Flawed Geoscience in Forensic Environmental Investigations

Part II: How Daubert Affects the Scope and Bases for Expert Opinions

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The discussions and conclusions presented in this paper: a) are solely the present opinions of the authors, b) may change as additional information becomes available, and c) may not reflect the views of the companies with whom they are affiliated.

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Abstract

Over the past few years, several cases have resulted in Daubert challenge rulings that are affecting the standards of practice and gradually providing guidance on what is required for the bases of opinions of testifying geoscience experts. Our initial paper on this subject was presented at the NGWA's Chicago Conference, 2004. This paper is an extension of this subject and will provide a summary of the types of opinions testifying experts are presenting and current rulings, some published and some not, that have limited the scope of the opinions that are being offered. These rulings can be used to develop some guidelines that if followed will generally allow a testifying expert to withstand many Daubert challenges and provide more credible opinions when needed.

Daubert affects the scoping process for developing opinions, the language applied in opinion statements, and, most importantly, the bases required to support the opinions offered. Examples of the areas about which geoscience experts may be qualified to provide expert testimony include: ground-water supply studies, water well and monitoring well designs and adequacy of completions, aquifer characteristics and prediction of likely yields and usability of ground water, scope of site investigations and historical practice regarding site investigation practices and typical flaws associated with site investigation procedures and interpretation of site analytical data, choice of remedial measures, and a host of other areas. We will also present examples of what is expected to be required for a geoscientist to offer opinions in any area based on examples of Daubert challenges and rulings.

I. Introduction

Over the past few years, several civil cases have resulted in "*Daubert* challenge" rulings that have limited the testimony of experts and, in turn, are affecting the standards of practice and providing guidance on what is required for the bases of an environmental expert's opinions if a geoscientist is to be allowed to testify as an expert. In previous reviews conducted during 2002 on the subject involving environmental professionals in general, Ries and Burns (2005) emphasized the need for professionals to be aware of the

current standards for expert opinions in environmental litigation in both federal and state courts.

Our initial paper on this subject was presented at the NGWA's Chicago Conference, 2004 (Campbell, *et al.,* 2004). That paper pointed out that the legal *Daubert* standard for admissibility can be more stringent than what a geoscientist may know as a result of a typical investigation. Specifically, the scope of investigations must rely less on assumptions and more on good practice for a practicing geoscientist to be able to testify in a trial. This paper summarizes certain types of opinions that testifying experts are presenting and court decisions that have limited or excluded such expert testimony. These decisions can be used to develop guidelines that should generally allow a testifying geoscientist (or geologic engineering) expert to withstand *Daubert* challenges and provide more credible opinions when needed.

Most of the *Daubert* rulings to date have entailed property or health-related damage claims associated with alleged exposure to potentially harmful levels of a chemical that may have caused either a personal injury (e.g., cancer) or limited the use and value of real property. In *Daubert*, the Supreme Court re-affirmed the principle that non-helpful, "non-expert" testimony can be confusing and lead to injustice and that such misleading testimony based on "bad science" should be excluded from trial. In doing so, the Supreme Court affirmed the need for experts in the many technical and otherwise complex matters that face most courts. For example, environmental cases should use experts to help a court or jury (often referred to as the "trier of fact") better understand the facts. Typically these cases involve the following contentions or hypotheses that can be tested based on the facts and the evidence developed by the experts. These contentions are consistent with the questions often addressed by a geoscientist in assessing the situation associated with such subjects as: ground-water supply development and conservation, water-well and monitoring-well designs and adequacy of completions, aquifer characteristics and prediction of likely yields and usability of ground water, and the nature and extent of a release of a hazardous or potentially harmful substance, material or waste. Examples of such questions include:

- What are the characteristics of an aquifer(s)?
- What is the impact on the usability of an aquifer from salt-water infiltration, over-pumping or releases of hazardous chemicals or substances?
- Were wells properly designed and installed for their intended purpose?
- Have wells (or borings) contributed to the migration of release(s)?
- What caused the release(s)/what is (are) the source(s) of the release(s)?
- What was the contribution from different releases?
- Where and how were the releases transported?

- Is there sufficient information to develop water balance or a mass balance and/or an accurate model of an aquifer for various purposes?

- Can the migration of a release be accurately modeled? Can its impact on water-supply wells or the environment be accurately modeled?

- Are there impacts or a potential for harm associated with the release(s)?

- What is the fate of a release(s)? Will it degrade over time?

- Is remediation required?

- How should the release(s) be remediated?

- Can the release(s) be adequately remediated to eliminate a potential risk associated with the potential for human exposure or to prevent permanent property damage or are alternative controls appropriate?

Accordingly, environmental geoscientists are often called upon to testify in cases of this nature. Sometimes they may be allowed to testify as expert witnesses as well as fact witnesses. Given the multidisciplinary nature of environmental investigations, many geoscientists and specifically educated and trained engineers conducting geoscientific investigations or studies have developed a broad expertise in environmentally-related fields and find themselves testifying as to facts and the meaning of those facts as they relate to water supply impacts, risk, toxicology, property values, regulatory requirements and accepted historical practice. In a typical tort claim, the testifying expert and in turn the trier of fact might be called on to conclude:

- That there is a basis for identifying the source or sources of the chemicals (or saline water) at issue,

- That the chemicals migrated or were transported to the subject properties or to the alleged point(s) of exposure,

- That the chemicals could be and were absorbed into the human bodies of the injured parties,

- That the personal injuries were caused by the exposure or that the property involved has been damaged (its use limited and its value decreased) as a result of the chemicals present, and

- That compensation is due in order to address the personal injury or property damage or natural resource damage (i.e., that compensation is required for the loss of life or resources, income or former abilities or that remediation is required to mitigate or reverse the property damage or protect human health).

