

New Approaches to Environmental Law and Agency Regulation: The *Daubert* Litigation Approach

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For trial lawyers and judges, the U.S. Supreme Court's "*Daubert* Four"—four unanimous decisions since 1993, *Daubert v. Merrell Dow Pharmaceuticals, Inc.*,¹ *General Electric Co. v. Joiner*,² *Kumho Tire Co. v. Carmichael*,³ and *Weisgram v. Marley Co.*⁴—overturned 70 years of trial practice regarding expert evidence, rewriting both when scientific and other expert evidence can and cannot be admitted at trial, and how a trial judge's decision to exclude or admit⁵ expert evidence is reviewable on appeal. Before *Daubert*, when a judge said "call your next witness," the experts in many cases would have been allowed to testify. After *Daubert*, when the judge instructed a lawyer to "call your next witness," none of the experts involved in these four Su-

1. 125 L. Ed. 2d 469, 23 ELR 20979 (1993) (holding that the Federal Rules of Evidence, not the common-law "general acceptance" test, provides the standard for admitting expert scientific testimony in federal trials). *Daubert* represents one of the many Bendectin cases that one commentator described as the "taj mahal of horror stories about the tort system." MARK GREEN, BENEDECTIN AND BIRTH DEFECTS: THE CHALLENGE OF MASS TOXIC SUBSTANCES LITIGATION 328 (1996).

2. 118 S. Ct. 512, 28 ELR 20227 (1997) (a toxic tort case alleging that exposure to PCBs "promoted" plaintiff's small-cell lung cancer in which the Court held that abuse of discretion is the proper standard by which to review a district court's decision to admit or exclude scientific evidence).

3. 118 S. Ct. 1167, 29 ELR 20638 (1999) (holding that *Daubert* applies to all experts and that a tire expert's proposed testimony regarding an allegedly defective tire was properly excluded).

4. 120 S. Ct. 1011 (2000). Three plaintiffs' experts were allowed to testify at trial, but were excluded on appeal on *Daubert* reliability grounds, the jury verdict for plaintiffs reversed and the case dismissed.

5. Justice Breyer in *Kumho* made clear that appellate courts can review both "'a trial court's decision to admit or exclude expert testimony.'" 118 S. Ct. at 1176, 29 ELR at 20641 (quoting *Joiner*, 118 S. Ct. at 515, 28 ELR at 20227). "[E]xcluding expertise that is *fausse* and science that is *junky*" is important, Justice Scalia underscored in his concurring opinion in *Kumho*, and the failure to do so is reviewable on appeal as an abuse of discretion. 118 S. Ct. at 1179, 29 ELR at 20642.

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preme Court cases were ultimately allowed to testify, and the same has been true in many other cases since 1993.⁶

This Article applies the *Daubert* Four to environmental and toxic tort⁷ litigation and regulation in three ways. In part I, the Article sets forth a public policy need, and opportunity, for a "next generation" of environmental regulation and litigation. Part II provides a litigator's guide to *Daubert* hearings and appeals regarding the admission and exclusion of expert witnesses, and sets forth a "does it work and why?" method for determining whether expert evidence is "reliable" enough to be admitted. Part III combines the new *Daubert* requirements for the use of experts at trial with a generalization of the underlying *Daubert* legal analysis of applying nonenvironmental federal law, such as the Federal Rules of Evidence, to environmental litigation. These two dimensions of *Daubert* are referred to as the "*Daubert* Litigation Approach." The *Daubert* Litigation Approach is then applied in 10 illustrative ways.

The implications of the *Daubert* Litigation Approach are novel and undoubtedly controversial. However, the *Daubert* Litigation Approach is intended to be persuasive both with governmental agencies and, in any event, in court as a means of achieving more effective, and innovative, remedies to environmental problems.

The Need for New Approaches to Environmental Law and Agency Regulation

Environmental laws in the United States have made important contributions to the environment and the public. Unfortunately, however, current environmental regulation and litigation too often leaves much to be desired. In the blunt opinion of two highly regarded observers, Michael Porter and Claas van der Linde, environmental regulation in the United States has "squandered" the opportunity for innovative solutions to environmental problems, has "spawned an industry of litigators and consultants that drains resources away from real solutions," with the Superfund law becoming their example of "the most inefficient environmental law in the United States."⁸ Supreme Court Justice Stephen Breyer has pointed out that "[w]ell-meaning, intelligent regulators, trying to carry out their regulatory tasks sensibly, can, nonetheless, bring about counterproductive results."⁹

To date, environmental regulation and litigation has been largely determined by the win-lose structure of trials rather than the dynamic innovation model of science. However, as Porter and van der Linde incisively observe, a "static view of environmental regulation, in which everything except regulation is held constant, is incorrect":

If technology, products, processes, and customer needs were all fixed, the conclusion that regulation must raise costs would be inevitable. But companies operate in the

real world of dynamic competition, not in the static world of much economic theory. They are constantly finding innovative solutions to pressures of all sorts—from competitors, customers, and regulators. Properly designed environmental standards can trigger innovations that lower the total cost of a product or improve its value. Such innovations allow companies to use a range of inputs more productively—from raw materials to energy to labor—thus offsetting the costs of improving environmental impact and ending the stalemate. Ultimately, this enhanced *resource productivity* makes companies more competitive, not less.¹⁰

In a book published in 1993, Supreme Court Justice Breyer provided a number of concrete examples that underscore the limitations of current environmental regulation and litigation.

Polychlorinated Biphenyls (PCBs)

One example is from his personal experience as a judge in a PCB case, *United States v. Ottati & Goss, Inc.*¹¹ In *Ottati*, the U.S. Environmental Protection Agency (EPA) was involved in litigation for 10 years "to force cleanup of a toxic waste dump in southern New Hampshire" even though the "site had been essentially cleaned up."¹² The last defendant disputed EPA's insistence that the small amount of highly diluted PCBs and volatile organic compounds (VOCs) in dirt in the dump be incinerated. Everyone involved apparently agreed that the dump as it then existed was clean enough for children to play on the site, that children could even eat small amounts of dirt for 70 days each year without any significant harm, and that about one-half of the VOCs would evaporate by the year 2000. Yet burning the dirt, as EPA insisted, would allow the children to eat small amounts of the dirt 245 days a year without any significant harm. There were, however, no dirt-eating children playing in the area because the dump was in a swamp. The *Ottati* litigation lasted years and resulted in a 40,000 page court record. Like the combatants in World War I, the parties kept fighting at enormous costs. The cost to EPA and the defendant is not known, nor is it known what the lost opportunity costs to the environment and the public would have been had EPA spent its limited resources elsewhere.

Toxic Dumps Generally

"A former EPA administrator put the problem succinctly," Justice Breyer explained,

when he noted that about 95 percent of the toxic material could be removed from waste sites in a few months, but years are spent trying to remove the last little bit. Removing that last little bit can involve limited technological choice, high cost, devotion of considerable agency resources, large legal fees, and endless argument.¹³

Asbestos

As to asbestos, Justice Breyer points out that "[m]ost experts believe that undamaged white asbestos left in place is

6. Eight members of the Supreme Court in *Joiner* and *Kumho* affirmed the exclusion of the experts at issue in those cases. The *Daubert* experts were not allowed to testify on remand. See generally Charles D. Weller, *Expert Evidence After Kumho: The Importance of Legal and Scientific Reasoning*, 8 TRIAL EVIDENCE (1999); and *Antitrust Economics as Science After Daubert*, 42 ANTITRUST BULL. 871 (1998).

7. For convenience, the term "environmental law" is used in the rest of this Article to mean environmental and toxic tort law.

8. Claas van der Linde & Michael Porter, *Green and Competitive: Ending the Stalemate*, reprinted in MICHAEL PORTER, ON COMPETITION 351, 364, 365 (1998) [hereinafter PORTER].

9. STEPHEN BREYER, BREAKING THE VICIOUS CIRCLE 11-12 (1993).

10. *Id.* at 351-52.

11. 900 F.2d 429, 20 ELR 20856 (1st Cir. 1990).

12. BREYER, *supra* note 9, at 11-12 (footnotes omitted).

13. *Id.* at 11 (footnote omitted).

virtually harmless," and that "[a]sbestos removal stirs up and sends into the air white asbestos fibers that would otherwise remain in place, thus threatening removal workers"; consequently, he concludes that "the risks accompanying leaving white asbestos in place are so small that removal is likely more dangerous than doing nothing."¹⁴

Justice Breyer also discusses the case of *Corrosion Proof Fittings v. U.S. Environmental Protection Agency*,¹⁵ where the Fifth Circuit struck down an EPA ban on asbestos piping. The court of appeals noted that "over the next 13 years, we can expect more than a dozen deaths from ingested toothpicks—a death toll more than twice what the EPA predicts will flow from the quarter-billion-dollar bans on asbestos pipe, shingles, and roof coatings."¹⁶

Benzene in the Workplace

With respect to benzene in the workplace, Justice Breyer notes that the Occupational Safety and Health Administration (OSHA) was authorized in 1970 to set occupational exposure limits for benzene. It wasn't until eight years later that OSHA finally promulgated its benzene standards. However, OSHA prohibited benzene exposure at an exposure level 10 times lower than had been demonstrated to be harmful. Not surprisingly, the Supreme Court struck down this OSHA standard, 10 years after OSHA was charged to take action. OSHA then spent seven more years trying to gather evidence to support its action.¹⁷

Air Pollution

Justice Breyer also noted that EPA similarly spent "considerable effort to achieve results that save very few lives at very high cost"¹⁸ under the Clean Air Act (CAA).¹⁹ This approach represents an example of what Justice Breyer terms "tunnel vision," where an agency pursues "the last 10 percent" and "effectively carries single-minded pursuit of a single goal too far, to the point where it brings about more harm than good."²⁰

To similar effect as Messrs. Breyer, Porter, and van der Linde views is the General Accounting Office's July 20, 1999, report, *Observations on the Environmental Protection Agency's Fiscal Year 2000*, which concluded that "EPA needs more comprehensive information on the condition of the environment to effectively set priorities, assess progress in achieving its goals and objectives, and report on its accomplishments in a credible way."²¹ The GAO also found that "EPA's data systems are often outmoded and difficult to integrate, and important gaps in the data also exist."²² Ac-

ording to the Inspector General, "EPA is not consistently using a scientifically based, systematic planning process to take actions at Superfund sites," and "EPA continues to rely extensively on level-of-effort cost reimbursable contracts that essentially buy labor hours, not results"²³

Perhaps Gus Speth, the Dean of the Yale School of Forestry and Environmental Studies and a long-time environmental advocate, summarized our current situation best when he said that what is needed is "a paradigm shift in our thinking about environmental governance," from a paradigm that is "confrontational; business was the enemy; 'sue the bastards' the motto," to a new way of thinking.²⁴

This Article shows how a litigation approach based on the *Daubert* Four can be applied to environmental adjudication and rulemaking in ways that may be contrary to current or conventional thinking, but, as *Daubert* has done in so many areas of law, leads in fresh, new directions for the environment, the public, and all affected parties.

Litigator's Guide to *Daubert* Hearings and Appeals

This section provides a practical litigator's guide to the admission and exclusion of expert testimony at *Daubert* hearings, trial, and appeals, including a "does it work and why?" method for analyzing the reliability of expert evidence.

Expert Evidence Under Daubert, Joiner, Kumho, and Weisgram

1. *All Experts.* With *Kumho*, it is clear that there is only one test for the admission or exclusion of all expert testimony in federal courts. As Justice Breyer stated, there is no "schematism that segregates expertise by type."²⁵ All expert evidence must be demonstrated by the offering party to be "reliable;" otherwise, it should be excluded.

