

Toxicological Animal Studies Disparate Treatment as Scientific Evidence

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I. INTRODUCTION

Toxicological animal studies are the cornerstone of the study of toxicology. Experiments can be controlled and timed on genetically identical animals in order to get the best possible data on the toxic effects of products and substances. Extrapolating that information to human exposure gives us the best risk information for purposes of regulation and risk management. Federal agency rulemaking procedures for environmental risks and drug approval processes, as well as civil consent decrees for rule enforcement are examples of the administrative use of toxicological data.

However, the use of toxicological animal studies in the courtroom is treated differently when application is extrapolated to humans. Even using scientific methodologies for extrapolation can be unconvincing to a court which sees mice and humans as “apples and oranges”. Because controlled studies of toxic exposures in specific amounts, over a specific time through a specific exposure pathway cannot be ethically conducted on humans, there will never be a perfect data set of toxic effects on humans, so science as well as the courts have only animal studies for this information. The studies that do involve humans are epidemiological studies which are after-the-fact, post-exposures analyzed to determine effects and any cluster effects, although the dose of the toxin, the pathway and length of exposure are likely very different, and the genetic

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types are going to have unknown effects on the outcome. Typically the exposure is due to an accidental exposure of a cluster of individuals. However, because this is human data, courts often see this type of scientific evidence as less confusing and more relevant.

In fact, the result has been that courts in some jurisdictions may admit epidemiological evidence alone as scientific evidence; but they may find irrelevant or inadmissible toxicological animal studies when offered as scientific evidence alone, or when they shows contrary results to proffered epidemiology studies.¹ This article will examine the jurisdictionally disparate treatment of toxicological animal studies as evidence and the courts' reasoning for the exclusion or limitation of the toxicological animal studies, explore the potential misunderstandings of the science of toxicology, and offer suggestions for more consistently applying the *Daubert* principles for the admission of scientific evidence to toxicological animal studies.

II. THE SCIENTIFIC FIELDS

The admissibility of scientific evidence from an expert requires that the expert be qualified in the field in which they are testifying.² Two distinct fields of study are considered here in the examination of the courts treatment of their admissibility. This section briefly describes both of these fields of study.

A. WHAT IS TOXICOLOGY?

¹ *Bell v. Swift Adhesives, Inc. a div. of Reichhold Chemicals, Inc.*, 804 F. Supp. 1577, 1580 (S.D. Ga. 1992) (refusing to "depart from precedent and allow plaintiff to rely primarily upon animal studies to carry her burden on the issue of causation."); *In re Agent Orange Product Liability Litigation*, 611 F. Supp. 1223, 1231 (E.D.N.Y. 1985) (Defendant's motion for summary judgment granted where the court commented that epidemiological studies were "the only useful studies having any bearing on causation.")

² See, e.g., *Fed R. Evid. 702, Santos v. Posadas de Puerto Rico Assoc.s, Inc.*, 452 F. 3d 59, 64 (1st Cir. 2006) ("The test is whether, under the totality of the circumstances, the witness can be said to be qualified as an expert in a particular field through any one or more of the five bases enumerated in Federal Rule of Evidence 702-knowledge, skill, experience, training, or education.")

Toxicology is defined in the classic toxicology text, *Casarett and Doull's Toxicology: The Basic Science of Poisons* as "the study of the adverse effects of chemical agents on biological systems."³ The study of the effects of these chemical agents on human health combines concepts of toxicology with risk assessment.⁴ Most importantly, in determining the potential health hazard, the effect of the agent as well as the dose required to produce that effect and the type of exposure that occurred must be known.⁵