At issue is often a claim for punitive damages related to alleged intent or negligence on the part of the defendants. Typically, experts with extended experience in a field may be called upon to testify as to:

- Accepted practice or standard of care,
- Whether the potential for harm was known or should have been known,
- Whether environmental regulations were violated and whether those violations were relevant to, i.e., contributed to that harm,
- Whether the injury could have been avoided,
- Whether certain technologies may have existed to prevent the releases,
- Whether there was an accepted practice or standard of care at the time to implement certain measures or controls or treatment methods that would have prevented the harm,
- To what extent did the defendants contribute to the harm,
- The economic impact of the harm, in terms of lost income, the cost to clean up a property or restore an aquifer to eliminate the damage, the financial assurance required by regulations and the uncertainty in that cost,
- Whether the defendants' practices reflected a pattern of negligence (e.g. multiple violations), and
- Whether the defendants, in effect, exhibited negligence.

II. Legal Background for Daubert Challenges

To begin, experts should always remember that the courts have long filled the role of "Gatekeeper" for the admission of expert opinions to ensure that expert testimony reaching the jury or being admitted as evidence meets basic levels of reliability. For many years, judges relied on a fairly stringent two-pronged standard to determine whether scientific evidence should be admitted into a trial: (1) whether the evidence was relevant to the case and (2) whether the evidence was "generally accepted" in the expert community (known as the *Frye* Test). *See Frye v. United States*, 293 F.2d 1013, 1014 (D.C. Cir. 1923). For over 70 years, the *Frye* test was commonly used by a majority of Federal Courts. But over time, this test proved to be a poor standard for separating new or novel scientific or technological concepts, advances and complex issues. Eventually, in 1993, the U.S. Supreme Court in *Daubert v. Merrill Dow Pharmaceuticals, Inc.*, 509

U.S. 579 (1993) ruled that the more flexible Federal Rules of Evidence had replaced the *Frye* test in determining whether an expert's opinion is admissible. Currently, Rule 702 of the Federal Rules of Evidence "assign[s] 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." *Id.* at 599. The text of Rule 702 provides as follows:

> "If scientific, technical, or other specialized knowledge will assist the trier of fact to understand the evidence or to determine a fact in issue, a witness qualified as an expert by knowledge, skill, experience, training, or education, may testify thereto in the form of an opinion or otherwise, if (1) the testimony is based upon sufficient facts or data, (2) the testimony is the product of reliable principles and methods, and (3) the witness has applied the principles and methods reliably to the facts of the case."

The gate keeping role of the court, as outlined in Daubert, applies to all expert testimony, not just "scientific" expert opinions. *See Kumho Tire Company v. Carmichael*, 526 U.S. 137 (1999). Since *Frye* and *Daubert*, the following court decisions (including the *Frye* and *Daubert* decisions) have had a significant impact on the criteria used to assess the admissibility of expert opinions as evidence.

The Frye Test

The *Frye* test was the first modern standard applied to the admissibility of expert scientific data. In this case, the trial court rejected evidence based on a precursor of the modern polygraph. The appellate court upheld the lower court's decision finding that ". . . the thing from which the deduction is made must be sufficiently established to have gained general acceptance in the particular field in which it belongs." *Frye v. United States*, 293 F.2d at 1014. This became known as the "Frye test." Where novel scientific evidence is at issue, the *Frye* test allows a judge to defer to scientific expertise precisely as to whether or not it has gained "general acceptance" in the relevant field. The trial court's role in this respect is conservative, thus helping to keep "pseudoscience" out of the courtroom. In the *Frye* decision, the court did not elaborate on the meaning of "general acceptance," which resulted in subsequent inconsistency in the application of the test and in conflicting appellate court decisions.

The Daubert Decision 1993

The *Daubert* decision represents the first of three significant Supreme Court decisions providing guidance on the admissibility of expert opinions. The two subsequent cases, *General Electric v. Joiner* and *Kumho Tire Co. v. Carmichael*, expanded upon the *Daubert* decision, and are discussed below. The *Daubert* case involved two children born with defects allegedly related to their mothers' use of Bendectin during pregnancy. *See Daubert v. Merrill Dow Pharmaceuticals, Inc.*, 509 U.S. 579 (1993). The Supreme Court's decision concluded that the Federal Rules superceded *Frye* and set two important precedents:

(1) It affirmed and strengthened the role of judges as "gatekeepers," screening expert evidence to ensure that what was admitted was both relevant and reliable. Judges would decide whether juries would get to hear plaintiffs' scientific evidence.

(2) It expanded the Federal Rules of Evidence to include specific, non-exclusive criteria for evaluating the reliability and relevance of both scientific experts and scientific evidence.