2. *"Reliability" the Test.* The Supreme Court in *Kumho* reiterated that Rule 702 of the Federal Rules of Evidence, the expert evidence rule, "establishes a standard of evidentiary reliability," and "requires a valid . . . connection to the pertinent inquiry as a precondition to admissibility."²⁶ "Reliability" has replaced the 70-year-old "general acceptance" standard for all expert evidence initially set forth in *Frye v. United States*.²⁷ As Justice Breyer stated the new law regarding experts in *Kumho*:

Rule 702 grants the district judge the discretionary authority, reviewable for its abuse, to determine reliability in light of the particular facts and circumstances of the particular case.²⁸

3. *The Expert Evidence Must Be Relevant.* Under basic rules of evidence and *Daubert*, of course, the expert evidence

14. *Id.* at 12 (footnote omitted). Similarly, EPA's Science Advisory Board concluded in 1987 and in 1990 that EPA's regulations regarding the most important risks it regulated were inconsistent with expert, as well as lay, opinion. DANIEL KAMMEN & DAVID HASSENZAHN, *SHOULD WE RISK IT?* 12 (1999).

15. 947 F.2d 1201, 22 ELR 20037 (5th Cir. 1991).

16. BREYER, *supra* note 9, at 14 (footnote omitted).

17. *Id.* at 15.

18. *Id.* See KAMMEN & HASSENZAHN *supra* note 14.

19. 42 U.S.C. §§7401-7671q, ELR STAT. CAA §§101-618.

20. BREYER, *supra* note 9, at 11.

21. *Id.* at 11.

22. *Id.* at 12.

23. *Id.* at 13.

24. James G. Speth, *A New Paradigm: Bring It On!*, Address at the Environmental Law Institute Annual Dinner (Oct. 26, 1999).

25. *Kumho Tire Co. v. Carmichael*, 118 S. Ct. 1167, 1176, 29 ELR 20638, 20641 (1999).

26. *Id.*, 118 S. Ct. at 1175, 29 ELR at 20640 (quoting *Daubert*, 125 L. Ed. 2d at 482, 23 ELR at 20982) (emphasis added).

27. 293 F. 1013 (D.C. Cir. 1923).

28. *Kumho*, 118 S. Ct. at 1179, 29 ELR at 20642.

must not only be reliable, it must also be relevant.²⁹ The "Rules of Evidence," the Supreme Court put it in *Daubert*, "assign to the trial judge the task of ensuring that an expert's testimony both rests on a reliable foundation and is relevant to the task at hand."³⁰

4. *Policy Reasons for the Reliability Test.* Expert evidence must be reliable for at least three reasons. First, as the Supreme Court emphasized in *Daubert*, courtrooms are intended "for the particularized resolution of legal disputes," they are not the place for the "search for cosmic understanding."³¹

Second, the Supreme Court returned to fundamental principles under the law of evidence regarding experts. As Professor James Maguire explained:

The field of expertness is bounded on one hand by the great area of the commonplace, supposedly within the ken of every person of moderate intelligence, and on the other by the even greater area of the speculative and uncertain.³²

Over time, science and other areas of expertise often change, so that what is totally speculative today may (or may not) become well-established tomorrow:

Of course these boundaries constantly shift as the former enlarges and the latter diminishes. Only a few years ago it would have been necessary to take expert evidence on issues with respect to the operation of motor cars, airplanes, or radio which are now so completely inside the domain of popular understanding that such evidence would be rejected as superfluous. A century ago purportedly expert evidence on these topics would have been rejected as visionary.³³

Disputes in trial, however, do not have the luxury of waiting for enlightenment. Science and all other areas of expertise at the speculative stage, however brilliant and important to the advance of knowledge, cannot be used to resolve disputes in the courtroom unless the expert evidence has advanced to the stage of being reliable.

29. In addition to relevancy, other rules of evidence may apply.

Throughout, a judge assessing a proffer of expert scientific testimony under Rule 702 should also be mindful of other applicable rules. Rule 703 provides that expert opinions based on otherwise inadmissible hearsay are to be admitted only if the facts or data are "of a type reasonably relied upon by experts in the particular field in forming opinions or inferences upon the subject." Rule 706 allows the court at its discretion to procure the assistance of an expert of its own choosing. Finally, Rule 403 permits the exclusion of relevant evidence "if its probative value is substantially outweighed by the danger of unfair prejudice, confusion of the issues, or misleading the jury . . ." Judge Weinstein has explained: "Expert evidence can be both powerful and quite misleading because of the difficulty in evaluating it. Because of this risk, the judge in weighing possible prejudice against probative force under Rule 403 of the present rules exercises more control over experts than over lay witnesses." Weinstein, 138 F.R.D., at 632.

Daubert, 125 L. Ed. 2d at 484, 23 ELR at 20982-83.

Please note that in *Logerquist v. McVey*, No. CV-98-00587-PR (Ariz. Apr. 19, 2000), the Arizona Supreme Court rejected the application of *Frye* and *Daubert* in cases involving Arizona Rule 702, which is patterned after Fed. R. Evid. 702.

30. 125 L. Ed. 2d at 485, 23 ELR at 20983.

31. *Id.* at 485, 23 ELR at 20979.

32. JAMES MAGUIRE, EVIDENCE: COMMON SENSE AND COMMON LAW 10 (1947).

33. *Id.*

The history of science soundly supports this result. Galileo struggled for 34 years before he advanced his theory of the constant acceleration of gravity, and his "34-year march" was "punctuated" with "misconceptions and erroneous arguments."³⁴ Similarly, Kepler discovered planetary orbits were elliptical, but only after he "struggled" from "one hypotheses, then to another, then to another, and ultimately to the hypotheses of the elliptical orbit,"³⁵ as he "slowly came to suspect that perhaps his predecessors of the previous 2,000 years were hasty in thinking the planetary orbits circular":

Hindsight makes us underestimate the strength of this ancient maxim; Kepler's challenge seems natural to us. But no bolder exercise of imagination was ever required: Kepler dared to "pull the pattern" away from all the astronomical thinking there had ever been.³⁶

Third, in jury trials particularly, as Justice Breyer underscored in *Kumho* citing Judge Learned Hand's classic 1901 article, *Historical and Practical Considerations Regarding Expert Testimony*,³⁷ the "trial judge's effort to assure that the specialized testimony is reliable and relevant can help the jury evaluate" the often "foreign experience" of an expert's testimony.³⁸ The jury should not have to decide between conflicting experts. "One thing is certain," Mr. Hand wrote, "the jury will do no better with the so-called testimony of experts than without, except where it is unanimous," because if "the jury must decide between such [experts] they are as badly off as if they had none to help."³⁹

In summary, because courts are "for the particularized resolution of legal disputes," not the "search for cosmic understanding," the *Daubert* Four requires that any expert's evidence be either reliable, or be excluded.

5. *Daubert "Gatekeeper" Hearings.* Whether proposed expert evidence is or is not reliable is a decision to be made by the trial judge at the "gatekeeper" stage, referred to as a *Daubert* hearing. As Justice Breyer summarized the law in *Kumho*:

We conclude that *Daubert's* general holding—setting forth the trial judge's general "gatekeeping" obligation—applies not only to testimony based on "scientific" knowledge, but also to testimony based on "technical" and "other specialized" knowledge. See Fed. R. Evid. 702. We also conclude that a trial court may consider one or more of the more specific factors that *Daubert* mentioned when doing so will help determine that testimony's reliability. But, as the Court stated in *Daubert*, the test of reliability is "flexible," and *Daubert's* list of specific factors neither necessarily nor exclusively applies to all experts or in every case. Rather, the law grants a district court the same broad latitude when it decides how to determine reliability as it enjoys in respect to its ultimate reliability determination.⁴⁰

The Court has also made it clear that it considers the judge's *Daubert* "gatekeeping function" to be very important. As

34. NORWOOD HANSON, PATTERNS OF DISCOVERY 72, 89 (1954).

35. *Id.* at 72 (footnote omitted).

36. *Id.* at 74.

37. 15 HARV. L. REV. 40, 54 (1901).

38. *Kumho*, 118 S. Ct. at 1174-75, 29 ELR at 20640.

39. Hand, *supra* note 37, at 56.

40. 118 S. Ct. at 1170, 29 ELR at 20639.

Justice Breyer explained in *Joiner*, a toxic tort case, the gatekeeper function of the trial judge is to assure that the “powerful engine” of tort liability “does not destroy” the wrong thing.⁴¹ When a unanimous Supreme Court speaks four times—*Daubert*, *Joiner*, *Kumho*, *Weisgram*—trial lawyers and judges, of course, listen.

6. *Use of Magistrate Judges.* In federal court, magistrate judges are authorized to and already have played an important role in *Daubert* hearings. Their decisions are subject to either *de novo* or clearly erroneous review by the district judge.⁴²

7. *Admission and Exclusion Rulings Reviewable on Appeal.* A trial judge’s decision to admit or exclude expert evidence is subject to appellate review under the “abuse of discretion” standard:

Our opinion in *Joiner* makes clear that a court of appeals is to apply an abuse-of-discretion standard when it “review[s] a trial court’s decision to admit or exclude expert testimony.”⁴³

Justice Scalia’s concurring opinion in *Kumho*, as noted, underscores the importance of excluding “expertise that is *fausse* and science that is junky,”⁴⁴ at the trial or appellate levels. The power, and obligation, of an appellate court to exclude expert evidence on appeal that was improperly admitted at trial below was unanimously underscored by the Court’s fourth *Daubert* ruling, covered next.

8. *Appellate Courts May Reverse on Daubert Grounds and Then Enter Final Judgment.* The Supreme Court’s fourth unanimous *Daubert* decision, *Weisgram*, was decided in February 2000.⁴⁵ It held that an appellate court that reversed the admission of expert evidence in the trial court below on *Daubert* or other grounds may also proceed to enter final judgment without remand in appropriate cases under Fed. R. Civ. P. 50. As Justice Ginsburg explained, “[s]ince *Daubert*, . . . parties relying on expert evidence have had notice of the exacting standards of reliability such evidence must meet,” so that “[i]t is implausible to suggest, post-*Daubert*, that parties will initially present less than their best expert evidence in the expectation of a second chance should their first try fail.”⁴⁶

The tragic case involved Bonnie Weisgram, who died of carbon monoxide poisoning during a fire in her home. Her son, Chad Weisgram, brought a diversity action in district court seeking damages for wrongful death allegedly caused by a defective heater manufactured by defendant Marley Company. The heater was alleged to have caused the fire that led to Bonnie Weisgram’s death. At trial, Weisgram introduced the testimony of three expert witnesses to prove the heater was defective and its causal connection to the fire. The district court overruled the Marley Company’s objec-

tions that the testimony was unreliable and inadmissible under Fed. R. Evid. 702 and *Daubert*. At the close of plaintiffs’ case, and again at the close of all the evidence, Marley unsuccessfully moved under Fed. R. Civ. P. 50(a) for judgment as a matter of law on the ground that plaintiffs had failed to meet their burden of proof on the issues of defect and causation.

The jury returned a verdict for Weisgram. The Marley Company again requested judgment as a matter of law and, in the alternative, a new trial pursuant to Rules 50 and 59. Among the arguments in support of its post-trial motions, Marley reasserted that the expert testimony essential to prove Weisgram’s case was unreliable and therefore inadmissible. The district court denied the motions and entered judgment for Weisgram.

