclioglu 1998). As the 1993 final report of the Carnegie Commission on Science, Technology, and Government stated:

The courts' ability to handle complex science-rich cases has recently been called into question, with widespread allegations that the judicial system is increasingly unable to manage and adjudicate science and technology (S & T) issues. Critics have objected that judges cannot make appropriate decisions because they lack technical training, that jurors do not comprehend the

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complexity of the evidence they are supposed to analyze, and that the expert witnesses on whom the system relies are mercenaries whose biased testimony frequently produces erroneous and inconsistent determinations. If these claims go unanswered, or are not dealt with, confidence in the judiciary will be undermined as the public becomes convinced that the courts as now constituted are incapable of correctly resolving some of the most pressing legal issues of our day. (Carnegie Commission on Science, Technology, and Government 1993, 11)

However, the widespread belief that the problem of scientific expert testimony is a sign of our times, a result of the increasing difficulties judge and jury have in handling the growing volume and complexity of late twentieth-century scientific evidence, does not withstand historical scrutiny. Far from being new, the putative problem of scientific expert testimony in common law courts has a long and rich history. Examining some of this history in eighteenth and nineteenth-century England, I will show here that discontent with scientific expertise in the courts has existed ever since there have been scientific expert witnesses in the courts, and that by the mid-nineteenth century, the debate over the meaning of these conflicts and the ways to resolve them had all the features that today are blithely assumed to be new.2

This essay has four parts. Part 1 is the introduction. In Part 2, I describe how the legal entity of the scientific expert witness, as we know it today, was molded in late eighteenth-century England. Scientific expert testimony, I show, was problematic from its earliest days. In Part 3, I discuss how the problem of scientific expert testimony, and the debate about its meaning and proper solution evolved during the nineteenth century, and how the scientific and legal communities reacted to it. Finally, in Part 4, I discuss some of the lessons we might learn from this history of scientific expert testimony.

### 2. The Rise of the Modern Scientific Expert Witness

Although scientific expert testimony has come to dominate the modern Anglo-American courtroom, the expert witness as a distinct and well-defined legal entity did not exist before the end of the eighteenth century. To be sure, experts were employed in the courtroom well before the eighteenth century, but they were

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2 I will not discuss medical expert testimony. Its misfortunes are well studied (Landsman 1998, 1995; Clark and Crawford 1994; Mohr 1993; De Ville 1990). Moreover, medical expert testimony has been considered by many then and now to be only partially scientific, and the disagreements between the medical witnesses were considered therefore to be far less problematic than those among "real scientists" (Cf. Loevinger 1995, 154). I should mention, though, that nineteenth-century medical expert testimony frequently verged on legal and scientific chaos, and that the protection the "mad doctors" seemed to offer violent criminals contributed significantly to the deterioration of the status of expert testimony in the eyes of both the general public and the legal profession (Tighe 1984).
summoned either as jurors or as independent advisors to the court (Beuscher 1941; Oldham 1983). Experts were also summoned as witnesses, but not as expert witnesses. The distinction is important. Physicians testified in criminal, insurance, and will cases; surveyors in property cases; merchants testified concerning the particular norms of their trade; tradesmen concerning the quality of particular goods; ship builders about the state and construction of vessels; other artisans testified to their respective subject of skill; and so on and so forth (Hand 1901). Still, despite a growing presence in the court, the expert witness was not regarded as a distinct legal entity. Unlike court experts or those serving in expert juries, there was no legal procedure to define experts *qua* expert witnesses. Moreover, an expert who had inspected the facts of the case and testified to his or her conclusion, was not distinguished from other lay witnesses who often were permitted to testify to their opinion, if this was based on direct observation of the facts of the case (Wigmore 1923, 4:101–103). Thus, in the absence of a particular legal procedure or a theory that would differentiate them, experts testifying in court were regarded merely as witnesses. Such a procedure and a theory evolved only late in the eighteenth century as part of a larger transformation of the English legal system that legal historians call the Adversarial Revolution.

The Adversarial Revolution is associated with the expanding presence of lawyers in criminal proceedings (Langbein 1978). Until early in the eighteenth century defendants were not allowed to have counsel in criminal trials. The judge dominated the proceedings, and evidence was mostly adduced either by direct in-court confrontation between accuser, accused, and the witnesses, or by the judge who examined and cross-examined the parties and the witnesses himself. In this environment, testimonial constraints had little, if any, meaning. Thus, although the requirement of common law that regular testimony be limited to personal knowledge based on perception was very old, regular witnesses were nevertheless allowed to testify to their opinion or present hearsay evidence. If an objection was raised, the court was content with allowing it to go to the weight of the testimony rather than to its admissibility (Landsman 1990a, 1990b; Holdsworth 1938, 9:211–14; McCormick 1954, 111).

The participation of lawyers from the 1730s onward slowly reshaped the processes of criminal litigation as they increasingly took over the examination of witnesses, established the right to argue points of law, and perfected the techniques of cross-examination. As the notion took root that the parties could be held responsible for developing their own proof in court, judicial involvement in the processes of litigation diminished. Consequently, the parties gained control over the production of the evidence in court. The articulation of prosecution and defense cases soon followed, and by the end of the eighteenth century the courtroom was split into well entrenched territories of the judge, the jury, the litigants, and the lawyers — and highly intricate rules of evidence were developed in order to

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3 Except in treason trials, where counsel was allowed since the 1690s.
mediate the newly dispersed legal authority among these territories (Langbein 1983; Landsman 1990a).

With the rise of the adversarial system, the practice of evidentiary objection grew in strength and sophistication, as lawyers fought over the content and the presentation of the evidence before the jury (Best 1854, 133; Langbein 1983, 131–32). By the end of the eighteenth century these objections had evolved into two distinct and 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 was susceptible to factual statements (Wigmore 1904).