In this ruling, the Supreme Court directed federal judges to examine the method or reasoning underlying the admission of expert evidence and to admit only evidence that was both relevant and reliable. The majority opinion in *Daubert* stated that the trial court has not only the power but the obligation to act as "gatekeeper." The Court then went on to develop the meaning of this two-prong test of relevancy and reliability. With regard to relevancy, an expert's testimony cannot be "helpful" to the trier of facts as required by Rule 702 unless the expert's scientific basis or hypothesis (theory in legal terms) in the expert's opinion is sufficiently tied to the facts of the case (and not to an unjustified extrapolation or distortion of the facts). With regard to reliability, the court specifically held (contrary to the general use of the *Frye* test) that an expert hypothesis on causation need not be generally accepted as reliable in the relevant scientific community in order to be admissible. In the *Daubert* case, the testimony could have been admitted but for the lack of a scientific basis in the facts of the case.

No longer are judges limited to automatically deferring to the scientific community to determine whether expert opinion evidence is reliable, nor should this be only left to the jury to decide. The *Daubert* decision provided (in addition to the Federal Rules of Evidence) a list of factors that judges may consider when assessing the reliability, or scientific validity, of expert opinion evidence. These have been referred to as the four principal Daubert criteria:

1. whether the theory or technique involves a testable hypothesis (i.e., can be, and has been, tested),

2. whether the theory or technique has been subject to peer review and publication,

3. what are the potential error rates and standards controlling the technique's operation, and

4. whether the method or technique is generally accepted in the scientific community.

See Section IV-2d-i-iv of this paper for an expansion on their impacts.

While "general acceptance" in the scientific community is still a factor for judges to consider, it is only one of many that might enter the judges' assessment of reliability and

helpfulness. These factors do not have to be considered in every case, and other factors may be included in the evaluation. District and Appellate Courts have responded with mixed signals (see Figure 1). Furthermore, not all states have adopted *Daubert* (see Part I of this series, *i.e*., Campbell, *et al*., 2004, and Table 2 therein, and Ries and Burns, 2005 herein).

Figure 1 – Mixed Signals from the Courts

General Electric Company v. Joiner (1997)

In another significant Supreme Court decision establishing new criteria on the admissibility of expert testimony, Mr. Joiner clamed that exposure to PCB on the job was responsible for his development of lung cancer, despite his history of cigarette smoking and family history of lung cancer. *See General Electric Co. v. Joiner*, 522 U.S. 136 (1997). While these factors may have predisposed him to developing lung cancer, his exposure to PCBs was alleged to have promoted his small cell lung cancer according to the plaintiff's expert. The expert had "pooled" data from prior studies to establish a new "weight-of-the-evidence" argument that such exposure would cause this particular type of small cell lung cancer. The District Court Judge ruled that the expert testimony offered in support of Joiner's claim was not admissible under the *Daubert* rule because the experts' conclusions were not supported by the scientific papers the expert cited. Through this case, the Supreme Court strengthened the power of judges to keep what some have called "junk science" out of the courtroom by noting:

- The cited animal studies were so dissimilar to the facts presented here (different species, different exposure routes, different doses, different cancers).

- The authors of two of the four studies cited were unwilling to suggest a link between increases in lung cancer and PCB exposure in humans.

The Court also clarified that, despite *Daubert*'s focus on an expert's methodology, as opposed to an expert's conclusions, "[a] court may conclude that there is simply too great an analytical gap between the data and the opinion proffered," and thus exclude the evidence. The opinions of different experts with different opinions regarding the same set of facts may all be admissible so long as these opinions are based on scientific principles and methodologies that the trier of fact can use in making a decision. An important ruling in this case is that an expert opinion must be based on sound science, and not just use of scientific research conducted by other scientists. Joiner's expert's opinion was not, in essence, peer-reviewed nor was it tested. This emphasizes the fact that an expert must base an opinion on both relevant data and/or methods, and the methods used to analyze the data could be tested or reviewed by others. An expert may rely on the work of others, but the testifying expert is expected to justify the relevancy of the work and its consistency with the facts of the case. This may be viewed by many as being overly strict when applied to factors and methodology involved in the geosciences (see Figure 2).

Figure 2 – Overly Strict Rules in Geoscience and Engineering Cases

Furthermore, the case required the court, acting as gatekeeper, to ensure that an expert's extrapolation, extending from the initial basis of the opinion to the expert's conclusion, is sound. This test is sometimes referred to as the "connective reliability" test, and focuses on the reasoning used by experts to lead from certain data or assumptions to the conclusion or opinion. If an expert's methodology or foundational data are sound but the expert's reasoning process applying that methodology or data are not sound or are not demonstrated, the opinion will not be admissible.

Kumho Tire Co. v. Carmichael (1999)

In *Kumho,* the Supreme Court evaluated whether *Daubert's* general holding, establishing a trial judge's gate keeping obligation with regard to scientific evidence, applies not only to scientific evidence, but to all expert testimony (including, for example, lab data and engineering reports). *See Kumho Tire Co. Ltd. v. Carmichael*, 526 U.S. 137 (1999). At issue was an Eleventh Circuit Court's decision holding that reversed the trial court's decision to reject testimony on the grounds that *Daubert* was strictly limited to the scientific context, and thus did not apply to an engineer's expert or other experts' testimony regarding the manufacture, design, and performance of a failed tire. Although the expert's testimony was not scientific *per se*, it was, however, based on the engineer's skill and experience-based opinions. The Supreme Court reversed the Eleventh Circuit Court, holding that *Daubert*'s general principles of reliability apply to all types of expert evidence in *Federal Rule of Evidence 702*, which makes no distinction between "scientific," "technical," or "other specialized knowledge." *See* FEDERAL RULES EVIDENCE 702. Thus, a court must establish a standard of reliability with regard to all specialized or technical evidence, based on the "intellectual rigor" used in the field.