On appeal, the Eighth Circuit held that Marley’s motion for judgment as a matter of law should have been granted because the testimony of Weisgram’s three expert witnesses, the sole evidence supporting the product defect charge, was speculative and not shown to be, and was therefore incompetent to prove plaintiffs’ case. The court of appeals then considered the remaining evidence in the light most favorable to Weisgram, found it insufficient to support the jury verdict, and directed judgment as a matter of law for defendant. The Eighth Circuit recognized that it had discretion to remand for a new trial under Rule 50(d), but held it was not required to do so, that this was not a closed case, that plaintiffs had had a fair opportunity to prove their strict liability claim and failed to do so, and there was no reason to give them a second chance. Thus, it entered a final judgment against plaintiffs at the appellate level.

In its fourth unanimous *Daubert* ruling, the Supreme Court affirmed. It held that Rule 50 permits an appellate court to direct the entry of judgment as a matter of law when it determines that evidence was erroneously admitted at trial and that the remaining, properly admitted, evidence is insufficient to constitute a submissible case. In Justice Ginsburg’s words for the Court, we “hold that the authority of courts of appeals to direct the entry of judgment as a matter of law extends to cases in which, on excision of testimony erroneously admitted, there remains insufficient evidence to support the jury’s verdict.”⁴⁷

9. *How to Determine “Reliability”?* *Daubert* provided two examples of how the reliability test is applied to experts proposing to testify regarding the “phases of the moon.” The first “phases of the moon” expert dealt with “whether a certain night was dark,” so that “if darkness is a fact in issue, the knowledge will assist the trier of fact,” as the study of the phases of the moon in this situation could “provide valid scientific ‘knowledge,’” and thus may be admitted.⁴⁸ The second example involved “evidence that the moon was full on a certain night” to prove “whether an individual was unusually likely to have behaved irrationally on that night,” which the Court found inadmissible “absent credible grounds sup-

41. 118 S. Ct. at 520, 28 ELR at 20229 (J. Breyer, concurring).

42. See, e.g., *Lithuanian Commerce Corp. Ltd. v. Sara Lee Hosiery Int’l*, 179 F.R.D. 450 (D.N.J. 1988); *Price v. Bic Corp.*, 54 F. Supp. 2d 757 (E.D. Tenn. 1998).

43. *Kumho*, 118 S. Ct. at 1176, 29 ELR at 20641 (citing *Joiner*, 118 S. Ct. at 515, 28 ELR at 20227).

44. *Id.* at 1179, 29 ELR at 20642.

45. 120 S. Ct. 1011 (2000).

46. *Id.*, slip op. at 7.

47. *Id.*, slip op. at 30. Recently, the Eighth Circuit applied *Daubert* to an economist’s testimony in a \$140 million antitrust case, once again finding the expertise inadmissible, reversing the trial court jury verdict and judgment, and entering judgment in favor of the defendant. *Concord Boat Corp. v. Brunswick Corp.*, No. 98-3732, 2000 U.S. App. LEXIS 4673 (8th Cir. Mar. 24, 2000).

48. *Daubert*, 125 L. Ed. 2d at 482, 23 ELR at 20982.

porting such a link.⁴⁹ Thus the Court found the first expert's evidence "reliable" and admissible, and the second not.

How do judges and litigators determine when expert evidence is, or is not, reliable and admissible? As a basic proposition, the Supreme Court emphasized in *Kumho* that a "trial judge" has "considerable leeway" in deciding "how to go about determining whether particular expert testimony is reliable."⁵⁰ Further, the unanimous Court's analysis in the *Daubert* Four, as well as what eight members of the Court actually did in affirming the exclusion of the expert evidence in part III of *Joiner* and *Kumho*, provide a roadmap that no court or litigator will want to miss. In addition, a "does it work and why?" analysis is presented below that sharpens and simplifies the analysis of reliability consistent with the "considerable leeway" the Supreme Court has given the courts.

Specifically, key holdings and methods for determining the reliability, or lack thereof, of expert evidence under the *Daubert* Four include the following.

□ *Daubert* Factors Permitted But Not Required. *Kumho* clarified that some, all, or none of the four factors listed in *Daubert*⁵¹ could be used to determine the reliability of proposed expert testimony. A "trial court may consider one or more of the more specific factors that *Daubert* mentioned when doing so will help determine that testimony's reliability," but "*Daubert*'s list of specific factors neither necessarily nor exclusively applies to all experts or in every case."⁵² The Court also repeated what it emphasizes in *Daubert*: the four factors "do not constitute a 'definitive checklist or test.'"⁵³

□ *Daubert* Factors Are Questions. In *Kumho*, the Court reiterated that the *Daubert* "factors" are in fact "questions." Justice Breyer explained that "a trial judge may ask questions of the sort *Daubert* mentioned," and noted that it is "appropriate for the trial judge to ask, for example, how often an engineering expert's experience-based methodology has produced erroneous results, or whether such a method is generally accepted in the relevant engineering community," or "to ask" a witness whose expertise is based purely on experience "whether his preparation is of a kind that others in the field would recognize as acceptable."⁵⁴ In *Daubert* itself, the so-called factors were in fact, questions.

Analytically, the difference between "factors" and "questions" is very important. It is not a mere slip of the pen. With questions, there is only one issue, "reliability," and as many questions as necessary are used to probe reliability. By contrast, factor analysis often takes on a life of its own, readily losing sight of the forest—the issue of reliability—in an ever denser foliage of factors. The questions may include any, or none, of the *Daubert* "factor-questions," and may naturally lead to sometimes many other questions. Unlike factors that lack an underlying rationale, questions add clarity and simplicity to the one ultimate issue—reliability.

49. *Id.*

50. *Kumho*, 118 S. Ct. at 1176, 29 ELR at 20641.

51. *Id.* at 1175, 29 ELR at 20640 (citing *Daubert*, 125 L. Ed. 2d at 482-83, 23 ELR at 20982).

52. *Kumho*, 118 S. Ct. at 1171, 29 ELR at 20639.

53. *Id.* at 1175, 29 ELR at 20641 (quoting *Daubert*, 125 L. Ed. 2d at 482, 23 ELR at 20982).

54. *Id.* at 1176, 29 ELR at 20641 (emphasis added).

□ *More Than "Unsupported Speculation."* The Supreme Court has also expressly ruled that "unsupported speculation" and "subjective belief"⁵⁵ are not sufficient to be admissible expert evidence.

□ *Some Good Science and Other Expert Evidence Will Be Missed.* The Supreme Court has acknowledged that some good evidence may even be lost from time to time. A "gatekeeping role for the judge, no matter how flexible, inevitably on occasion will prevent the jury from learning of authentic insights and innovations."⁵⁶ The Court explained, however, that result "is the balance that is struck by Rules of Evidence designed not for the exhaustive search for cosmic understanding but for the particularized resolution of legal disputes":

[T]here are important differences between the quest for truth in the courtroom and the quest for truth in the laboratory. Scientific conclusions are subject to perpetual revision. Law, on the other hand, must resolve disputes finally and quickly. The scientific project is advanced by broad and widening consideration of a multitude of hypotheses, for those that are incorrect will eventually be shown to be so, and that in itself is an advance. Conjectures that are probably wrong are of little use, however, in the project of reaching a quick, final, and binding legal judgment—often of great consequence—about a particular set of events in the past.⁵⁷

□ *Legal Reasoning Controls.* In *Joiner*, Justice Rehnquist emphasized that a "court may conclude that there is simply too great an analytical gap between the data and the opinion proffered" by an expert to be accepted.⁵⁸ Similarly, Justice Breyer in *Kumho* repeated what the Court had said in *Joiner*, "[n]othing . . . requires a district court to admit opinion evidence that is connected to existing data only by the *ipse dixit* of the expert."⁵⁹

Thus, in court, judges are to decide whether expert evidence is reliable enough to be admitted into evidence by using legal reasoning. As shown below, Part III of the *Joiner* and *Kumho* opinions go to great lengths showing how to use legal reasoning to determine reliability. Legal reasoning, not what is generally accepted by the expert's discipline, determines whether or not the expert evidence is reliable enough to be admitted for trial. *Kumho* and *Joiner* also illustrate de facto the use of a "does it work, and why?" analysis, presented next, that can be used by judges and litigators to sharpen and simplify reliability analysis, consistent with the "considerable leeway" the courts have to determine reliability under *Kumho*.

□ "Does It Work, and Why?" Analysis to Determine Reliability. "Since a babe was born in a manger," Alfred North Whitehead wrote about a new method of reasoning that first appeared in the 1600s, "it may be doubted whether so great a thing has happened with so little stir."⁶⁰ This "new tinge to

55. *Daubert*, 125 L. Ed. 2d at 481, 23 ELR at 20981.

56. *Id.* at 485, 23 ELR at 20983 (emphasis added).

57. *Id.*

58. *Joiner*, 118 S. Ct. at 519, 28 ELR at 20229.

59. *Kumho*, 118 S. Ct. at 1179, 29 ELR at 20642 (quoting *Joiner*, 118 S. Ct. at 520, 28 ELR at 20229).

60. ALFRED WHITEHEAD, SCIENCE AND THE MODERN WORLD 2 (1925).

modern minds," he explained, "broadly spread through the educated world," so much so that we now take it for granted.⁶¹

What is this new method of reasoning, this "new tinge to modern minds"? Whitehead⁶² defines it succinctly to be the "union of passionate interest in the *detailed facts* with equal devotion to *abstract generalization*," that is, "a vehement and passionate interest in the *relation of general principles to irreducible and stubborn facts*."⁶³ Not just theory, not just facts, but the combination of both:

All the world over and at all times there have been practical men, absorbed in "irreducible and stubborn facts": all the world over and at all times there have been men of philosophic temperament who have been absorbed in the weaving of general principles. It is this union of passionate interest in the detailed facts with equal devotion to abstract generalization which forms the novelty in our present society.⁶⁴

Thus Whitehead identified a new method of reasoning that interactively combines empirical verification with intellectual rigor, which can be described as basically asking two questions, "does it work?" and "why?"

Most lawyers will immediately recognize this new method of reasoning includes modern legal reasoning. The interaction of law and fact is what the modern lawyer is taught to do, and is what the modern lawyer does every day. Thus, the "does it work and why" method is one way to describe modern legal reasoning. As such, it can be readily used by judges and litigators as a powerful tool to analyze the reliability of expert evidence. Lawyers, of course, are especially well-trained and experienced in asking "does it work?" and "why?"

Further, perhaps surprisingly, the pervasiveness of this new method of reasoning includes modern science, and more specifically, how science determines reliability.⁶⁵ Thinking like a lawyer is fundamentally the same as thinking like a scientist. Einstein stated, "the only justification" for a scientific theory or "mental structure" is "*whether and in what way*" it works, that is, "does it work?" and "why?"⁶⁶ Or, as Yale physics and philosophy professor Henry Margenau put it, "scientific truth, that is to say the validity of an accepted theory," depends on two important kinds of factors: first, "empirical verification" (does it work?) and second, "guiding principles" or intellectual rigor (why?).⁶⁷

The first test, empirical verification—"does it work?"—is very demanding. As Murray Gell-Man, a Nobel

laureate in physics, bluntly stated to a Cleveland audience on the last day of the Michelson-Morley Centennial Celebration on October 31, 1987: "No amount of elegance can save a wrong theory."⁶⁸ Unlike purely theoretical or abstract disciplines or scientific theories that have been proposed but not tested, valid or reliable science is science that has advanced beyond the speculative stage and demonstrably fits the facts. Perhaps Richard Feynman, a Nobel prize winner in physics, stated the "does it work, and why?" method of reasoning best. As to the "does it work?" question, he explained:

[W]e . . . see if it works. If it disagrees with experiment it is wrong. In that simple statement is the key to science. It does not make any difference how beautiful your guess is. It does not make any difference how smart you are, who made the guess, or what his name is—if it disagrees with experiment it is wrong.⁶⁹

As to the second test, the "why?" question, Feynman wonderfully stated the fundamental inquiry thus:

I wonder why. I wonder why.
I wonder why I wonder.
I wonder why I wonder why
I wonder why I wonder!⁷⁰

Several examples from modern science illustrate how the two questions are applied. Science contains many examples of elegant and rigorous theories that did not fit the facts, and thus were rejected.