The hearsay and opinion doctrines slowly differentiated the expert witness into a distinct legal entity. However, they did so not directly by construction, but indirectly by curtailing the privileges of all other sources of specialized information until only the expert witness was left as the last, but necessary, exception to the rules (Hand 1901). Thus, the modern expert witness was born as an exception—a freak in the new adversarial world, the only type of witness the new system could not rationalize under its evolving doctrines—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 new adversarial system not only created the role of the expert witness, but also had a dramatic effect on its deployment in the courtroom. Traditionally, experts, whether as a part of the jury or as court advisors, were called and controlled by the court, which conferred on these experts a large degree of impartiality. However, during the eighteenth century, as the court assumed a neutral position, free reign was increasingly given in the courtroom to partisan views. As the interested parties began to summon their own expert witnesses to represent them before the jury, a potential problem seemed to emerge: how to ensure that lay jurors would still have access to reliable expert guidance when they needed it? However, an analysis of the rulings in leading eighteenth- and early nineteenth-century cases shows that there was little concern about this problem. While the judges were interested in 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 analysis of a 1782 case which has become iconic in the legal literature as "the court’s seal of approval on the whole adversarial apparatus including contending experts, hypothetical questions, and jury evaluation" (Landsman 1995, 141) will provide a clear example of this peculiar judicial disregard.

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4 Collecting his data from political state trials, Wigmore situated these developments toward the middle of the eighteenth century. Non-political criminal trials, however, lagged a generation or two behind.
The Wells Harbor Case

The chronicles of common law designate Folkes v. Chadd — an English civil case from 1782 — as the primary precedent that established the admissibility of scientific expert testimony and shaped the modern option of having the expert testify directly to the jury as a partisan witness. At issue in Folkes v. Chadd were the causes for the decay of the harbor of the town of Wells, on the northern coast of Norfolk. Having no river or other inland fresh water source, Wells Harbor relied 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. When the harbor became clogged with silt, the trustees of the harbor blamed it on a certain embankment that, so they argued, had weakened the body of back water available for scouring. The owners of the embankment, Sir Martin Folkes and Mr. Hales, hired the services of a renowned civil engineer, Robert Mylne, F.R.S., to disprove the accusations against them in court and to persuade the jury that their embankment caused no harm to the harbor (Mylne 1781). The authoritative testimony of a fellow of the Royal Society who had made a special study on the causes of the decay of the harbor must have left a strong impression with the jury, which returned a verdict for the embankment's owners. The trustees of Wells Harbor requested a new trial on the grounds that they “were surprised by the doctrine and reasoning of Mr. Mylne.” The royal judges of the King's Bench approved the request on the grounds that the trustees of the harbor should have had the opportunity to counter Mylne's testimony with their own expert since “in matters of science, the reasoning of men of science can only be answered by men of science” (Folkes v. Chadd 1782, 3:157, 159).

For the new trial, Sir Martin and Mr. Hales hired the services of the leading authority on harbors in the Kingdom, John Smeaton, F.R.S. After traveling from London to Wells and spending a week of inspections there, Smeaton submitted an exhaustive report to his employers (Smeaton [1782] 1812). Launching his report with a lengthy theoretical discussion of the general principles that govern the creation and decay of non fresh-water harbors, Smeaton concluded that Wells Harbor was doomed by the same formidable forces of the sea and the weather that had once created it.

The progressional operation of nature, which originally formed the harbor 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 to a firm ground, fit for arable purpose, and those of pasturage, the very spot where ships have rode at anchor. (Ibid., 31)

This progression of nature, Smeaton added, could have been countervailed by “the industry, art, and hand of man,” but these required money and expertise. Instead,

5 For a detailed study of Folkes v. Chadd, see (Golan 1997, 1-65).
the commissioners of Wells Harbor chose to build cheap and faulty sluices, and then blamed other people for their troubles (ibid., 35).

At the trial, when Smeaton was called to the witness stand, the trustees of Wells Harbor objected. Smeaton's testimony, they argued, "was a 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." The presiding judge, Henry Gould, Chief Justice of the Royal Court of Common Pleas, agreed and did not allow Smeaton to address the jury from the witness stand. He did allow the jury to read Smeaton's written report, but the report did not suffice to convince the jury, which gave a verdict for the trustees of the harbor who were allowed to cut the embankment that allegedly choked up their harbor. Sir Martin and Mr. Hales asked immediately for a new trial on the ground that the judge improperly rejected the evidence of their leading expert (Folkes v. Chadd 1782, 158).

Lord Mansfield, Chief Justice of the King's Bench and arguably the most influential English judge of the eighteenth century, found Smeaton's exclusion from the witness stand to be an error and granted a new trial. True, Mansfield reasoned, Smeaton's testimony was "a matter of opinion." However,

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. ... It is a matter of judgement what has hurt the harbor. ... 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 harbors, the causes of their destruction and how remedied. In matters of science no other witnesses can be called. (Folkes v. Chadd 1782, 159)

According to the noted legal historian John Wigmore, Mansfield's decision of "the great case of Folkes v. Chadd" was the first instance of the modern conception which allows the expert to give an opinion whether he or she had observed the facts of the case directly or not.

[Smeaton] 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 opinion serve as decisive? (Wigmore 1923, 4:103)

In Wigmore's opinion, there could have been only one reason for listening to Smeaton's testimony, namely, "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" (ibid., 4:105). Wigmore, however, had his facts wrong. Smeaton not only had seen the place, but also had made a detailed report on his findings, which was accepted by the court as evidence. Thus, although Wigmore's claim may still stand, it nevertheless cannot rely, as it does, on Mansfield's decision as its precedent.