In *Kumho* the engineer relied on his extensive tire-testing experience but could not provide a rationale for determining when a tire would fail and, in effect, whether it had failed. His testimony could have been admitted but for its speculative nature which the court decided could have been subjected to a test of intellectual rigor utilizing the *Daubert* criteria noted above. The court specifically stated that an expert's testimony could be admissible if the expert ". . . employs in the courtroom the same level of intellectual rigor that characterizes the practice of an expert in the relevant field."

In summary, according to *Daubert,* an expert may testify in a case if the expert's testimony is grounded in the facts of the case and would be helpful to a trier of fact. It need not be based on "general acceptance," but when appropriate it must be testable, capable of meeting the test of peer reviews and being published, and not just based on experience. *See Daubert v. Merrell Dow Pharmaceuticals, Inc., 509 U.S. at 589-91.* The *Daubert* rule applies not only to scientific knowledge, but also to technical or other specialized knowledge. *See Kumho Tire Co., Ltd. v. Carmichael, 526 U.S. at 141.* The two-pronged determination as to the relevance and reliability of such evidence is to be made by the trial court. *See id. at 158.* As to the first prong, the inquiry into relevance requires the court to decide whether the expert testimony will assist the trier of fact in understanding or determining a fact in issue, *i.e.*, whether the expert's testimony "fits" the facts of the case. *See Daubert, 509 U.S. at 594-95.* "The 'helpfulness' standard incorporated in [Rule] 702 means that the expert's opinion must *relate to* an issue that is actually in dispute and must provide a valid scientific connection to the pertinent inquiry." *See* Margaret A. Berger, *Procedural Paradigms for Applying the Daubert Test*, 78 MINN. L. REV. 1345, 1351 (1994). As to the second prong of reliability, *Daubert* set forth specific factors, such as "testing, peer review, error rates, and 'acceptability' in the relevant scientific community," which the trial court may consider in determining reliability. *See Daubert v. Merrell Dow Pharmaceuticals, Inc.,* 509 U.S. at 595.

However, the *Daubert* test is flexible and its "list of specific factors neither necessarily nor exclusively applies to all experts or in every case." *See Kumho Tire Co. Ltd. v. Carmichael,* 526 U.S. at 151.

For the test of reliability, the Supreme Court has explained that trial courts should "make certain that an expert ... employs in the courtroom the same level of intellectual rigor that characterizes the practice of an expert in the relevant field." *Id. at 152*. Furthermore, expert testimony can be considered reliable where it has "a traceable, analytical basis in objective fact ...." *Bragdon v. Abbott*, 524 U.S. 624, 653, 141 L. Ed. 2d 540, 118 S. Ct. 2196 (1998) (citing *General Elec. Co. v. Joiner*, 522 U.S. 136, 139 L. Ed. 2d 508, 118 S. Ct. 512 (1997)). Finally, in determining reliability the court must generally "focus ... on principles and methodology, not on the conclusions that they generate." *Daubert*, 509 U.S. at 595.

The following selection of various court decisions provide guidance as to what may be admissible and in turn on how potential testifying geoscientific experts should scope their work and derive their opinions. These decisions are drawn from courts across the U.S. (including some state Supreme Court and lower court decisions).

***Christophersen v. Allied-Signal Corp.*, 939 F.2d 1106 (5th Cir. 1991).** The plaintiff's expert claimed that exposure to chemical fumes at the battery manufacturing plant where the decedent worked caused his fatal colon cancer. The Fifth Circuit, using the *Frye* test, concluded that the methodology or reasoning that plaintiff's expert used was not "generally accepted" within the relevant scientific community.

***Rutigliano v. Valley Business Forms*, 929 F. Supp. 779, 783 (D.N.J. 1996).** In this case, the District Court found that plaintiff's expert failed to prove specific causation because there was no proof that some other substance did not cause the injury. The expert must eliminate other possible explanations. In other words, the testifying expert must test his or her theory or "initial conclusion" before the expert's opinions can be considered reliable.

***Wright v. Williamette Industries, Inc*., 91 F.3d 1105, 1107-08 (8th Cir. 1996).** Residents near a manufacturing plant brought a negligence action against the plant owner, claiming damage from exposure to plant emissions. Despite evidence of exposure, the court excluded plaintiffs' evidence of causation because they only produced speculative evidence regarding the level of exposure actually hazardous to humans. In other words, a testifying expert cannot provide speculative testimony.

***Merrell Dow Pharmaceuticals, Inc. v. Havner*, 953 S.W.2d 706 (Tex. 1997).** In this Texas State Supreme Court decision, plaintiffs presented epidemiological evidence to prove that Bendectin caused their child's injuries. The Texas Supreme Court recognized that the evidence only proved an association, not causation. The state Supreme Court eliminated the testimony and ultimately found for the defendant, holding that the evidence presented was insufficient to prove causation. In other words, "association" is not the same as "causation."