□ *Galileo and the Center of the Universe*. Galileo is generally credited with the birth of modern science.⁷¹ In the early 1600s, Galileo applied a new device, a telescope, to the heavens to see which of two theories best fit the facts.⁷² One theory, that the earth was the center of the universe, had been elegantly refined by Ptolemy in 150 A.D. and used with great success for more than 1,000 years. The second theory had been proposed by Copernicus about 50 years before Galileo's time. Copernicus suggested that the sun, not the earth, was the center of the universe. Using a telescope, Galileo gathered the facts that showed that "the Ptolemaic heaven simply did not work," and that "Copernicus's powerful guess had been right."⁷³

Judge Posner recently used Galileo's experience to describe this fundamental difference between two important methods of human thought, science, and faith:

When Cardinal Bellarmine refused to look through Galileo's telescope at the moons of Jupiter, whose existence seemed to refute the orthodox view that the planets were

61. *Id.*

62. Felix Frankfurter wrote in 1948 on Mr. Whitehead's death that "no single figure has had such a pervasive influence" as Whitehead, eloquently putting in context the value of Whitehead's insights. Frankfurter letter to the N.Y. TIMES (Jan. 8, 1948), reprinted in ALFRED WHITEHEAD, *THE AIMS OF EDUCATION* vii (1929; Mentor reprint).

63. WHITEHEAD *supra* note 60, at 3.

64. *Id.*

65. There are, of course, many ways to define science and scientific validity. Einstein, Margenau, and Feynman, covered next, in addition to Whitehead, should be more than sufficient to meet Justice Breyer's "considerable leeway" test in *Kumho*.

66. ALBERT EINSTEIN & LEOPOLD INFELD, *THE EVOLUTION OF PHYSICS* 294 (1938) (emphasis added).

67. LAWRENCE LESHAN & HENRY MARGENAU, *EINSTEIN'S SPACE AND VAN GOGH'S SKY: PHYSICAL REALITY AND BEYOND* 83 (1982). See also HENRY MARGENAU, *THE NATURE OF PHYSICAL REALITY* (1950).

68. One of the authors, Mr. Weller, was present at his lecture.

69. Quoted in JOHN & MARY GRIBBIN, *RICHARD FEYNMAN* 178 (1997).

70. *Id.* at 74. The "why" question, of course, has many dimensions. For example, in Margenau's words:

The guiding principles of science, the criteria employed in the acceptance as well as rejection of constructs and complexes of constructs called theories, have been loosely enumerated as simplicity, extensibility, multiple connections, logical fertility, stability of interpretation, causality, and elegance.

LESHAN & MARGENAU, *supra* note 67, at 81; see also MARGENAU, *supra* note 67, at 75-99.

71. See, e.g., WHITEHEAD, *supra* note 60, at 9, and JACOB BRONOWSKI, *THE ASCENT OF MAN* 202 (1973).

72. BRONOWSKI, *supra* note 71, at 164, 194-218.

73. *Id.* at 204.

fixed to the surface of crystalline spheres, he was not being irrational. He was just refusing to play the science game, in which theories are required to conform to observations, to "the facts," rather than the other way around.⁷⁴

□ *Galileo and the Leaning Tower of Pisa.* Galileo dropped a large and a small stone from the Leaning Tower of Pisa in another famous Galileo experiment to test the prevailing and common sense theory that heavy stones fall faster than light ones.⁷⁵ Galileo's experiment showed the large stones and small stones fell to the earth at the same speed. The prevailing theory did not fit the facts, and thus did not work. Galileo eventually came up with a theory that did explain the facts. As noted, his 34-year effort led to the theory that gravitational acceleration near the earth is constant, making the size of the stones immaterial.

□ *Michelson-Morley and the Speed of Light.* In the late 1800s, Newtonian physics was at its height after more than two centuries of remarkable achievement. Then, in 1887, Albert Michelson and Edward Morley performed an experiment in Cleveland, Ohio, that bounced light back and forth between mirrors mounted on a five-foot square table that rocked the foundations of classical Newtonian physics. As a physicist-poet wrote for the Michelson-Morley Centennial Celebration in Cleveland in 1987:

The Michelson-Morley collusion
Forced the world to accept the conclusion:
Since the fringe didn't shift
Then the earth's not adrift
And the ether is just an illusion.⁷⁶

There was no ether. The speed of light did not change with motion, it was constant. One of the greatest theories the world had ever known, Newtonian physics, did not always fit the facts. The theory was not reliable in this application. New theories were needed. Out of the ashes of Newtonian physics moving at the speed of light, Einstein developed relativity theory. Einstein later told Michelson, "your marvelous experimental work paved the way of the development of the theory of relativity."⁷⁷

□ *Dr. Semmelweiss and Childbed Fever.* Childbed fever was a major cause of death for women in the 1800s. Dr. Semmelweiss, a young obstetrician, observed that the death rate for mothers seen by doctors was much higher than for mothers treated by midwives. He noticed that midwives washed their hands, and that doctors did not. Based on the facts he observed, he made people treating his patients wash their hands, even though hand washing was not required by

and had no explanation in prevailing medical practice or theory. The death rate for his patients dropped dramatically. Dr. Semmelweiss, fortunately, rejected prevailing theory when it did not fit the facts. It took science another 25 years to develop the germ theory of disease that did explain how childbed fever was transmitted and why hand washing could mean the difference between life and death for mother and child.⁷⁸

Empirical verification, "does it work?," is a very tough master, but it is not enough. The second test to probe the reliability of expert evidence is its intellectual rigor, "why?" In Einstein's words, it is critical "in what way" theories are linked to "the wide world of sense impressions." Several examples from science and mathematics are illustrative.

□ *Euclidean and Non-Euclidean Geometry.* The importance of assumptions and logic to intellectual rigor is nicely illustrated in the field of geometry, where conclusions vary dramatically with the assumptions used.

For over 2,000 years, there was one geometry, Euclidean geometry. It is based on 10 assumptions, including one called the Parallel Postulate.⁷⁹ Twenty-four hundred years after Euclid, two 19th Century mathematicians, Gauss and Riemann, thought it would be interesting to see what happened if they changed the Parallel Postulate. They used 9 of Euclid's assumptions, plus a 10th that contradicted the Parallel Postulate. They created an entirely new set of intellectually rigorous geometries. The Non-Euclidean geometries yield theorems just as rigorously as Euclidean geometry, but some directly contradict the theorems of Euclidean geometry. For example, in Euclidean geometry the sum of the angles of a triangle equals 180 degrees. In Gauss' Non-Euclidean geometry, the sum of the angles of a triangle never equals 180 degrees. In Riemannian geometry, the sum of the angles of a triangle is between 180 and 540 degrees.⁸⁰

□ *Relativity Theory.* As noted, Michelson and Morley proved experimentally that the speed of light was constant, a fact that contradicted classical Newtonian physics. Einstein, rather than try to attempt to save classical Newtonian theory in this area, developed an entirely new, intellectually rigorous theory—the theory of relativity—that rested on the empirically determined fact that the speed of light was constant. "In an ingenious mental turnaround, Einstein turned this puzzle [of the speed of light being a constant] into a postulate! Instead of worrying, for the moment, how it might happen, he simply accepted the experimentally irrefutable fact that it does happen."⁸¹

In summary, the "does it work, and why?" questions provide a simple yet analytically rigorous approach to analyzing the reliability of expert evidence under the *Daubert* Four. What eight members of the Supreme Court actually did when they affirmed the exclusion of expert evidence as not reliable in *Joiner* and *Kumho* illustrates, without so stat-

74. RICHARD A. POSNER, *OVERCOMING LAW* 7 (1995).

75. BRONOWSKI, *supra* note 71, at 204.

76. Barbara Perris, *Light Fantastic*, N. OHIO LIVE August 1987, at 65. Classical physics had demonstrated that light was a wave. It was therefore necessary that the waves moved through a medium called the luminiferous (light-carrying) ether, like waves move through water. Michelson, the first American to win the Nobel Prize in physics, explained his experiment with two light waves as being like two swimmers, "one struggling upstream and back, while the other covering the same distance, just crosses the river and returns. The second swimmer will always win, if there is any current in the river." *Id.* at 67. There wasn't. There was no ether.

77. *Id.* at 69. See also Jerry Bishop, *Arcane Equations Led Einstein and All of Us Into a Relative World: His Theories Upset Newton's*, WALL ST. J., Dec. 5, 1991 at A1.

78. EUGENE ROBIN, *MATTERS OF LIFE AND DEATH: RISKS VS. BENEFITS OF MEDICAL CARE* 67 (1987); Joshua Lederberg, *Infectious History*, 288 SCIENCE 287 (2000).

79. This is the assumption that given a line and a point not on the line, there is one and only one line in the same plane that passes through the point and does not meet the other line. Morris Kline, *Geometry*, 211 SCI. AM. 60, 66 (1964).

80. *Id.*

81. GARY ZUKAV, *THE DANCING WU LI MASTERS: AN OVERVIEW OF THE NEW PHYSICS* 135 (1979).

ing, "does it work, and why?" analysis in practice, as shown next.

□ *Joiner Part III.* In Part III of *Joiner*, the Court affirmed the trial court's exclusion of all of the plaintiff's expert evidence using animal and epidemiological studies. The plaintiff's theory was that his small cell lung cancer was "promoted" by his exposure to PCBs and PCB derivatives while working for General Electric. The plaintiff presented two experts on the issue that the trial court excluded as not reliable. The first expert would have testified that he believed it "more likely than not" that the plaintiff's lung cancer was "causally linked to cigarette smoking and PCB exposure," and the second expert would have testified that the lung cancer was "caused by or contributed to in a significant degree by the materials with which he worked," citing animal and epidemiological studies.⁸² Eight members of the Supreme Court affirmed the trial court's exclusion of both experts' evidence.

□ *Joiner Animal Studies.* The Court first reviewed the animal studies, which involved infant mice that had developed cancer after PCB exposure. The Supreme Court concluded that the "studies were so dissimilar to the facts presented in this litigation that it was not an abuse of discretion for the District Court to have rejected the experts' reliance on them."⁸³

First, the Court cited the "massive doses" of PCBs the infant mice received in contrast to the plaintiff's "alleged exposure to PCBs," which was "far less than exposure in the animal studies."⁸⁴ Second, the mice received injections of highly concentrated PCBs, but the fluid the plaintiff was exposed to had a much lower PCB concentration. Third, the mice developed a different cancer, alveolar adenomas, rather than small-cell carcinomas. Fourth, no study showed PCBs caused cancer in any other species than mice, and no study showed PCBs caused cancer in adult mice rather than just infant mice.

Finally, the Court focused on the "why" question of how the experts linked facts and theory and found the experts reasoning insufficient:

Rather than explaining how and why the experts could have extrapolated their opinions from these seemingly far-removed animal studies, respondent chose "to proceed as if the only issue [was] whether animal studies can ever be a proper foundation for an expert's opinion." . . . The issue was whether *these* experts' opinions were sufficiently supported by the animal studies on which they purported to rely. The studies were so dissimilar to the facts presented in this litigation that it was not an abuse of discretion for the District Court to have rejected the experts' reliance on them.⁸⁵

□ *Joiner Epidemiological Studies.* Next, the *Joiner* Court reviewed four epidemiological studies relied upon by plaintiff's experts and found them to be just as unpersuasive. One epidemiological study, which involved mortality among

PCB-exposed workers at an Italian capacitor plant, found higher-than-expected lung cancer deaths. The authors of the study, however, declined to associate the cancers with the exposures.