Another famous legal historian, James Thayer, read yet another fundamental modern distinction into Mansfield's decision. Thayer presented it as the first instance of "the modern conception ... which regards the expert as testifying, like other witnesses, directly to the jury" (Thayer 1892, 666). A close reading of Mansfield's decision, however, shows that Mansfield's decision to allow Smeaton to testify directly to the jury was an endorsement not of partisan expert testimony but of the opinion of men of science such as Smeaton. Mansfield's reasoning and choice of precedents show complete disregard for the distinction between the court expert and the partisan expert witness. In fact, Mansfield analyzed Smeaton's testimony as if Smeaton was a court expert:

> When such questions come before me, I always send for some brethren of the Trinity House. I cannot believe 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. Handwriting is proved every day by opinion. ... I have myself received the opinion of Mr. Smeaton respecting mills as a matter of opinion. 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. On this such men as Mr. Smeaton alone can judge. Therefore we are of opinion that his judgement, formed on facts, was very proper evidence. (Fokes v. Chadd 1782, 159)

The brethren of the Trinity House, the famous club of sea captains which was chartered by Henry VIII in 1514, performed many official marine functions such as licensing and supervision of lighthouses, and they were summoned as court experts in cases arising out of events on the high seas (Twiss 1876, 463–64; Beuscher 1941, 1109–10). Smeaton's previous appearances at the Court of the King's Bench were also, in all likelihood, as a court expert or as an arbitrator for the Court. Nevertheless, Lord Mansfield did not find it important to refer to the crucial fact that Smeaton's courtroom appearance in the Wells Harbor case was different — Smeaton had not served as a court-nominated consultant or arbitrator, but had appeared as a partisan witness selected and paid for by one of the parties to represent its case before the jury.

Thus, far from being "the court seal of approval on the whole adversarial

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6 Moreover, three years later, in 1785, in an insurance case, Mansfield excluded the expert testimony of ship-builders on the question of sea worthiness, for "not having examined the ship themselves" (Oldham 1992, 1:146).

7 For an example of a King's Bench trial that Smeaton arbitrated, see Cook and Others v. Bisson and Others in (Oldham 1992, 2:1588).
apparatus including contending experts, hypothetical questions, and jury evaluation," Mansfield's famous decision shows little awareness, let alone concern, of the difficulties that might await the deployment of experts in the new adversarial courtroom. Analysis of other late eighteenth- and early nineteenth-century leading rulings provides similar results. One, then, could justly wonder: Did the experienced royal judges overlook the problem of partisan experts? The absence of judicial anxiety about the switch of the expert from an independent and impartial position to one which was wholly dependent upon the side that hired him or her is all the more remarkable if we take into account that there was ample judicial dismay about lay witnesses for hire (Oldham 1992, 2:1066–1078; Gilbert 1795, 93–135). The late eighteenth century was a period when the slightest interest in the result of the trial rendered the witnesses unreliable. Persons were not allowed to testify in cases in which they had financial interest. Husbands and wives were forbidden from testifying for or against each other. Even the parties to the lawsuit themselves, by the same reasoning, were not allowed to testify. Why, then, the partisan expert?

The answer is not clear. The growing deployment of expertise in society in general seems to be part of the answer. Experts proved themselves very useful in the increasingly industrialized and urbanized late eighteenth-century English society, and royal judges obviously were not going to give them up because of legal peculiarities. Still, it is not clear why the authoritative royal judges did not mold a new procedure that would keep the experts out of the adversarial fire. Perhaps the judges were not worried about the behavior of fellow gentlemen, who, by ties of honor, could be counted on to give disinterested opinion on the witness stand (Shapin 1994). Perhaps it was the aloofness of the eighteenth-century royal judges who dominated their 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 influence of the partisan expert in the courtroom. In either case, one can only appreciate in retrospect the irony in the judicial leniency towards the new partisan role experts took as witnesses. Soon, the tremendous expansion of industry, and the subsequent rise of the culture of professional expertise, turned the scientific expert witness into a pivotal figure in the courtroom, and by the mid-nineteenth century, partisan expert testimony had become an acrimonious and persistent thorn in the side of common law. I now turn my attention this development.


The 1795 edition of Lord Gilbert's seminal Law of Evidence was the first legal text to dedicate a distinct discussion to proof by expert testimony. In a new section titled "Of Proof by Experts," the editor, an English barrister named Capel Lofft,
discussed the station of expert opinion on the legal continuum between fact and speculation: “In proportion as Experience and Science advances, the uncertainty and danger from this kind of proof diminishes,” he reasoned. But, he reminded his readers:

formerly, when the Mother of an illegitimate Child was indicted for the Murder of it, if the Lunges, being immersed in Water would float, it was held Proof on which Surgeons might justify an opinion that the Child was born alive; the inflated lungs, in consequences of the Air which had been drawn into them having being rendered specifically lighter than Water. But this presumption is now held insufficient, for that the Air included in the vesicles of the Lunges from other causes may be adequate to the production of this effect in the lunges of a still-born Child. (Gilbert 1795, 301)

Lofft’s point was clear. Caution must be taken with this growing genus of witnesses who were given exceptional license to deliver their personal opinions in court. Still, in spite of Lofft’s warning, vigilance was not the order of the day. “Though witnesses can in general speak only as to facts,” wrote Thomas Peak in his 1801 Compendium of Law on Evidence,

yet in questions of science, persons versed in the subject, may deliver their opinions upon oath, on the case proved by other witnesses . . . for though not a particular fact, it is still general information which the rest of mankind stand in need of, to enable them to form an accurate judgment on the subject of dispute. (Peak 1801, 4)

The growth and spread of industry in the early nineteenth century along with the constantly enlarging application of science to the various wants of society had inevitably expanded the legal uses of scientific experts and tended to make the courts more dependent upon their advice. Thus, among the crowds of experts allowed into the nineteenth-century courtroom as expert witnesses, besides the traditional figures of the physician, the cleric, the navigator, the sea captain, and the merchant, we find the growing presence of men of science — chemists, microscopists, geologists, engineers, mechanists, etc. These experts untangled for the court and the jury the complexities of the rising tide of cases involving science. They appraised disputed claims with their experimental techniques, and, in general, offered their knowledge of the basic principles of nature, which the jurors then could apply to the facts at issue before them.