***Anglado v. Leaf River Forest Products, Inc.*, 716 So.2d 543 (Miss. 1998).** In this case,

the Mississippi Supreme Court dismissed plaintiffs' stigma claim because plaintiffs could not affirmatively prove that defendant was the source of the chemical found on their property. The mere association of the chemical with the defendant was insufficient. The expert must explain how the chemical arrived on the plaintiff's property, not just that it was also on the plaintiff's property and could have come from the defendant's facility. As above, association and exposure are not the same as proving that a particular source was the cause of the harm and damage.

***Lofgren v. Motorola, Inc.*, CV 93-05521, Ariz. Super. Ct. Maricopa Cty. June 1, 1998.** An Arizona trial court explicitly cited Joiner in rejecting the methodology-conclusion distinction, instead holding that it must scrutinize an expert's reasoning process. The court proceeded to exclude plaintiff risk expert testimony and concluded that the plaintiff expert had failed to demonstrate that his contentions "through reliable scientific theory to be an appropriate extrapolation from existing studies…". The court did not rule out the use of such extrapolations; only their use in the absence of other studies based on reliable scientific theory. In effect, the court ruled that the expert required corroborating evidence to support his theory. Absent sufficient evidence, his exposure-causation testimony was excluded.

***Blum v. Merrell Dow Pharmaceuticals, Inc.*, 705 A.2d 1314 (1997); and 764 A.2d 1 (2000).** A Pennsylvania Appellate Court stated that "we do not ask whether the expert's conclusions … are generally accepted. Rather, we consider the 'underlying principle' which must be generally accepted to be that the methods used by the experts to arrive at their conclusions actually give an accurate prediction…." The court concluded that the underlying scientific principle of the plaintiffs' expert testimony was not generally accepted in the relevant scientific community. Accordingly, the underlying scientific principle behind a geoscientist's work generally should be identified and established as being generally accepted in the relevant scientific community.

***Goeb v. Tharaldson*, 615 N.W.2d 800 (Minn. 2000**). In Goeb, The Minnesota Supreme Court held that under its version of *Frye*, a novel scientific technique must not only be generally accepted in the relevant scientific community, but "the particular evidence derived from that test must have a foundation that is scientifically reliable." Accordingly, this ruling would suggest that a new sampling, measurement, or investigation technique must have undergone some testing and become accepted as reliable and that the use of the data must also be reliable.

***Lara v. New York City Health & Hospitals Corp.*, 2003 WL 21171497 (N.Y. Sup 2000), aff'd, 305 A.D.2d 106, 757 N.Y.S.2d 740 (1st Dept. 2003).** A New York trial court excluded testimony on the grounds that the plaintiff's expert failed to show that his causation theory for cerebral palsy was generally accepted in the field of child neurology and also failed to show that his conclusion "was based on any scientifically valid methodology." The key relevance of this case to a geoscientist, although based on a medical causation question, is that an expert's opinion must have a foundation of some "scientifically valid methodology."

***E.I. DuPont De Nemours & Co. v. Castillo ex rel.*, 748 So.2d 1108, 1116 (Fla. Dist. Ct. App. 2000).** Plaintiff claimed that exposure to the fungicide Benlate caused a child's birth defects. Plaintiffs' expert relied on *in vivo* tests, which are generally accepted methods. The court held that "the methodology used in the studies, including the method of extrapolating from the achieved results, must be generally accepted in the relevant scientific community." The court ultimately concluded that the "direct extrapolation method" used by the plaintiffs' experts was not generally accepted, and therefore the testimony should be excluded. The mere use of an extrapolation using a referenced statistical method is not sufficient to say that the "conclusion" of the statistical extrapolation is valid. It too must be tested.

***Mississippi Transportation Commission v. Dennis McLemore and Tammy McLemore*, 863 So.2d 31, (Miss.2003).** The Mississippi Supreme Court applied the State's newly adopted "modified *Daubert* test" as set out in the Court's May 29, 2003 amended rules, and expressly rejected the *Frye* standard. The State Supreme Court determined that the trial court erred in admitting the McLemores' expert appraisal witness testimony. The Supreme Court reversed the judgment of the trial court and granted MTC's motion for a new trial.

III. The Impact of *Daubert* on Toxic Tort, Property Damage and Liability Allocation Claims

In environmental, natural resource and tort liability allocation cases, the judge must decide whether the evidence does indeed prove, by legal standards of proof in civil cases (i.e., preponderance of the evidence), both *general causation* (whether the alleged source was likely to have caused the kind of harm alleged) and *specific causation* (whether the source actually caused this particular harm to the plaintiff). In liability allocation cases the judge must decide whether the evidence is sufficient to prove both liability and the allocation of a percentage of the liability to each liable party.

In nearly all scientifically-based investigations there is an element of uncertainty. Geoscientists and specifically-educated and appropriately-trained engineers reach their conclusions largely from their experience, given limited information. However, *Daubert* criteria tend to be more absolute regarding the admissibility of evidence. Since some uncertainty is inherent in scientific studies, application of the *Daubert* criteria can make it more difficult for evidence to meet the "causation" standard. In effect, the *Daubert* criteria tend to require experts to base their opinions on a similar level of "intellectual rigor" that requires supporting data, and similar to that applied by the editors of a highly-respected peer-reviewed journal.