The second study was a 1979 mortality study of workers at a PCB plant in Illinois that also found a higher-than-expected incidence of lung cancer deaths. However, the authors found the increase to be statistically insignificant and did not suggest there was a causal link.

The third study was from Norway, and it did not mention PCBs. The Supreme Court noted that the study "(1) made no mention of PCBs and (2) was expressly limited to the type of mineral oil involved in that study," and concluded that it "thus did not support these experts' opinions."⁸⁶

The fourth study involved people who had been exposed to numerous carcinogens, but not to PCBs. The Court reasoned that the "subjects of this study . . . had been exposed to numerous potential carcinogens, including toxic rice oil that they had ingested," and held that "nothing in either *Daubert* or the Federal Rules of Evidence requires a district court to admit opinion evidence which is connected to existing data only by the *ipse dixit* of the expert."⁸⁷ As Justice Rehnquist emphasized, a "court may conclude that there is simply too great an analytical gap between the data and the opinion proffered."⁸⁸

□ *Kumho Part III.* In Part III of *Kumho*, Justice Breyer reversed the Eleventh Circuit and affirmed the trial judge's exclusion of the tire expert's evidence that the tire company's tire was defective on *Daubert* reliability grounds. Both analyses are extensive, and important. Justice Breyer first pointed out that the trial judge did not question the tire expert's qualifications, but focused on the issue of whether the expert reliably determined the cause of the failure of the tire in the case.

Justice Breyer also explained that the tire expert's own testimony cast considerable doubt upon the reliability of his theories:

Among other things, the expert could not say whether the tire had traveled more than 10, or 20, or 30, or 40, or 50 thousand miles, adding that 6,000 miles was "about how far" he could "say with any certainty." . . . The court could reasonably have wondered about the reliability of a method of visual and tactile inspection sufficiently precise to ascertain with some certainty the abuse-related significance of minute shoulder/center relative tread wear differences, but insufficiently precise to tell "with any certainty" from the tread wear whether a tire had traveled less than 10,000 or more than 50,000 miles.⁸⁹

Justice Breyer further explained that the trial judge found that the expert had conceded that the tire had traveled far enough that it should have been taken out of service; that the tire had been repaired inadequately for punctures; that the tire bore marks that indicated abuse rather than a tire defect; that there was nothing in the record that other tire experts used the same approach, and that there were no articles that validated or used his approach.⁹⁰

82. *Joiner*, 118 S. Ct. at 518, 28 ELR at 20228.

83. *Id.*

84. *Id.*

85. *Id.* (citation omitted).

86. *Id.* at 519, 28 ELR at 20228-29.

87. *Id.* at 519, 28 ELR at 20229.

88. *Id.*

89. *Kumho Tire Co. v. Carmichael*, 118 S. Ct. 1167, 1177, 29 ELR 20638, 20641 (1999).

90. *Id.* at 1177-78, 29 ELR at 20641-42.

Finally, Justice Breyer's analysis in Part III of *Kumho*, without so stating, also illustrates the general "does it work, and why" method of analysis presented here, and its application in the law, modern legal reasoning.

Next, "does it work, and why?" analysis simplifies and sharpens the "four factor" analysis that is now commonly used by the lower courts.

□ *The Daubert "Factors" as the Two Questions.* *Daubert's* four questions have become commonly known as the "four factors" for analyzing "reliability." By using the "does it work, and why" method, the four factors can be reordered to sharpen and clarify their use. The first and third *Daubert* questions are actually examples of the "does it work?" question:

[1.] Whether a "theory or technique . . . can be (and has been) tested;"

[3.] Whether, in respect to a particular technique, there is a high "known or potential rate of error" and whether there are "standards controlling the technique's operation."⁹¹

The second and fourth *Daubert* questions are actually "why?" questions:

[2.] Whether it "has been subjected to peer review and publication;"

[4.] Whether the theory or technique enjoys "general acceptance" within a "relevant scientific community."⁹²

Reordering the four factors into the two "does it work, and why?" questions thus provides an understandable and powerful rationale that readily leads to followup questions tailored to the specific facts and circumstances of the case, focused on the one issue, reliability. The Court's analysis in part III of *Joiner* and *Kumho* illustrates how many focused questions result, not just four. Also, on remand in *Daubert*, the Ninth Circuit added the question of "whether the experts are proposing to testify about matters growing naturally and directly out of research they have conducted independent of the litigation, or whether they have developed their opinions expressly for purposes of testifying."⁹³ This question includes both the "does it work" and "why" questions, as it probes both where and how extensively and effectively the expert's theories have been applied, as well as their intellectual rigor.

□ *Daubert's Many Factors as the Two Questions.* In *Daubert*, the Supreme Court cited but did not quote more than 20 other questions that had been suggested by a number of authorities.⁹⁴ All can be better understood and more probingly applied when regrouped around the two questions:

Does It Work? (1) whether the theory or technique can be, and has been, tested empirically; (2) its error rate; (3) the use which has been made of the new technique; (4) the care with which the technique was employed in the case; (5) the soundness and re-

liability of the process or technique used in generating the evidence; (6) the proffered connection between the scientific research or test result to be presented, and the particular disputed factual issues in the case; (7) the existence and maintenance of standards governing its use; and (8) presence of safeguards in the characteristics of the technique.

Why? (1) whether it has been subjected to peer review and publication; (2) the extent to which the technique has been accepted by scientists in the field involved; (3) the availability of other experts to test and evaluate the technique; (4) the reputation of the expert within the scientific community; (5) the strengths of opposing views and the standing of the persons who express them; (6) whether the expert is prepared to discuss uncertainties in the techniques used to prepare the evidence and in the conclusions; (7) the expert's qualifications and stature; (8) the existence of specialized literature; (9) analogy to other scientific techniques whose results are admissible; (10) the novelty of the new invention; (11) the extent to which the technique relies on the subjective interpretation of the expert; (12) whether both sides to the controversy have reasonably comparable access to scientific authorities; (13) the clarity and simplicity with which the technique can be described and its results explained; and (14) the nature and breadth of the inference adduced.

In summary, the "does it work, and why?" method adds simplicity and analytical rigor to the *Daubert* Four's mandate to determine whether an environmental or any other expert's proposed evidence is reliable, or whether, in Justice Scalia's colorful words, it is "expertise that is *fausse* and science that is junky" that must be excluded.

The next section applies the *Daubert* Four and its underlying legal analysis, combined as the *Daubert* Litigation Approach, to 10 examples in environmental litigation and regulation.

The *Daubert* Litigation Approach

This section first reviews how *Daubert* applies to all federal environmental laws, then how its underlying analysis can be generalized beyond the Federal Rules of Evidence. It then presents 10 illustrations of the application of this *Daubert* Litigation Approach.

Daubert Applies to All Federal Environmental Laws

There are approximately 26 different federal environmental statutes, including the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA),⁹⁵ the Toxic Substances Control Act (TSCA),⁹⁶ the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA),⁹⁷ the CAA, the Occupational Safety and Health Act (OSH Act),⁹⁸ the

91. *Id.* at 1175, 29 ELR at 20640 (citing *Daubert*, 125 L. Ed. 2d at 482-83, 23 ELR at 20982).

92. *Id.*

93. *Daubert v. Merrell Dow Pharmaceutical, Inc.*, 43 F.3d 1311, 1317, 25 ELR 20856, 20858 (9th Cir. 1995).

94. *Daubert*, 125 L. Ed. 2d at 484 n.12, 23 ELR at 20982 n.12.

95. 42 U.S.C. §§9601-9675, ELR STAT. CERCLA §§101-405.

96. 15 U.S.C. §§2601-2692, ELR STAT. TSCA §§2-412.

97. 7 U.S.C. §§136-136y, ELR STAT. FIFRA §§2-34.

98. 29 U.S.C. §§651-678.

Food, Drug, and Cosmetic Act (FDCA),⁹⁹ and the Atomic Energy Act,¹⁰⁰ administered by 8 different agencies, such as EPA, the Department of Health and Human Services (HHS), and the Nuclear Regulatory Commission (NRC),¹⁰¹ each applying widely varying legal standards. For example, one of the Clean Water Act¹⁰² legal standards is the "best available technology economically achievable." One of the Safe Drinking Water Act (SDWA)¹⁰³ standards is, among other requirements, to assure safe drinking water "to the extent feasible (taking costs into account)." FIFRA requires no "unreasonable adverse effects," and one of the OSHA standards is "to the extent feasible." The CAA requires "an ample margin of safety"; the Resource Conservation and Recovery Act¹⁰⁴ requires standards "as may be necessary to protect human health and the environment"; and TSCA provides that highly toxic substances be banned.¹⁰⁵

Thus, the numerous federal environmental laws have varying legal standards that have developed in a piecemeal manner over the decades. One of the striking implications of the *Daubert* Four for environmental law is that it applies uniformly to any and all of the many federal environmental laws and standards. No matter what environmental law or standard is involved, when there is expert testimony, *Daubert* is controlling federal law in federal court

99. 21 U.S.C. §§301-395.

100. 42 U.S.C. §§2011-2297g-4.

101. BREYER, *supra* note 9, at 8 (citing LESTER B. LAVE & ARTHUR C. UPTON, *TOXIC CHEMICALS, HEALTH, AND THE ENVIRONMENT* 29 (1987) (regarding 13 widely used statutes: the FDCA, FIFRA, the CAA, the OSH Act, the Consumer Product Safety Act, the Clean Water Act, the Safe Drinking Water Act, TSCA, RCRA, the Hazardous Materials Transportation Act, CERCLA, and the Superfund Amendments and Reauthorization Act)).

102. 33 U.S.C. §§1251-1387, ELR STAT. FWPCA §§101-607.

103. 42 U.S.C. §§300f to 300j-26, ELR STAT. SDWA §§1401-1465.

104. *Id.* §§6901-6992k, ELR STAT. RCRA §§1001-11011.

105. KAMMEN & HASSENZAHN, *supra* note 14, at 12, 337. More specifically, TSCA requires agency action when a chemical substance "[p]resents or will present an unreasonable risk of injury to health or the environment." 15 U.S.C. §2605(a), ELR STAT. TSCA §6(a) (1994); FIFRA, 7 U.S.C. §136a(c)(5)(D), ELR STAT. FIFRA §3(c)(5)(D) (1994) (prohibiting pesticides that "cause unreasonable adverse effects on the environment."); CWA, 33 U.S.C. §1313(c)(2)(A)-(B), ELR STAT. FWPCA §303(c)(2)(A)-(B) (1988) (states' water quality standards must ensure that states' designated use of eaters will be protected); *id.* §1317(a)(1), ELR STAT. FWPCA §307(a)(1) (1975) (amended 1977) (effluent level for toxic pollutants "shall take into account toxicity of the pollutant, its persistence, degradability, the usual or potential presence of the affected organisms . . . and the nature and extent of the effect of the toxic pollutant on such organisms"); SDWA, 42 U.S.C. §300g-1(b)(4), ELR STAT. SDWA §1412(b)(4) (1988) (maximum drinking water contaminants are "set at the level at which no known or anticipated adverse effects on the health of persons occur and which allows an adequate margin of safety"); CAA, *id.* §7409(b)(1), ELR STAT. CAA §109(b)(1) (1988) (standards for commonplace "criteria" air pollutants must "allow [] an adequate margin of safety . . . requisite to protect the public health"); *id.* §7412(a)(1), ELR STAT. CAA §112(a)(1) (1988) ("the President shall select a remedial action that is protective of human health and the environment . . ."); *cf.* OSH Act, §6(b)(5), 29 U.S.C. §655(b)(5) (1988) (permanent standards for toxics should be set at a level "which most adequately assures, to the extent feasible . . . that no employee will suffer material impairment of health or function capacity"); RCRA, 42 U.S.C. §6924(m)(1), ELR STAT. RCRA §3004(m) (1988) (standards for treatment of hazardous wastes disposed onto land shall "substantially diminish the toxicity of the waste or substantially reduce the likelihood of migration of hazardous constituents from the waste so that short-term and long-term threats to human health and the environment are minimized"). See Wendy Wagner, *The Science Charade in Toxic Risk Regulation*, 95 COLUM. L. REV. 1613, 1618 n.15 (1995).

and, as shown below, is arguably controlling law on expert evidence in federal agency adjudication and rulemaking as well.