In spite of their ascent, men of science quickly found their forays into the courtroom exceedingly frustrating. Moving across professional and institutional boundaries, from the exclusivity of their lecture theaters, workshops, laboratories, and societies to the public courtroom, they hoped to represent there laws which were not controlled by human whim. Instead, they found themselves quarantined in the witness box, excluded from the legal decision-making processes, and manipulated as mere tools in the hands of the lawyers. Browbeaten and set against
each other by the lawyers, scientific witnesses quickly found that their standard strategies for generating credibility and agreement did not well withstand the adversarial heat of the courtroom. Often, the outcome was an embarrassing public display of eminent scientists zealously opposing each other from the witness stand, a display that cast serious doubt on their personal integrity, and on the integrity of their science (Hamlin 1986; Golan 1997, 66–155).

The legal profession was also frustrated. Science promised to deliver a superior tool for the resolution of human disputes. Differences of opinion, as Prince Albert, the great benefactor of Victorian science, explained in 1859, may exist for a time in the natural sciences too:

But the process of removing them and resolving them into agreement is a different one from that in the moral and political sciences. These [the moral and political sciences] are generally approached by the deductive process; but if the reasoning be ever so acute and logically correct, and the point of departure, which may be arbitrarily selected, is disputed, no agreement is possible; whilst we proceed here by the inductive process, taking nothing on trust, nothing for granted, but reasoning upwards from the meanest fact established, and making every step sure before going one beyond it, like the engineer in his approaches to a fortress. We thus gain ultimately a roadway, a ladder by which even a child may, almost without knowing it, ascend to the summit of truth and obtain that immensely wide and extensive view which is spread below the feet of the astonished beholder. (Basalla et. al 1970, 52–53)

As the nineteenth century progressed, however, the legal profession learned that the promised scientific ladder to the summit of truth could not always bear the weight of adversarial proceedings. Collapsing time and again in the courtroom, the scientific ladder often provided the astonished onlooker with a view not of the hard facts of the case, but of definitions in disarray, conflicting hypotheses, inconsistent experimental results, and contradictory conclusions. Finally, there was the public, which was also frustrated. As one writer put it in 1860:

The public had been taught to believe that in judicial investigations the chemists and the microscopist would be able to place the truth before the court in such a manner as to secure justice, and it was a terrible blow to find that the professors were at variance among themselves as to the truth. (J. W. 1860, 285)

Severn, King and Company v. the Imperial Insurance Company

A fire on November 10, 1819, that annihilated a large sugar factory in London belonging to Severn, King and Company provides a vivid illustration of the early importance that scientific experts came to occupy in the courtroom, the expecta-
tions their testimony aroused, and the disappointment it created. The fire was not unusual. At least twenty English sugar factories burned down within the first two decades of the nineteenth century. The processes of sugar refining required heating sugar solutions in large pans over open fire. Constant care was needed to prevent the highly combustible solutions from boiling over the open fire and onto the wooden floor whose timber was extremely dry from intense and prolonged heat. Even if they did not spill, the boiling solutions could produce inflammable gas that was apt to explode. The danger of fire was therefore imminent and frequent attempts were made to improve the safety of sugar-refining. One of them was developed by Henry Wilson, a civil engineer who made his name in chemical manufacturing. In Wilson’s process, whale oil was heated in a remote boiler. Once a thermometer ascertained that the oil had reached the desired temperature, a cast-iron pump circulated the oil through copper coils immersed in the pan and then back to the boiler to be reheated (Fullmer 1980, 9).

Severn, King and Company began to use Wilson’s process three months before the fire occurred. After the fire, the companies that insured the factory refused to honor their policies on the ground that Wilson’s process, the use of which was not reported to them, introduced an increased risk of fire that voided the terms of their policies. Severn, King and Company sued the insurance companies to recover their losses, and in the series of trials that followed, an unprecedented crowd of England’s finest chemists and chemical technologists was summoned by the litigants to represent them in the £70,000 question of which process of refining sugar was safer.8

During the first day of the first trial, against the Imperial Insurance Company, a long line of highly respected men of science stepped onto the witness stand and swore for the plaintiffs that Wilson’s process was infinitely “less dangerous than the old one.”9 First and foremost, they explained, the temperature-controlled process kept the sugar from boiling over. And if it did boil over, there was no danger of fire since there was no open fire under the pan. Equally important, Wilson’s process eliminated the dangers of inflammable gases. The circulating whale oil was heated only to about 350°F, which kept the sugar solutions at

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8 Daily reports of the trials were given in the London *Times* (April 12–14, and December 14–19, 1820).

9 Among the plaintiffs’ experts were: William Brande — Secretary to the Royal Society, Sir Humphry Davy’s successor as a professor of chemistry at the Royal Institution, and the author of the authoritative *Manual of Chemistry*; Friedrich Accum — librarian of the Royal Institution, lecturer on chemistry at the Surrey Institute, chief engineer for the Chartered Gas Light and Coke Company, and the author of many well-known books on theoretical and practical chemistry; Samuel Parkes — experimental and practical chemist, whose book *Chemical Catechism* was at its 10th edition by the time of the trial; William Allen, F.R.S. — practical chemist, and lecturer on chemistry at Guy’s Hospital; John Thomas Cooper — manufacturer of chemical and laboratory apparatus, and a lecturer on chemistry at the Russell Institution; Henry Coxwell — chemist, and secretary to the Committee of Chemistry in the Society of Arts; Bryan Donkin — chairman of the Committee of Mechanism in the Society of Arts; Charles Sylvester — chemist, and the author of the “chemistry” articles in Rees’ *Cyclopedia*; Thomas Barry — a manufacturing chemist. For a fuller description of the witnesses, or for a fuller analysis of the trial see (Fullmer 1980, 11–15; Golan 1997, 70–97).
approximately 250°F. But whale oil was known to emit inflammable gases only above 600°F, and sugar solutions emit them only above 350°F. Even if small quantities of gases were somehow created, the jury was assured, being lighter than air they would promptly escape the boiler through its venting pipe.