Several limited surveys of cases have been performed to assess the impact of *Daubert* on admissibility decisions. For example, Carolyn Raffensperger with the Science & Environmental Health Network (SEHN) lists a "small sampling of …interpretations of scientific methods, standards, and data that have been used repeatedly by federal judges [in a gate-keeping role to exclude plaintiff expert testimony] …." Others have cited a 90 percent reduction in the use of expert testimony in exposure-damage claims as a result of

the new admissibility tests. Examples of expert opinion evidence that has been excluded are as follows:

- Extrapolations of data from one location/circumstance/set of facts to another,

- Statistical analysis of data that show significance but not sufficient significance,

- Evidence of cause-effect relationships that have been ruled incomplete, and therefore inconclusive or invalid if the *mechanisms* are not understood or properly tested.

Reviewing the *Joiner* case law provides a basis for concluding that the Supreme Court did not intend for there to be wholesale exclusions of certain types of methodologies, but rather a case-by-case test of whether "intellectual rigor" was utilized in the application of the methodologies and in the interpretation of the data and derivation of opinions. Various *Daubert* decisions provide guidance as to the criteria that can be applied to assess the reliability and hence the helpfulness of expert testimony. Instead of "black and white" tests of admissibility, it is evident that the Supreme Court has established a more important test - whether the work reflects "intellectual rigor."

Margaret Berger in the Federal Judicial Center's Reference Manual on Scientific Evidence, as well as others, noted that the *Daubert* and *Joiner* decisions adopt a flexible approach to defining what is admissible as expert opinions. *See*, Margaret A. Berger, *The Supreme Court's Trilogy on the Admissibility of Expert Testimony, in Federal Judicial Center, Reference Manual on Scientific Evidence*, Chapters 9 and 11 (2d ed. 2000). This approach stresses the importance of identifying "the particular circumstances of the particular case at issue." The four *Daubert* factors "may or may not be pertinent;" it depends on the nature of the issue, the expert's particular expertise, and the subject matter of the expert's testimony. Determining which factors are indicative of reliability in a particular case cannot be accomplished solely by categorical *a priori* characterizations about the particular field in question. In all cases, a court must exercise its gate-keeping obligation so that the expert, whether relying on "professional studies or personal experience," will, when testifying, employ "the same level of intellectual rigor" that the expert would use outside the courtroom when working in the relevant discipline." *Id.*

In *Joiner,* the Court refused to find that the methodology the plaintiff expert was advocating could never be used by an expert: "…the specific issue before the court was not the reasonableness in general of …an expert's use of a visual and tactile inspection to determine [the cause of the tire failure]…. Rather, it was the reasonableness of using such an approach, along with the [plaintiff's expert's] particular method of analyzing the data thereby obtained, to draw a conclusion regarding the particular matter to which the expert testimony was directly relevant. The Court then discussed numerous case-specific factors that made it reasonable for the district court to conclude that the plaintiff's expert testimony was not reliable because "it fell outside the range where experts might

reasonably differ, and where the jury must decide among the conflicting views of different experts…." *Id.*

In practice, most *Daubert* decisions are not recorded. Even when *Daubert* challenges have not limited the admissibility of some highly questionable expert testimony, *Daubert, Kumho and Joiner* criteria are increasingly being used to assess the "weight of the evidence" and discount poor-quality evidence. A case in point is the admissibility of environmental standards and criteria and of environmental data. Relative to standards in numerous cases, testimony that the standards have been exceeded or that regulatory violations have occurred has been admitted. Also admitted has been testimony that the regulatory standards are not based on legal theories of causation, but rather on different purposes or factors related to safety. In effect, most environmental standards are conservatively based to reduce the risk of harm. They do not establish when harm will occur or even if harm will necessarily occur. Geoscientists should be aware that violations of regulatory standards are not equivalent to causation.

As is reflected in the following cases, the rules on data admissibility (aka, legal defensibility) used by the courts can be very different from those established in regulation. In particular, courts have found that data evidence may be admissible and considered reliable even if there were major deviations from methods specified by regulation, or if the analysis was done in a non-accredited laboratory, and even if accreditation were required by regulation. As to the "weight" put to evidence, the validation of the method, the training and experience of personnel, the accuracy of the equipment, and the quality-system documentation can and have been equally relevant. Consequently courts and juries have discounted the value of some data even though the data were considered admissible.

Cases Where Controversial Data Have Been Admitted:

***People v. Hale*, 34 Cal. Rptr.2d 690 (Cal.Ct.App. 1994), *review denied* (Cal. Jan. 5, 1995).** This case involved the illegal dumping of 1,1,1-trichloroethane into waste dumpsters. The appeal focused on major deviations from EPA's guidance for environmental investigations and testing methods, SW-846:

- no sampling plan was used,
- the lab had used Method 8015 instead of the accepted methods 8010 or 8240,
- the samples were frozen instead of cooling to 4 °C, and
- the 14-day holding time was exceeded.

The California Appellate Court ruled that the deviations were harmless, stating:

> "We discern no *per se* rule which automatically precludes the introduction of evidence of disposal of hazardous waste just because the gathering of the sample does not follow every jot and title of the EPA manual."

***People v. Adams*, 131 Cal. Rptr. 190, 191 (Cal. Ct. App. 1976**). In *Adams,* a California Appeals Court found that where a statute fails to provide that evidence shall be excluded for failure to comply with that said statute, such evidence is not inadmissible. The court further noted that statutory compliance or non-compliance goes to the weight of the evidence, not admissibility.