Generalizing Daubert: Applying Nonenvironmental Laws to Environmental Law

The underlying *Daubert* legal principle of applying federal law from outside environmental law, like the Federal Rules of Evidence in *Daubert*, to cases involving environmental issues can be generalized to other nonenvironmental federal laws. This generalized *Daubert* approach applies other federal laws, in addition to the Federal Rules of Evidence, to support innovative approaches to environmental law and litigation.

It is neither possible nor necessary here to survey all of the federal laws outside environmental law that creative lawyers and judges may be able to apply in new ways to federal environmental law and litigation.¹⁰⁶ Four examples are sufficient for present purposes: the Federal Rules of Civil Procedure, particularly as applied in the *Manual for Complex Litigation*¹⁰⁷; the Civil Justice Reform Act¹⁰⁸; the Unfunded Mandates Reform Act (UMRA)¹⁰⁹; and the federal antitrust laws. Federal antitrust law is not controlling federal law like the others. However, the antitrust laws illustrate a dynamic approach to remedies for competition that provide precedent for innovative and dynamic remedies in environmental law and litigation.

Ten Examples of the Daubert Litigation Approach

The following 10 examples illustrate the application of the *Daubert* Litigation Approach in environmental litigation and regulation. This section does not purport to provide a definitive or exhaustive analysis of the issues raised, but is intended instead to suggest the wide potential scope of the *Daubert* Litigation Approach to achieve innovative new directions in environmental litigation and regulation.

1. *Holding Early Daubert Hearings for the Remedy Phase or Any Other Dispositive Litigation Issue.* Section 33.7 of the *Manual for Complex Litigation* focuses on Superfund, the CAA, the National Environmental Policy Act (NEPA),¹¹⁰ and other environmental litigation, and includes a variety of examples of case management tailored to environmental litigation.¹¹¹ Experts are used on numerous key issues, and there are well-known procedures used by trial judges to manage expert evidence, such as requiring the pre-

106. See, e.g., STEPHEN BREYER ET AL., *ADMINISTRATIVE LAW AND REGULATORY POLICY* 118 (1999) [hereinafter BREYER ET AL. TEXT]. See generally *id.* at 102-44; ch. 4, *The Scope of Judicial Review*; ch. 5, "Common Law" Requirements; ch. 6, *Procedural Requirements*.

107. See also Jerome Simandle, *Resolving Multi-Party Hazardous Waste Litigation*, 2 VILL. ENVTL. L.J. 111 (1991) [hereinafter Simandle]; Jerome Simandle, *Superfund Case Management And Settlement Processes*, C352 ALI-ABA 175 (1988) (U.S. District Court Judge Simandle has described in some detail some of the methods he utilizes to aggressively manage cases and settlement in large multi-party litigation).

108. 28 U.S.C. §§471-482.

109. 2 U.S.C. §§1501 et seq.

110. 42 U.S.C. §§4321-4370d, ELR STAT. NEPA §§2-105.

111. *MANUAL FOR COMPLEX LITIGATION* §33.7 (3d ed. 1995). See also *id.* §33.2, *Mass Torts*.

cise issues to be addressed by experts to be defined, setting deadlines for the exchange of expert reports, critiques of adverse experts' reports, the serving of rebuttal experts' reports, and taking expert depositions.¹¹² In addition, as the *Manual for Complex Litigation* points out, "[t]he order of trial (and of the corresponding settlement discussions) can be varied to address dispositive issues first."¹¹³

As a threshold matter, the *Daubert* Four is controlling law regarding expert evidence in any environmental litigation in federal court. In *Freeport-McMoran Resource Partners Ltd. Partnership v. B-B Paint Corp.*,¹¹⁴ the court rejected plaintiff's claim that the *Daubert* requirements did not apply in Superfund cases and found that the testimony of plaintiff's expert was "utterly lacking in any indicia that would establish any of the *Daubert* standards."¹¹⁵

Daubert hearings add two important dimensions to expert evidence in environmental litigation. First, a *Daubert* hearing may result in the exclusion of an expert critical to a party's case. Second, as a practical matter, *Daubert* hearings increase the trial judge's persuasive powers in settlement negotiations that occur after an expert's *Daubert* hearing but before the ruling on the admissibility or exclusion of the expert.

As a result, the use of a *Daubert* hearing focused on dispositive expert issues early in a case may be particularly effective. For example, changing the order of a Superfund case to focus on the remedy phase of litigation early,¹¹⁶ combined with a *Daubert* hearing on a plaintiff's remedy experts, could facilitate prompt and creative settlements. In addition, as a basic trial technique it is advisable for defendants to present compelling alternative remedies or other equities that support their position at the same time, such as an expert witness like the former EPA administrator identified by Justice Breyer who could testify that "about 95 percent of the toxic material could be removed from waste sites in a few months, but years are spent trying to remove the last little bit" with "limited technological choice, high cost, devotion of considerable agency resources, large legal fees, and endless argument."¹¹⁷ Obviously if a plaintiff's remedy experts are excluded at a *Daubert* hearing or there is a risk that that will happen, the opportunity for creative settlements should increase.

An article by Judge Simandle discusses methods that lead to "global" settlements of Superfund cases, including cases that have reached the stage of seeking past response costs before EPA has yet to complete a remedial investigation and feasibility study or adopt a record of decision on a final phase of remediation.¹¹⁸ At the time the article was published, 1991, Judge Simandle did not have the benefit of the *Daubert* Four on expert evidence. Now, incisive judicial supervision could combine *Daubert* hearings on remedy ex-

perts with presentations by the government and potentially responsible parties (PRPs) on their competing remedial plans, resulting in a settlement process that produces a "hybrid remedial plan" that takes "the best characteristics of the competing plans of the government and of the participating PRPs."¹¹⁹

As another example, consider the *Ottati* litigation. Could EPA's remedy experts in the *Ottati* litigation survive a *Daubert* hearing? Could they "reliably" testify that "nonexistent dirt-eating children" or the public would benefit by burning the dirt as EPA insisted? A *Daubert* hearing in the *Ottati* case on EPA's remedy experts may have avoided years of litigation and all associated direct and lost opportunity costs for the environment and the public.

Accordingly, the *Daubert* Litigation Approach suggests moving to exclude agency remedy or other experts at any dispositive stage of Superfund or other litigation by use of a *Daubert* hearing, coupled with judicial settlement proceedings, as a means for the courts and/or defendants to obtain innovative settlements and avoid wasteful *Ottati*-type litigation.¹²⁰

2. *Daubert* Applies to Agency Adjudication and Rulemaking. The Supreme Court, by way of the *Daubert* Four, has revolutionized the use of expert evidence in federal court. Rarely in history has the Supreme Court unanimously and definitively redefined an area of law as it did for expert evidence in the *Daubert* Four. What about federal agencies when they act as courts or promulgate rules? As a matter of policy and statutory interpretation, the *Daubert* reliability standard should apply to federal environmental agencies in rulemaking and adjudication.¹²¹

First, consider the Administrative Procedure Act (APA). The use of experts and other evidence in federal agencies has been well-established for actually a much shorter time than the use of expert evidence in federal courts, which had been established for 70 years. Will the Supreme Court extend *Daubert* to APA agencies? The APA has express language that directly supports the application of the Supreme Court's *Daubert* Four. APA §556(d) states that "a sanction may not be imposed or rule or order issued except . . . [when] supported by and in accordance with the reliable, probative, and substantial evidence."¹²² Thus, agency rules, orders, and sanctions by statute must be "supported by . . . reliable" evidence, which is precisely the *Daubert* standard for experts. Indeed, the APA case is actually simpler. Unlike *Daubert*, where "reliability" was added by judicial gloss to Fed. R.

119. *Id.* at 125.

120. Two recent cases illustrate the importance of *Daubert* in the context of Superfund litigation. *Kalamazoo River Study Group v. Rockwell Int'l Corp.*, 171 F.3d 1065, 29 ELR 21003 (6th Cir. 1999), where the Sixth Circuit affirmed the exclusion of plaintiffs' expert on *Daubert* grounds and also found defendant's expert more credible and reliable, and *Freeport-McMoran Resource Partners L.P. v. B-B Paint Corp.*, 56 F. Supp. 2d 823 (E.D. Mich. 1999).

121. A thorough analysis of this issue and various types of rulemaking and adjudication is beyond the scope of this Article. On various types of rulemaking, see, e.g., BREYER ET AL. TEXT, *supra* note 106, at 561-644.

122. 5 U.S.C. §556(d), available in ELR STAT. ADMIN. PROC. (emphasis added). The relevant text reads in full: "a sanction may not be imposed or rule or order issued except on consideration of the whole record or those parts thereof cited by a party and supported by and in accordance with the reliable, probative, and substantial evidence." *Id.*

112. *Id.* §21.48 at 97-99.

113. *Id.* §33.72.

114. 56 F. Supp. 2d 823 (E.D. Mich. 1999).

115. *Id.* at 833.

116. See, e.g., Simandle, *supra* note 107, at 125, for a discussion of a case "where the issue of remedy would have been the first issue tried." *Id.* at 119-20 n.25; *United States v. Price*, 523 F. Supp. 1055, 11 ELR 21047 (D.N.J. 1981), *aff'd*, 688 F.2d 204, 12 ELR 21020 (3d Cir. 1982), *denied motion*, 577 F. Supp. 1103, 13 ELR 20843 (D.N.J. 1983).

117. BREYER, *supra* note 9, at 11 (footnote omitted).

118. Simandle, *supra* note 107, at 124.

Evid. 702, reliability is expressly required in the language of the APA itself. As a result, federal agencies could still *consider* a wide range of evidence without the restrictions imposed in federal court, but they may not impose a sanction in adjudication or issue a rule that is not based on "reliable" expert or other evidence.

As to appellate review, APA §706 expressly contains the same "abuse of discretion" standard the Supreme Court held applies to expert evidence in federal courts. Section 706 of the APA states that "the reviewing court shall . . . hold unlawful and set aside agency action, findings, and conclusions found to be . . . arbitrary, capricious, an abuse of discretion, or otherwise not in accordance with law . . ." ¹²³ This is the precise *Daubert* standard for courts announced in *Joiner*.

Second, and alternatively for non-APA agencies and additionally for any federal agency, the Supreme Court's reliable expert evidence rulings in *Daubert* have already been extended to federal agency actions. In *Libas, Ltd. v. United States*, ¹²⁴ the Federal Circuit Court of Appeals applied *Daubert* to the U.S. Customs Service, even though the Federal Rules of Evidence did not apply. It then reversed the agency's use of an expert witness that was not demonstrated to be "reliable." In so ruling, Judge Cudahy cogently captured the Supreme Court's fundamental instruction in the *Daubert* Four:

[I]f a trial court relies upon expert testimony, it should determine that the expert testimony is reliable. It would make little sense to say that a trial court in its fact-finding role should accord much if any weight to expert testimony, the reliability of which is not established. ¹²⁵

This same analysis readily applies to any federal environmental or other agency's rulemaking or adjudication, whether or not the APA applies.