During the second day of the trial, an equally distinguished roster of men of science testified under oath for the defense that they were certain that the old process did not have "the slightest danger" and that the new process was "extremely dangerous." These experts explained to the judge and the jury that: (1) the repeated heating and cooling altered the nature of the whale oil, making it increasingly volatile and apt to explode; (2) the temperature of used whale oil could rise much more quickly than expected; (3) used whale oil produces highly inflammable gases at much lower temperatures than those specified for a new oil; and (4) the inflammable gases have greater specific gravity than atmospheric air, and they would not escape through the venting pipe but rather accumulate close to the ground, ready to explode.

True to both traditions, legal and scientific, the two scientific teams backed their authoritative opinions with detailed experimental results; many of them manufactured especially for the trial. Unfortunately, these experimental results were completely contradictory. In the plaintiffs' experiments inflammable gas never occurred under 600°F for new oil, and 585°F for used oil. In the defense's experiments, however, the used oil temperature rose quickly, producing gusts of fires, combustive vapors, and sudden explosions at temperatures as low as 280°F (Fullmer 1980; Parkes 1821; Anonymous 1820).

As the London Times reported, the presiding judge, Chief Justice Lord Dallas made plain his frustration over the conflicting evidence in his charge to the jury:

They had heard the evidence, he 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 labors, 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. (London Times, April 14, 1820; Fullmer 1980, 17–18)

10 The defense list of experts included: Michael Faraday — Davy's former assistant, and chemical operator at the Royal Institution; Arthur Aikin — Secretary to the Society for the Encouragement of the Arts, and author of the Dictionary of Chemistry; Richard Phillips — professor of chemistry at the Royal Military College, lecturer on chemistry at the London Institution, and chairman of the London Chemical Society; Dr. John Bostock, F.R.S. — lecturer on chemistry at Guy's Hospital; Alexander Garden — a chemist who had just isolated naphthalene from coal, and was also known as translator of some of the Continental most advanced chemical literature; George Children, F.R.S. — a close associate of Davy who often did joint experiments with him; John Taylor and John Martineau — chemical engineers, and owners of a large sugar factory, and of several key patents in sugar manufacturing.
Lord Dallas advised his jury to throw "the contradictory results of experiments" out the window and stated his disgust at the partisanship displayed during the trial. "It must be a matter of general regret," he said, to find the respectable witnesses "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" (ibid.). It took the scientific experts two long days to testify to their conclusions. It took the jury only half an hour to find a full verdict for plaintiffs. Even in those days, jurors did not like insurance companies, especially when they attempted to avoid payment.

The Imperial Insurance Company moved for a new trial on the ground that the verdict was against the weight of the evidence. The royal judges approved the request, but suspended the new trial until one of the suits against the other three insurance companies was tried, "and the result of certain proposed experiments affecting the point in dispute be made known" (Severn v. Olive 1896, 565). Informed by Chief Justice Dallas about the confusing nature of the scientific evidence, the judges, it seems, were hoping that with further experimentation science would be able to clarify the evidentiary mess, and offer the jurors better grounds 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-insurances are regulated" (London Times, April 12, 1820).

The second trial was against the Phoenix Insurance Company. The basic rosters of scientific experts, as well as their arguments, remained unchanged. However, both parties recruited additional experts and carried out an even more elaborate program of experimentation to carry the full weight of their arguments in court. Alas, the experts and their experimental results remained as contradictory as they were at the first trial. Chief Justice Lord Dallas, as the Times reported, 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 deplorable 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,

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11 The most important expert added by the plaintiffs was Dr. Thomas Thomson — professor of chemistry at the University of Glasgow, editor of Annals of Philosophy, and the author of the influential System of Chemistry. Others were: John Dalton — President of the Manchester Literary and Philosophical Society, whose work on gases was well known; Dr. John Davy, F.R.S. — Sir Humphry's young brother; and two well-respected gentlemen of science, Drs. John Paris, and John Pearson, F.R.S. The defense's most significant reinforcement was Alexander Tilloch, the editor of the Philosophical Magazine.
and that all that rested on experiment was new. (London Times, Dec. 19, 1820; Fullmer 1980, 23–24)

This time, it took the jury an hour and forty-five minutes before they returned, again, a full verdict for the plaintiffs. No other trials were reported. The rest of the insurance companies must have settled with Severn, King and Company out of court.

Such cases, where not only the opinions of the experts but also their definitions, observations, and experimental data were flatly contradictory, were frequent enough to appall the courts. The judges were ready to tolerate, to a certain degree, disagreements among the scientific experts. After all, legal commentators pointed out, most scientific disagreements were not about facts but opinion, on which men of science, like everybody else, could entertain legitimate differences. 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 a speculation admitted as evidence only out of necessity, because no one else was qualified to give a better opinion. Experimental evidence, however, was a different story. It was considered to be among the surest species of evidence, and the judges found it exceedingly difficult to accept the fact that similar experiments 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 corruption of their science, of selling its credibility to the higher bidder (Golan 1997, 97–111).