IV. Court's Criteria for Experts to Use in Scoping Their Work

Based on the cases cited in this paper, the following criteria can be used as guidance to help experts scope their work:

1. "Reliability"- The testifying expert must develop a scope of work that will yield a reliable basis for the expert's opinions. The expert must have the appropriate qualifications to be able to reach the opinions regarding the contentions in a case. "Is the qualified expert qualified proposing to testify to scientific knowledge" that is more likely true than not rather than to speculation based merely on what the expert thinks or believes (see *Daubert,* 509 U.S. at 593).

    a. Credentials, training or experience. Potential experts should be able to cite their background and demonstrate that it is adequate for them to render opinions regarding the contentions of the case. If not, the testifying expert needs to have consulted with and/or relied on the work of others in filling in the gaps of her or his training and experience.

    b. Theory. Potential experts should view their initial findings as theories which must be tested. While the data may suggest a conclusion that the expert feels is more likely than not, can the data be used to refute valid questioning?

    c. Test the Hypothesis. The scope of a testifying expert's work should include testing the expert's "theory(ies)" or opinion(s). Typically three lines of corroborating evidence are used to support a conclusion. The scope of the expert's work should include developing multiple lines of evidence. If the evidence is corroborating and the appropriate intellectual rigor has been applied, then the opinion is arguably valid and scientifically sound.

    d. Test for Alternative Explanations. The scoping should include testing for alternative explanations. Do the data support reasonable alternatives that could also explain the "facts" of the case? Could there be other sources,

other sources of exposure, other factors that could have affected property values, and other factors that already limit property use? Are there data to eliminate these other reasonably plausible alternative explanations?

2. "Fit" – "Can the reasoning or methodology underlying the testimony be properly applied to the facts of the case?" *See Daubert,* 509 U.S. at 593. The answer depends on the basis of the reasoning or methodology.

    a. Scientific. An opinion is scientific when its derivation applies a grounding in the methods and procedures of science. *Id. a*t 590. In other words, a testifying expert should be required to explain how the data were gathered and analyzed and how they were used to develop and test the expert's hypotheses, and how alternative explanations were eliminated.

    b. Knowledge. An opinion based on subjective belief or unsupported speculation is without foundation. *Id.* In other words, a testifying expert must demonstrate knowledge of the subject area and offer a basis for knowing that the conclusions are valid.

    c. Inferences and Assertions. An opinion based on inferences and assertions must be derived by the scientific method and supported by appropriate validation. *Id.* In other words, the scope of a testifying expert's work must include testing of the assertions (hypotheses) and providing the basis behind the assertions.

    d. *Daubert* Factors. *Daubert's* four non-exclusive factors should be applied where appropriate. *Id.* at 593. The testifying expert should be able to specifically address the following:

        i. Whether the scientific theory or technique can be and has been tested—whether the conclusions derived from such "theories", techniques, or methods are grounded in solid science.

        ii. Whether the scientific theory or technique has been subjected to peer review and publication. Not all opinions must be peer-reviewed, but have the methods used to derive the opinions been peer reviewed?

        iii. Whether the scientific theory or technique has a known or potential rate of error, and if standards exist to control the technique's operation and error. At a minimum, a testifying expert should be able to address the uncertainty in the data and whether the expert's opinions would change if the actual conditions were at the margin of the uncertainty in the data. This requires sensitivity testing of the calculations and modeling input used to develop opinions.

iv. Whether the scientific theory or technique has attained general acceptance within the relevant scientific community. Would others support the same conclusions if the work would be peer reviewed? This assumes the work to authoritative reviewers is a helpful process in supporting the findings and not based on evolving techniques.

e. Factors Considered by Other Courts:

i. Is the opinion based on "Courtroom Science?" Is the expert proposing to testify about matters "growing naturally and directly out of research they have conducted independent of the litigation" i.e., as a test of objectivity and independence, did the research follow methods not derived specifically for the litigation and which would have naturally come from their work. See *Daubert II*, 43 F.3d 1317 (9th Cir.).

ii. Use of Pre-existing Research. Is the testifying expert using legitimate pre-existing research or techniques and methods not developed for the litigation? Such "provides the most persuasive bases for concluding that the opinions the expert expresses were "derived by the scientific method." *Id.*

iii. Peer Review or Use of Peer-Reviewed Methods. The testifying expert must develop a good bibliography and reference sources in their work as if writing for a publication. The way the sources are used should be adequately explained. "Absent peer review or publication, the expert must point to some objective source, such as a treatise, published article, or a statement of a professional association…" or authoritative text. *Id.*

iv. Self Assertion vs. Independent Verification. A testifying expert should be able to demonstrate beyond assertions that the expert's work is based on valid application of the techniques of the expert's fields. "The proponent may not rely on their own expert's unsupported assertions that they have employed standard scientific methods." There must be some external source that can validate their methodology. *Id.; see also Moore v Ashland Chemical, Inc.*, 151 F.3d 769 (5th Cir. 1998).

v. Reliance on Credentials Without Case-Specific Investigations. The scope of the testifying expert should include use of site-specific data and analyses of such data in testing hypotheses and reaching conclusions. In other words, credentials are not enough; – "the hiring of reputable scientists, impressively credentialed, to testify for a fee to propositions that they have not arrived at

through the methods they use when they are doing their regular professional work rather than being paid to give an opinion helpful to one side in a lawsuit" is to be avoided. In such cases, the expert opinions are based only on experience and not on a case-specific, site-specific investigation of sufficient scope to reach definitive opinions. *See Braun v. Lorillard, Inc.,* , 84 F.3d 230, 235 (7th Cir. 1996).