Obviously the application of the *Daubert* reliability standard to experts in agency proceedings would represent a sea-change in federal agency law. Federal agencies, like the federal courts before *Daubert*, may have operated for decades under different standards for experts. Before *Daubert*, the federal courts, like federal agencies, liberally admitted expert evidence under a "general acceptance" standard. This standard is no longer the law or practice in federal courts. Since 1993, the Supreme Court has ruled unanimously four times that only "reliable" expert evidence is admissible. Why should federal environmental or other agency adjudication or rulemaking be any different?

3. *American Trucking: Daubert Procedural Defects.* The *Daubert* Litigation Approach suggests several alternatives to the nondelegation doctrine as a legal basis that may support the same result reached in *American Trucking Ass'n v. U.S. Environmental Protection Agency*. ¹²⁶ If *Daubert* applies to rulemaking, the expert evidence used by EPA to sup-

port a rule must have been demonstrated to be reliable. If not, it would be reversible as procedurally defective, since it would be an abuse of discretion for EPA to promulgate rules under APA §556(d) that were not "supported by . . . reliable . . . evidence" ¹²⁷ under *Libas*.

4. *American Trucking: Daubert Substantive Defects.* As a substantive matter, if the *Daubert* Four applies to EPA rulemaking, expert evidence relied on by EPA to support the rules involved in the case must meet the "reliability" test under the APA and *Daubert*. Was each rule "supported by . . . reliable . . . [expert] evidence" under APA §556(d) and *Daubert* (an analysis beyond the scope of this Article)? If pivotal expert evidence was not "reliable," then APA §706 directs that the "reviewing court shall . . . hold unlawful and set aside agency action . . . [as] an abuse of discretion." It would then be an abuse of discretion for EPA to promulgate the rules involved in *American Trucking*, thus providing an additional or alternative basis to the nondelegation doctrine for the result in the case.

5. *Applying Daubert as an Additional Basis for Chlorine Chemical Council v. EPA.* In *Chlorine Chemical Council v. U.S. Environmental Protection Agency*, ¹²⁸ the D.C. Circuit held that EPA's December 1998 rule adopting a maximum contaminant level goal (MCLG) for chloroform of zero under the SDWA was arbitrary and capricious, and in excess of its statutory authority under the APA. The court of appeals vacated the rule.

Under the SDWA, EPA is required to use "the best available, peer-reviewed science and supporting studies." ¹²⁹ Chloroform is a byproduct of the chlorine process that disinfects virtually all of the drinking water in the United States. ¹³⁰ Contrary to the zero chloroform rule EPA adopted in December 1998, a panel of experts organized by the International Life Sciences Institute, peer-reviewed by an independent panel and convened under the auspices of EPA, had concluded that a chloroform dose level above zero was *not* carcinogenic. However, EPA chose to ignore this finding and its "best available" science statutory mandate. Accordingly, EPA's zero chloroform rule was ruled illegal.

Daubert suggests an additional basis for holding the rule unlawful under the APA, *Libas*, or both. There does not appear to have been any "reliable" evidence that supported the rule.

6. *UMRA Requires Incentives Instead of "Command-and-Control" Remedies.* The *Breyer et al. Text* ¹³¹ provides a fascinating and important interpretation of §1535 of UMRA. ¹³² It provides the first illustration of the generalized *Daubert* approach advanced here, i.e., applying a federal law from outside environmental law, UMRA, to environmental law. Section 1535, entitled "Least Burdensome Option Or Explanation Required," requires covered agency

123. *Id.* §706, available in ELR STAT. ADMIN. PROC. (emphasis added).

124. No. 97-1145, 1999 U.S. App. LEXIS 24966 (Fed. Cir. Oct. 7, 1999).

125. *Id.* at *14.

126. 175 F.3d 1027, 29 ELR 21071 (D.C. Cir. 1999), modified, 195 F.3d 4, 30 ELR 20119 (D.C. Cir. 1999) (holding that EPA's construction of the CAA in promulgating revised national ambient air quality standards for ozone and particulate matter effects an unconstitutional delegation of legislative power).

127. See, e.g., *Libas* and *Black v. Food Lion, Inc.*, 171 F.3d 308 (5th Cir. 1998) (cases reversed for failure to determine the reliability of expert evidence under *Daubert*).

128. No. 98-1627, 2000 U.S. App. LEXIS 5825 (D.C. Cir. Mar. 31, 2000).

129. 42 U.S.C. §300g-1(b)(3)(A), ELR STAT. SDWA §1412(b)(3)(A).

130. *Weird Science*, WALL ST. J., Apr. 12, 2000, at A26.

131. BREYER ET AL. TEXT, *supra* note 106.

132. See Appendix.

rulemaking to consider the “least costly,” “most cost-effective,” or “least burdensome” forms of rulemaking. The *Breyer et al. Text* suggests that this provision means that when UMRA §1535 applies, federal agencies “may well be required to use economic incentives where they now use technological requirements.”¹³³ “In many cases it is questionable,” the text explains, “whether an agency has chosen the cheapest means of accomplishing regulatory goals” because “economic incentives may well be able to achieve these goals at much less expense than command-and-control alternatives.”¹³⁴ Thus, UMRA “provides the opportunity for a good deal of litigation . . . and a good deal of rethinking of existing tools.”¹³⁵

A different UMRA theory was advanced and rejected in *American Trucking*.¹³⁶ In *American Trucking*, the D.C. Circuit ruled that EPA, in the rulemaking at issue, could not be challenged directly under UMRA for failing to issue a regulatory impact statement (RIS) or to “choose the least burdensome from a range of alternative[s],” citing the limitation on judicial review in §1571(b). The court also rejected an arbitrary and capricious challenge that incorporated UMRA:

Even if the petitioners and the amicus are correct regarding the interaction of the UMRA and the CAA—a point the EPA strongly contests—we can provide them with no relief. See *id.* §1571(a)(3) (The inadequacy or failure to prepare [a RIS] . . . shall not be used as a basis for staying, enjoining, invalidating or otherwise affecting [an] agency rule); *id.* §1571(b) (Except as provided in [§1571(a), which does not mention §1535,] . . . any compliance or noncompliance with the provisions of this chapter . . . shall not be subject to judicial review; and no provision of this chapter shall be construed to [be] . . . enforceable by any person in any . . . judicial action).¹³⁷

The *Breyer et al. Text*'s interpretation of §1535 was not used or at issue in the case. It thus may prove useful in environmental remedy and settlement proceedings in court.¹³⁸

7. Antitrust Remedies as a Basis for Innovative Remedies.

Antitrust remedies for decades have avoided command-and-control remedies in favor of dynamic remedies designed to promote and protect competition and innovation. As the Supreme Court eloquently explained in 1927 in *United States v. Trenton Potteries Co.*,¹³⁹ Congress adopted an approach to the antitrust laws that protected the competitive process and rejected a command-and-control regulatory approach to the problem before it—price setting. Otherwise, the Court noted, regulators would have to make a “minute inquiry whether a particular price is reasonable or unreasonable,” and monitor whether “the reasonable price fixed today may . . . become the unreasonable price of tomorrow.”¹⁴⁰

Given the uncertainties of environmental science and technology, and, more importantly, the need to encourage scientific and technological innovation, antitrust remedies and the equitable power of federal courts provide a model and a firm legal basis for innovative environmental remedies. The antitrust laws, of course, are not controlling law in environmental litigation, but they deal with a similar problem faced by environmental regulation and relief. Environmental agencies and defendants can agree voluntarily or a court may order antitrust-like remedies. As the Court of Appeals for the Third Circuit in *United States v. Price*¹⁴¹ stated, the fundamental law of equity jurisprudence that applies in an environmental case is that a “court of equity has traditionally had the power to fashion any remedy deemed necessary and appropriate to do justice in the particular case.”¹⁴²

Specifically, the *Daubert* Litigation Approach suggests as a matter of trial practice a two-part factual presentation of the equities. First, present the limitations of command-and-control remedies. Second, present the superiority of innovative alternatives. As to the first, environmental agencies often seek command-and-control remedies that erroneously assume that the best environmental science and technology for the problem has been discovered. Scientifically, and, thus, environmentally, this assumption is often false and fundamentally unscientific. Science is dynamic and changing, not static, fixed, and certain. As Albert Einstein explained, “[t]here are no eternal theories in science,” since it “always happens that some of the facts predicted by a theory are disproved by experiment.”¹⁴³ Even physics, viewed by many as the most stable and certain of all sciences today, is known to rest on “two foundational pillars” that are “mutually incompatible”; i.e., they “cannot both be right.”¹⁴⁴ Thus, even though quantum physics and relativity theory work wonderfully and reliably well in their respective spheres, there is room for improvement in modern physics. Similarly, command-and-control environmental remedies that foreclose innovation and provide no incentives for innovation are fundamentally unscientific.

To illustrate the problem, assume command-and-control remedies were applied to personal computers (PCs). Assume an agency regulated PCs. If the agency used the static command-and-control approach rather than a dynamic approach, the agency might issue an order requiring use of the agency's view of the best available technology at a point in time, say, the 8088 chip. Given the time it takes to adopt, let alone amend, command-and-control remedies, 8088 chips would likely still be the common chip used today.

Many environmental problems are like PCs. The command-and-control regulation of science is like public utility regulation of the economy. It is far inferior to a private market. The most effective remedies often are those that stimulate innovation, rather than freeze innovation under government control. Environmental remedies should be designed to maximize private scientific and technological innovation, as is the case with antitrust remedies, rather than impose a government agency's view of the best science and technology.

133. BREYER ET AL. TEXT, *supra* note 106, at 118.

134. *Id.*

135. *Id.* at 117-18.

136. 175 F.3d at 1027, 29 ELR at 21071, *modified*, 195 F.3d at 4, 30 ELR at 20119.

137. 175 F.3d at 1043, 29 ELR at 21075, *modified*, 195 F.3d at 4, 30 ELR at 20119.

138. No attempt is made here to analyze all the numerous specific issues and opportunities raised by this suggestion.

139. 273 U.S. 392, 397-98 (1927).

140. *Id.*

141. 688 F.2d 204, 12 ELR 21020 (3d Cir. 1982).

142. *Id.* at 211, 12 ELR at 21023.

143. EINSTEIN & INFELD, *supra* note 66, at 75.

144. The two pillars are general relativity and quantum mechanics. BRIAN GREENE, *THE ELEGANT UNIVERSE 3* (1999).

The second issue is to present innovative remedies that are superior to command-and-control remedies. Michael Porter and Claas van der Linde have proposed a "resource-productivity model" to replace the current "pollution-control model." It brings two ideas together: environmental improvement and competitiveness. Under their approach, "environmental improvement" becomes a "competitive opportunity," with "profound implications for the debate about environmental policy—about how to approach it, how to regulate it, and how strict the regulation should be."¹⁴⁵

One of their real-world examples of putting environmental improvement and competitive opportunity together in their resource-productivity model is the Dutch flower industry. The Dutch largely eliminated the environmental problems of pesticides and associated chemicals by developing a new approach that did not require pesticides:

Intense cultivation of flowers in small areas was contaminating the soil and groundwater with pesticides, herbicides, and fertilizers. Facing increasingly strict regulation on the release of chemicals, the Dutch understood that the only effective way to address the problem would be to develop a closed-loop system. In advanced Dutch greenhouses, flowers now grow in water and rock wool, not in soil. This lowers the risk of infestation, reducing the need for fertilizers and pesticides, which are delivered in water that circulates and is reused.