**The Disenchantment of Scientific Expert Testimony**

As the nineteenth century advanced, the court began to develop a skeptical view not only of the opinions of men of science, but also about their integrity. In 1820, we saw the royal judges willing to postpone further litigation until further experimentation would clarify the disputed facts. By the 1850s, such experiments were already looked on with distrust — not because nature could lie but because its torturers might. In 1853, for example, a crowd of geologists, chemists, microscopists, mining engineers, and others sorts of men of science assembled in Edinburgh to debate the identity of a certain mineral whose mining rights were under dispute (Gillespie v. Russell 1854–55). The scientific evidence had been so contradictory that the losing side moved for a new trial on the ground that the discrepancy in the scientific evidence "could only be accounted for on the hypothesis that the specimens submitted to the examination had not all of them been genuine" (ibid., 12). However, the Lord President of the Court of Session, Duncan McNeill, failed to

12 Among the experts, for example, was the authoritative triumvirate of British chemistry — Thomas Graham, August Hoffman, and Edward Frankland.
see how new specimens would help to diminish the disagreement among the scientific experts. "They are all agreed upon the theory," he remarked sarcastically, "but they all disagreed on what they looked at with their own eyes. I see no ground for assuming that they are different specimens because parties differ in the result about them. My opinion is that they would differ in the result to the end of time" (ibid.). "Are we sure that they will be ever agreed?" asked a second judge, Lord Rutherford,

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. (Ibid., 15)

The Lords' sarcasm was not uncommon. "The evidence of Experts is just now the object of general derision," complained the editor of the Chemical News, William Crookes, in 1862:

Smart newspaper writers, wishing to indite a telling article, select the discrepancies in scientific evidence for a theme; noble Lords, anxious to enliven the dull debates of our hereditary legislators, find nothing so provocative of laughter as a story about the differences of 'mad doctors;' and barristers, ready to advocate any opinion, and anxious, perhaps, for a monopoly of the 'any-sidedness,' when addressing a jury, dilate with a well-simulated indignation on the fact that eminent scientific men are to be found in the witness box on opposite sides. (Crookes 1862; Lucier 1996, 153)

Ironically, this "general derision" with which scientific expert testimony was regarded, resulted largely from the overwhelming success of Victorian science in promoting the scientific method as the yardstick of truth, or, at least, of certainty, and the impartial man of science as the best keeper of this truth. Once one believed these claims, then the zealous opposition among the scientific witnesses could only be interpreted as a sign of moral corruption. The authoritative analysis of one of the most influential judicial figures of the nineteenth century, Chief-Justice James Fitzjames Stephen, can serve as an example of this deep irony. According to Sir James, both physical and legal inquiries into matters of fact rest upon the same great assumptions — the general uniformity of nature, and the general trustworthiness of the senses. Still, Chief-Justice Stephen explained, scientific knowledge was much closer to certainty, because "in physical inquiries the relevant facts are usually established by testimony open to no doubts, 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" (Stephen 1863, 189–190). No wonder, then, that Sir James also interpreted scientific opposition in the courts not as legitimate debates but as a sign of moral decadence.

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13 For similar characterizations, see (Quarterly Review 1862, 32–33; London Times, March 25, 1885, p. 9, col. 4).
As to want of will to speak the truth, 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. (Ibid., 199)

Early in the nineteenth century, English men of science sought no government support, saw very limited employment opportunities, and their leading organization, the Royal Society, was little more than a fashionable club controlled by amateur gentlemen of independent means who conceived of science mainly as a personal calling. Thus, they felt little need for public apologetics.14 However, by the early 1860s, a self-conscious scientific community had been forged that had successfully challenged the intellectual authority of religion and metaphysics, and its speakers were no longer willing to explain the frequent in-court controversies among its members as part of “the uncertainties of the scientific knowledge of the day” and to brush them off as legitimate disagreements (Turner 1993). The evil done by the scandals of expert testimony, leaders of the Victorian scientific community emphasized again and again, was great not only for the administration of justice but also for the public image of the scientific community which was toiling hard to advance its professional status, and to expand its influence into the public domains of education, industry, health, administration and culture in general (Hamlin 1986; Macleod 1996).

Most scientific commentators found the adversarial proceedings to be the source of their troubles in court. “No class of men,” the prominent sanitary chemist Robert Agnus Smith complained in 1860, “will so fully agree with each other as the scientific, if not kept separate by the present corrupting [legal] system, and no class will spread a more beneficial influence over society if not contemptuously treated by counsel, as they often are, in a witness box” (Smith 1860, 137). Even those who were ready to concede that scientific opinions may legitimately differ did not believe that “the profoundly ignorant” judge, let alone the jury, could reliably assess such differences. “The fact is,” concurred William Crookes, “the machinery of ordinary judge and jury for the trial of cases which depend on chemical evidence is simply ‘a mockery, a delusion and a snare.’ A chemist might just as reasonably sit at Westminster to decide point of law” (Crookes 1862, 183).

Thus, throughout the second half of the nineteenth century, men of science repeatedly demanded that the English legal system reform its procedures of expert testimony and employ the scientific expert independent of the parties either as part of a special tribunal or as an advisor to the court (Golan 1997, 159–187). However, even those in the legal profession who empathized with the frustrated scientific

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14 Arthur Aikin, Secretary to the Society for the Encouragement of the Arts, brushed off the conflicting testimonies in the 1820 Severn litigation as representative of “the uncertainties of the scientific knowledge of the day” (London Times Dec. 19, 1820, p. 3, cols. 3, 4). Another witness, Dr. Bostock, also “was not surprised by the [contradictory] results, considering the general uncertainty of all experiments with oil” (Bostock 1821, 50).
community were well aware that the operation of fundamental principles of the adversarial system rendered the reforms proposed by the scientific community unworkable. Instituting special tribunals to decide the scientific facts at issue ran against the fundamental political right to a trial by a jury of one's peers; and the suggestion to allow the court to call in experts independent of the parties ran against two other equally fundamental postulates — the right of the parties to furnish all evidence, and the neutrality of the court. The legal profession therefore rejected these suggestions of reform as "remedies far worse than the disease."15

While most men of science blamed their disagreements in the courts on the adversarial proceedings, many of them also found these disagreements to reflect on the men of science who produced them. At first, such allegations were directed at a (usually unspecified) minority of unscrupulous men of science who sold their testimony to the higher bidder (Smith 1860, 136–137, 143, 144). But as the nineteenth century progressed, some commentators came to see the conflicts in courts as a reflection of two ominous problems that faced the Victorian scientific enterprise as a whole — the overwhelming of the ideal of science as a personal calling by the utilitarian passions of the age, and the eroding of the ethical code of gentlemanly voluntarism by the rising Victorian culture of professionalism.