vi. Cart Before the Horse. The testifying expert should not reach conclusions before they have been tested by the data and alternative explanations considered. "Coming to [or accepting as given] firm conclusions and then doing research to support … [the conclusions] is the antithesis of scientific method." *See Estate of Mitchell v. Gencorp, Inc.*, 968 F.Supp. 592, 600 (D.Kan.1997).

vii. Invalid Steps or Untested or Unreasonable Assumptions. The testifying expert should identify how data were extrapolated and the assumptions inherent in their analysis; the data analyses methods and assumptions should be consistent with those routinely used in similar circumstances. The potential impact on the expert's conclusions due to uncertainty in the assumptions or methods may require further evaluation. In general, the expert's scope should include the gathering of more data than would ordinarily be required for the typical site investigation. Supplemental investigations will often be required. As in mathematical proofs of theorems, "(a)ny step that renders the analysis unreliable… renders the expert's testimony inadmissible. This is true whether the step completely changes a reliable methodology or merely misapplies the methodology." *See Mitchell v. Gencorp, Inc., 165 F.3d 778*, (10th Cir 1999), *quoting In e Paoli R.R. Yard PCP Litigation*, 35 F.3d 717, 745 (3rd Cir. 1994).

viii. Use of Scientifically Genuine Techniques. In summary, a testifying expert should ask the question of whether the basis of the expert's analyses is scientifically founded or is it based on the expert's beliefs. Under *Daubert*, the judge must determine "whether the evidence is genuinely scientific, as distinct from being unscientific speculation offered by a genuine scientist." *Id.*

V. Conclusions

We conclude that neither the Plaintiff Bar nor the Defense Bar can anticipate what effects *Daubert* will have on cases. *Daubert* has changed how many of us conduct our investigations and the associated scope of the studies. Those companies that fund these investigations must be made aware that the costs to bring or defend cases involving the

geosciences as well as engineering-related cases will increase in order to meet the demands placed on the expert by the new rulings and the Court. See Figure 3. Those companies that do not support this increase run the risk of undermining the expert's capability to conduct appropriate studies and thereby decrease the weight of the expert's testimony.

Figure 3 – Increased Pressure on Plaintiff and Defendant Experts to Provide Basis for Opinions

VI. References

Bernstein, D. E. (2001), Frye, Frye, Again: The Past, Present, and Future of the General Acceptance Test, *Jurimetrics Journal*, Vol. 41, pp. 385-407.

Campbell, M. D., R. C. Bost, and M. David Campbell, (2004), Flawed Geoscience Forensic Environmental Investigations: *Part I: The Effect of Daubert Challenges on Improving Investigations***,** *in Proc***.,** May 5-6, Congress Plaza Hotel/Chicago, Illinois, pp. 1-24. [http://www.mdcampbell.com/Baltimore/index.htm#Chicago]

Clark, D. W. (2004). *Mississippi Joins the Ranks of Tort Reform Success Stories*. Legal Opinion Letter, Vol. 14, No. 12, June 25, 2004. Washington Legal Foundation, Washington, D.C. ISBN 1056 3059.

Granato, G. E. *et al*. (1998). *Data Quality Objectives and Criteria for Basic Information, Acceptable Uncertainty, and Quality-Assurance and Quality-Control Documentation.* US DOI & USGS, Marlborough, Mass. Open-File Report 98-394.

Kennedy, S. (1997). *Options in Data Validation: Principles for Checking Analytical Data Quality*. WTQA '97 – 13th Annual Waste Testing & Quality Assurance Symposium.

O'Connor, T. (updated 2004). *Admissibility of Scientific Evidence under Daubert*, Lecture Notes for Forensic Law (JUS 425), North Carolina Wesleyan College. Internet: http://faculty.ncwc.edu/toconnor/daubert.htm.

Pagliaro, J.D., *et al.* (2000). *Recent Trends in Environmental Tort Litigation*. Morgan, Lewis & Bockius, LLP.

Raffensperger, C. and N. Myers (2003). Detox for Torts: How to Bring Justice Back the Tort System – Part I. Science & Environmental Health Network (SEHN). *The Networker,* Vol. 8, No. 3, June 2. http://www.sehn.org/Volume_8-3.html.

RAND Research Brief (2002). *Changes in the Standards for Admitting Expert Evidence*. Summary of research fully documented in: Dixon, L. and B. Gill (2001). *Changes in the Standards for Admitting Expert Evidence in Federal Civil Cases since the Daubert Decision*. RAND MR-1439-ICJ, 114 pp., ISBN: 0-8330-3088-4. Internet: http:// www.rand.org/publications/RB/RB9037/

Ries, D. G. and R. L. Burns, (2005). Expert Opinions in Environmental Litigation: Gatekeeping Twelve Years after Daubert, *Environmental Forensics*, Vol. 6, pp. 219-229, especially p. 223.

Scientific Knowledge and Public Policy (SKAPP) Planning Committee (2003). *Daubert: The Most Influential Supreme Court Ruling You've Never Heard Of*. Coordinated by the Tellus Institute.

Simmons, B.P. (no date provided). *Using Field Methods – Experiences and Lessons: Defensibility of Field Data.* Department of Toxic Substances Control, Hazardous Materials Laboratory, Berkeley, CA. http://cluin.org/download/char/legalpap.pdf

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