The tightly monitored closed-loop system also reduces variation in growing conditions, thus improving product quality. Handling costs have gone down because the flowers are cultivated on specially designed platforms. In addressing the environmental problem, then, the Dutch have innovated in ways that have raised the productivity with which they use many of the resources involved in growing flowers. The net result is not only dramatically lower environmental impact but also lower costs, better product quality, and enhanced global competitiveness.¹⁴⁶

Accordingly, Porter and van der Linde advocate "innovation-friendly regulation" based on the "following principles of regulatory design [that] will promote innovation, resource productivity, and competitiveness":

- Focus on outcomes, not technologies.
- Enact strict rather than lax regulation.
- Regulate as close to the end user as practical, while encouraging upstream solutions.
- Employ phase-in periods.
- Use market incentives.
- Harmonize or converge regulations in associated fields.
- Develop regulations in sync with other countries or slightly ahead of them.
- Make the regulatory process more stable and predictable.
- Require industry participation in setting standards from the beginning.
- Develop strong technical capabilities among regulators.
- Minimize the time and resources consumed in the regulatory process itself.¹⁴⁷

Thus, the *Daubert* Litigation Approach suggests a two-part evidentiary presentation of, first, the unscientific and environmentally inadequate nature of com-

mand-and-control remedies, and second, the environmental advantages of innovative remedies like the resource productivity model that serve as the foundation of antitrust remedies.

Litigation and regulation easily gravitate to command-and-control relief, which tends to squelch innovation. Why shouldn't, instead, environmental remedies be designed to result in a "Moore's Law-like" performance for the environment, doubling in value every 18 months?¹⁴⁸

8. *UMRA's "Mandate Impact" Statements.* Section 1532 of UMRA requires covered federal agencies to issue written statements, called "mandate impact statements" here, before promulgating a proposed or final rule that will cost the public or private sector \$100 million or more annually. This requirement presents a second illustration of the generalized *Daubert* approach. The agency must issue a written statement that includes a number of important issues to environmental law, including "a qualitative and quantitative assessment of the anticipated costs and benefits" of the mandate, "the effect of the federal mandate on health, safety, and the natural environment," and "the effect on the national economy," including "effect on productivity, economic growth, full employment, creation of productive jobs, and international competitiveness."

Section 1571(a) of UMRA expressly provides certain forms of judicial review regarding UMRA mandate impact statements. An agency that fails to provide the required statement may be compelled by a court "to prepare such written statement" that "may be considered part of the record for judicial review." Specifically, UMRA §1571(a) states that "[a]gency compliance or noncompliance" with §1532 or §1533(1)-(2) is only subject to review under APA §706(1). If an agency "fails to prepare the written statement (including the preparation of the estimates, analyses, statements, or descriptions)" under §1532 or the written plan under §1533(a)(1)-(2), then "a court may compel the agency to prepare such written statement." In "any judicial review under any other Federal law of an agency rule for which a written statement or plan is required" under these sections, the inadequacy or failure to prepare such statement (including the inadequacy or failure to prepare any estimate, analysis, statement, or description) or written plan shall not be used as a basis for staying, enjoining, invalidating or otherwise affecting such agency rule. However, UMRA §1571(a) also states that "[a]ny information generated" under these sections that is "part of the rulemaking record for judicial review under the provisions of any other Federal law may be considered as part of the record for judicial review conducted under such other provisions of Federal law." Section 1571(b)(2) states that "no provision of this Act shall be construed to create any right or benefit, substantive or procedural, enforceable by any person in any administrative or judicial action."

Experience with NEPA environmental impact statement requirements is obviously relevant and instructive. Again, however, a thorough analysis of all the relevant issues involved is beyond the scope of this Article. Nonetheless, UMRA represents another federal law from outside environmental law that, like *Daubert*, provides a source of po-

145. PORTER, *supra* note 8, at 369, 371, 373-74. See also Daniel Esty & Michael Porter, *Industrial Ecology and Competitiveness*, 2 J. INDUS. ECOLOGY 35 (1998).

146. PORTER, *supra* note 8, at 352.

147. *Id.* at 366.

148. See generally Elizabeth Teisberg et al., *Sustainable Business: Opportunities and Value Creation*, INTERFACES (forthcoming 2000).

tentially controlling federal law that can lead to innovative new directions for environmental law.

9. *Combinations of the Above.* As the *Manual for Complex Litigation* indicates, combining some or all of the above when appropriate may be particularly effective in *Daubert* hearings, and may be the best way to provide what Judge Simandle termed "incentives for creative bench-bar settlement programs."¹⁴⁹ For example, one could reorder the sequence of litigation to first focus on the dispositive issue of the remedy, with a *Daubert* hearing on the remedy phase of the litigation. Further, if a remedy expert proposes command-and-control remedies, one could include questions going to the *Breyer et al. Text* interpretation that UMRA requires economic incentives rather than command-and-control orders, as well as questions exploring whether command-and-control remedies in the particular case are unscientific. Finally, the *Breyer et al. Text's* interpretation of UMRA as authority for remedies that use economic incentives rather than command-and-control orders could prove helpful in settlement or remedy proceedings, as well as the *Daubert* Four itself.

10. *Applying the Above at the State Level as Applicable.* Many states have adopted, or state courts may well find persuasive, the *Daubert* Four and the *Daubert* Litigation Approach presented here, so that any of the applicable ideas discussed above for federal environmental law may be applicable at the state level as well.

Conclusion

Since 1993, the *Daubert* Four have profoundly narrowed the use of expert evidence to evidence that is demonstrated to be reliable, with far-reaching implications for every area of law that, even now, is just beginning to be fully realized. The application of the *Daubert* Litigation Approach—the *Daubert* Four and their underlying legal rationale—to environmental litigation, and agency adjudication and rulemaking, provides the courts, defendants, and government agencies with a new tool that can lead to innovative approaches to environmental law, litigation, and agency regulation.

APPENDIX UMRA Excerpts

§1532. Statements to accompany significant regulatory actions

(a) In general. Unless otherwise prohibited by law, before promulgating any general notice of proposed rulemaking that is likely to result in promulgation of any rule that includes any Federal mandate that may result in the expenditure by State, local, and tribal governments, in the aggregate, or by the private sector, of \$100,000,000 or more (adjusted annually for inflation) in any 1 year, and before promulgating any final rule for which a general notice of proposed rulemaking was published, the agency shall prepare a written statement containing -

(1) an identification of the provision of Federal law under which the rule is being promulgated;

(2) a qualitative and quantitative assessment of the anticipated costs and benefits of the Federal mandate, including the costs and benefits to State, local, and tribal governments or the private sector, as well as the effect of the Federal mandate on health, safety, and the natural environment and such an assessment shall include -

(A) an analysis of the extent to which such costs to State, local, and tribal governments may be paid with Federal financial assistance (or otherwise paid for by the Federal Government); and

(B) the extent to which there are available Federal resources to carry out the intergovernmental mandate;

(3) estimates by the agency, if and to the extent that the agency determines that accurate estimates are reasonably feasible, of -

(A) the future compliance costs of the Federal mandate; and

(B) any disproportionate budgetary effects of the Federal mandate upon any particular regions of the nation or particular State, local, or tribal governments, urban or rural or other types of communities, or particular segments of the private sector;

(4) estimates by the agency of the effect on the national economy, such as the effect on productivity, economic growth, full employment, creation of productive jobs, and international competitiveness of United States goods and services, if and to the extent that the agency in its sole discretion determines that accurate estimates are reasonably feasible and that such effect is relevant and material; and

(5)(A) a description of the extent of the agency's prior consultation with elected representatives (under section 1534 of this title) of the affected State, local, and tribal governments;

(B) a summary of the comments and concerns that were presented by State, local, or tribal governments either orally or in writing to the agency; and

(C) a summary of the agency's evaluation of those comments and concerns;

(b) Promulgation. In promulgating a general notice of proposed rulemaking or a final rule for which a statement under subsection (a) of this section is required, the agency shall include in the promulgation a summary of the information contained in the statement.

(c) Preparation in conjunction with other statement. Any agency may prepare any statement required under subsection (a) of this section in conjunction with or as a part of any other statement or analysis, provided that the statement or analysis satisfies the provisions of subsection (a) of this section.

* * *

§1533. Small government agency plan

(a) Effects on small governments. Before establishing any regulatory requirements that might significantly or uniquely affect small governments, agencies shall have developed a plan under which the agency shall -

(1) provide notice of the requirements to potentially affected small governments, if any;

(2) enable officials of affected small governments to provide meaningful and timely input in the development of regulatory proposals containing significant Federal intergovernmental mandates

149. Simandle, *supra* note 107, at 136.

§1535. Least Burdensome Option Or Explanation Required

(a) **In General.** Except as provided in subsection (b), before promulgating any rule for which a written statement is required under section 202, the agency shall identify and consider a reasonable number of regulatory alternatives and from those alternatives select the least costly, most cost-effective or least burdensome alternative that achieves the objectives of the rule, for —

(1) State, local, and tribal governments, in case of a rule containing a Federal intergovernmental mandate; and

(2) the private sector, in the case of a rule containing a Federal private sector mandate.

* * *

§1571. Judicial Review

(a) **Agency statements on significant regulatory actions.**

(1) In general. Compliance or noncompliance by any agency with the provisions of sections 202 and 203(a)(1) and (2) [2 USCS §§1532 and 1533(a)(1) and (2)] shall be subject to judicial review only in accordance with this section.

(2) Limited review of agency compliance or noncompliance.

(A) Agency compliance or noncompliance with the provisions of sections 202 and 203(a)(1) and (2) [2 USCS §§1532 and 1533(a)(1) and (2)] shall be subject to judicial review only under section 706(1) of title 5, United States Code, and only as provided under subparagraph (B).

(B) If an agency fails to prepare the written statement (including the preparation of the estimates, analyses, statements, or descriptions) under section 202 [2 USCS §1532] or the written plan under section 203(a)(1) and (2) [2 USCS §1533(a)(1) and (2)], a court may compel the agency to prepare such written statement.

(3) Review of agency rules. In any judicial review under any other Federal law of an agency rule for which a written statement or plan is required under sections 202 and 203(a)(1) and (2) [2 USCS §§1532 and 1533(a)(1) and (2)],

the inadequacy or failure to prepare such statement (including the inadequacy or failure to prepare any estimate, analysis, statement or description) or written plan shall not be used as a basis for staying, enjoining, invalidating or otherwise affecting such agency rule.

(4) Certain information as part of record. Any information generated under sections 202 and 203(a)(1) and (2) [2 USCS §§1532 and 1533(a)(1) and (2)] that is part of the rulemaking record for judicial review under the provisions of any other Federal law may be considered as part of the record for judicial review conducted under such other provisions of Federal law.

(5) Application of other federal law. For any petition under paragraph (2) the provisions of such other Federal law shall control all other matters, such as exhaustion of administrative remedies, the time for and manner of seeking review and venue, except that if such other Federal law does not provide a limitation on the time for filing a petition for judicial review that is less than 180 days, such limitation shall be 180 days after a final rule is promulgated by the appropriate agency.

(6) Effective date. This subsection shall take effect on October 1, 1995, and shall apply only to any agency rule for which a general notice of proposed rulemaking is promulgated on or after such date.

(b) **Judicial review and rule of construction.** Except as provided in subsection (a) —

(1) any estimate, analysis, statement, description or report prepared under this Act, and any compliance or non-compliance with the provisions of this Act, and any determination concerning the applicability of the provisions of this Act shall not be subject to judicial review; and

(2) no provision of this Act shall be construed to create any right or benefit, substantive or procedural, enforceable by any person in any administrative or judicial action.