These anxieties were not new. Earlier in the nineteenth century, the correlation of science and utility had been the target of criticism by romantic thinkers such as Samuel Taylor Coleridge and Thomas Carlyle who conceived of the popularity of science as symptomatic of the mechanistic and materialistic values of the middle class who were interested only in the practical benefits which followed from the control of nature (Carlyle 1840; Coleridge 1839). As the nineteenth century progressed, the comprehension of the innate tensions between the advancement of science and its promotion was increasingly shared by the more conservative gentlemen of science who were afraid that the attempt to popularize science would lead to its plebification, and by researchers who were concerned that scientific research would be overpowered by the demand for immediately useful knowledge (Morrel and Thackray 1981; Yeo 1981).

The growing discontent with scientific expert testimony provided ample ground for these anxieties. The quickly growing species of men of science who earned their living by directing the perpetual flow of new scientific facts and processes to the wants of society, found the courts to be a most profitable, if not appreciative, arena for their talents. Patent litigation, in particular, became a lucrative sideline and sometimes even a principal activity for many leading men of science. In 1853, for example, the court appearances of August Hoffman, the German professor at the Royal College of Chemistry, augmented his yearly income by eight to nine

15 This was the reaction of the ex-General Attorney, Mr. Whiteside, M.P., to the 1862 report of the committee created by the British Association for the Advancement of Science to consider the defects of the legal procedures of expert testimony, and the manners in which they could be best corrected (Harcourt 1862).
thousand pounds (Brock 1976, 186). No wonder, then, that “on more than one occasion it would seem ... that all the chemists in London were being shared by aggrieved parties in a patent action” (ibid.). This bull market of scientific expertise, however, did not sit well with the scientific code of ethics forged in an era when science was not regarded as a means of livelihood. The scientific gentleman was supposed to work for the love of knowledge not money, and his heart was supposed to be in his researches, oriented toward community interest rather than to individual self-interest. No matter how useful practical men of science were, if their object in life was to get money, they were morally tainted.

The growing problem of expert testimony brought to the surface, therefore, tensions between the promotion of science and its professionalization; between the earlier ideal of science as a personal calling whose end was spiritual betterment, and the growing demand for immediately useful knowledge. In this sense, the debate about science in the courts became a part of the larger Victorian debate about the role of men of science in an increasingly industrialized and professionalized world.

For Norman Lockyer, a noted astronomer, founder and editor of Nature, and one of the more vocal champions of the public image of late Victorian science, the appearance of men of science as experts in a court of law, where their “devotion” to their employer caused them to contradict the statements of other men of science on the other side, doubtless equally “devoted,” was the worst example of the moral degeneration caused by the professionalization of Victorian science. In Lockyer’s eyes, the scientific witness was a mercenary who made a living by becoming “the friend of the manufacturers and a persona grata to limited liability companies.” Their “lust of money” led scientific witnesses to forsake “the fair fields of knowledge,” and “drag her reputation through the mud” by tailoring their opinions to the wants of their clients. To that end they cultivated a penchant for throwing dust in the eyes of the credulous jury by emphasizing certain statements and evading others, “the effect of which was actually worse than lying” (Lockyer 1885, 74).

For their part, the new species of professional men of science who lived by their expertise celebrated adversarial legal procedures as a means to disparage what they conceived as a corrupt scientific establishment. The growing criticism of expert testimony, they argued, did not reflect on the ethics of expert witnessing, nor on the morals of the individual experts, nor on the legal mode of their deployment, but rather on the outdated ethical and epistemological codes of the scientific community (Odling 1860, 1885; Hamlin 1986). Thus, Lockyer’s accusations were countered by a series of editorials in the Journal of Gas Lighting, Water Supply, and Sanitary Improvement (GLS) which decried the hypocrisy and double standards that prevailed in the scientific establishment. The law of nature, these editorials argued, just like the law of the land,

16 For comparison — a typical yearly academic salary of a professor of Hoffman’s caliber was around 300 pounds.
is susceptible of more than one interpretation, and men of science, like lawyers, contradict one another daily upon every known issue. It is indeed the natural way and most notorious habit of men of science. Why, then, should there be any peculiar loss of dignity accruing to the fact of contradicting and being contradicted in court? (Anonymous 1885b, 1145)

According to the GLS, the alleged contradiction between the values of the scientific community and expert witnessing was only an apparent one, for “truth is not less truth because it is made to serve the immediate profit of interested person” (ibid.). It is only by applying the obsolete code of scientific voluntarism to a free market situation that the scientific community persuades itself otherwise. However, once we accept that the legal market of scientific evidence is an open market, we find that the question of the proper conduct in such a situation was neither new nor unique to science. It had been asked by many professions and had found its resolution in the well-tested liberal code of the free market.

How far an advocate may go in the interest of his client. ... How far may an auctioneer go in the way of forcing up his sales by commendation of the wares? Nay, the same question applies to all sellers of marketable commodities, down to the costermonger in the street. There is no reason, therefore, for condemning the system of expert witnesses in lawsuits because to their case, as soon as ever they accept a retainer, the maxim “caveat emptor” may be applied as aptly as to any other commercial transaction. (Ibid.)

This laissez faire rhetoric found a sympathetic ear within the legal profession, which also objected to attempts by the scientific community to monopolize expertise by drawing a line between scientific and non-scientific men, and by referring to the students of the exact sciences as the only true representatives of the laws of nature. As Thomas Webster, F.R.S., a barrister and a leading authority on patent law, put it in 1860: “a man who acquired a particular kind of knowledge by long training 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” (Smith 1860, 144). Thus, in spite of frequent scientific protests, the nineteenth-century English legal market of scientific evidence remained an open one where clients shopped around among the various experts who were offering the service of their scientific views. The scandals were frequent, but they were generally justified by the legal profession as a price worth paying in what was believed to be a competitive free market of legal evidence that constituted both the best mechanism of proof-testing and the best protection from the abuse of executive power (Stephen 1883, 574–575; Pollock 1904, 33–34).
4. Discussion

What can we learn from this brief history of English scientific expert testimony? Four main points come to mind. The first is that the modern expert witness is a product of late-eighteenth-century England. With the constantly enlarging application of science to the various wants of society and the rising tide of cases involving technological and scientific argumentation, the courts became increasingly dependent upon the advice of experts. At the same time, the position of the experts in court was shifted from independent and impartial status to total dependence on the side that hired them. These simultaneous developments, by-products of the Industrial and the Adversarial Revolutions, have molded the modern identity of the scientific expert witness — an indispensable and influential yet incompatible and inharmonious figure in the modern adversarial courtroom.

Second, expert testimony as a profitable activity figured prominently in Victorian science. In an era when scientific expertise provided only a limited means of livelihood, men of science found the legal system to be a lucrative, if unappreciative, market for their expertise. Scientific experts served as consultants and witnesses in the mounting litigious activities concerning matters of patents, energy (first gas, and later electricity), environment (pollution and contamination), public health (food and drug adulteration, water supply, sewage treatment), transportation, agriculture, mining, industry, insurance, and, of course, forensics.

Third, the debate over the growing problem of scientific expert testimony was an important locus for the intensive discussion about the character of the Victorian scientific community, its function in society, and the values by which it judged the work of its members. Underlying the epistemological and ethical debate about the souring issue of expert testimony was an enduring power struggle over the direction and shape of the thriving Victorian scientific enterprise. Thus, Robert Smith inveighed in 1860 against the system of expert testimony, and lobbied for scientific assessors as part of his campaign for state-sponsored science whose authoritative representatives were to be the official guardians of the public from the perils of industrialism. Likewise, Norman Lockyer’s denunciation of the expert witness in 1885 was part of the dispute between researchers and practitioners about what it meant to be a man of science in an increasingly industrial and professional world. It was no coincidence that Norman Lockyer was a leading figure in astronomy, the supreme field of Victorian science, while most of the expert witnesses belonged to the more utilitarian and inferior fields of Victorian science, such as chemistry and microscopy. Represented by the *Journal of Gas Lighting, Water Supply, and Sanitary Improvement*, these men of science celebrated the normative commitment of the legal system to develop two sides to every story as a means to disparage the

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17 In 1863, under the Alkali Act, Smith became the leading scientific figure in the first successful governmental policy directed towards the regulation of the chemical industry (Macleod 1996, 85–112).
hypocritical scientific establishment which, they felt, had long turned into a stagnant bastion of social privilege that suppressed instead of expediting scientific progress.

Fourth, conflicting scientific testimonies have existed ever since there have been scientific expert witnesses in the courts, and the debate over the meaning of these conflicts and the ways to resolve them had assumed by 1860 the basic outlines it still presents today. Some commentators blamed the frequent disagreements on the corruption of scientific expert witnesses; others, on the adversarial mode of their deployment. Almost all agreed, however, that the partisanship displayed in court prevented the appropriate resolution of the scientific issues presented in court, tarnished the public image of science, and thus should be neutralized one way or another. Only a minority group refused to acknowledge the frequent scientific disagreements in court as being detrimental to either law or science. These controversies, these commentators maintained, reflected the actual day-to-day workings of science which the scientific community refused to acknowledge, and were brought to light by the superior ability of the adversarial legal procedures to disclose areas of uncertainty and interpretive conflicts within seemingly robust scientific claims.

The problem of scientific expert testimony has a long and rich history. This simple lesson is particularly important in the context of the current tendency to present the problem of scientific expert testimony as a late twentieth-century pathology that threatens to escalate out of control (Huber 1991; Federal Judicial Center 1994; Harvard Law Review 1995; Angell 1996; Erzinclioglu 1998). The long view makes it clear that conflicting expert testimony has been a chronic phenomenon for over two centuries now. Much research is still needed on late nineteenth- and twentieth-century developments. Nevertheless, it is clear that in spite of all the efforts to keep the problem of scientific expert testimony under check, it has continued to simmer in Common law courts (Royal Commission on Criminal Justice 1993; Carnegie Commission on Science, Technology, and Government 1993). Indeed, the 1990s saw the revival of widespread political and public concern over the problem and renewed pressure on the legal system to reform its adversarial procedures of expert testimony (Daubert 1993; Woolf 1996). The growing deployment of expertise in modern society, on the one hand, and the political persistence of the adversarial system, on the other, indicate that neither the problem nor the debate over its meaning and proper solution will go away any time soon. Are the scientific disagreements created or merely exposed by adversarial proceedings? Does more judicial control mean less scientific controversy? Does less controversy mean better adjudication? While historical analysis alone cannot solve these important questions, it should nevertheless better inform their discussion.
References


Anonymous. 1820. "Facts respecting the Increased Volatility and Inflammability which Fish Oil and its Vapours Acquire by Continued or Renewed Exposure to Certain High Temperatures." *Philosophical Magazine 55*: 252–289.


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