The regulatory aspect of toxicology involves the regulation of risks through the application of risk assessment principles within the framework of the statutory and regulatory authority delegated to the agencies. The implementation of risk assessment allows governmental agencies to establish chemical concentrations that can be present in the environment without putting humans at risk.⁶ Human health risk assessment methodology includes the following four components: (1) data collection and evaluation, (2) exposure assessment, (3) toxicity assessment and (4) risk characterization.⁷ Each factor plays a vital role in determining at what level a chemical can be present, yet pose minimal risk from an ecological and human health perspective. Risk assessment provides necessary information to lawmakers in the regulatory process. Throughout the process, agencies work with regulatory toxicologists, who have responsibility for deciding, based on the data, whether a chemical or a pharmaceutical drug poses a sufficiently low risk to be marketed.⁸ The Food and Drug Administration must take into consideration potential health effects based on risk characterizations in determining whether a drug, cosmetic or food additive can be sold in the market according to the Federal Food, Drug and Cosmetic Act (FDCA).⁹ Additionally, the Environmental Protection Agency (EPA) relies on conclusions by regulatory toxicologists, incorporating

³ LOUIS J. CASARETT, JOHN DOULL & CURTIS D. KLAASSEN, *CASARETT AND DOULL'S TOXICOLOGY : THE BASIC SCIENCE OF POISONS*, 3 (5th ed. 1996).

⁴ MARK E. STELLJES, *TOXICOLOGY FOR NONTOXICOLOGISTS*, 109 (2d ed. 2008).

⁵ CASARETT, *supra* note 3, at 13.

⁶ STELLJES, *supra* note 4, at 3.

⁷ *Id.* at 110.

⁸ CASARETT, *supra* note 3, at 19-26.

⁹ *Id.* at 13. See also, e.g., 21 U.S.C. § 342(a)(1).

descriptive toxicological studies and risk assessment, in establishing standards for the level of chemicals permitted in the air or drinking water.¹⁰

In measuring exposure, toxicologists often turn to descriptive animal toxicity tests.¹¹ This is particularly important concept in toxicology, as regulatory toxicologists often extrapolate this data in determining risk to human health. According to *Casarett & Doull's Toxicology*, "Two main principles underlie all descriptive animal toxicity testing. The first is that the effects produced by a compound in laboratory animals, when properly quantified, are applicable to humans The second principle is that exposure of experimental animals to toxic agents in high doses is a necessary and valid method of discovering possible hazards in humans."¹² Both of these fundamental tenets of toxicology become particularly relevant in the discussion of how courts should treat toxicological studies as opposed to epidemiological evidence. Differences among species, and even within species can sometimes produce varied results, which make extrapolation to human exposure more uncertain. However, interpretive tools and methodologies that are generally accepted in the field account for these uncertainties in the field of toxicology. Thus, courts have differed on how to treat toxicological evidence in the form of animal studies based on validity and the presence of epidemiological studies, which may on their face appear more reliable because they involve humans.

B. WHAT IS EPIDEMIOLOGY?

Epidemiology is the field of public health and medicine that studies the incidence, distribution, and etiology of disease in human populations. The purpose of epidemiology is to better understand disease causation and to prevent disease in groups of individuals....

Judges and juries increasingly are presented with epidemiologic evidence as the basis of an expert's opinion on causation. In the courtroom, epidemiologic research findings are offered to establish or dispute whether exposure to an agent caused a harmful effect or disease.¹³

¹⁰ See *In re Paoli*, 35 F.3d 717, 734 (3d Cir. 1994).

¹¹ *Id.* at 27.

¹² CASARETT, *supra* note 3, at 28.

¹³ Michael D. Green, D. Mical Freedman & Leon Gordis, *Reference Guide on Epidemiology*, in FEDERAL JUDICIAL CENTER, REFERENCE MANUAL ON

Exposure may be suggested by epidemiology studies, but most often epidemiological studies are offered to prove causation. Through the identification of random individuals in a given geographical area, sampling of the exposed population produces data which can be used to show association with exposure and disease. This association alone does not demonstrate specific causation (i.e., causation of disease in a particular individual).¹⁴ Confounding factors which may have been the cause of the disease must be examined. A number of meta-analysis tools must be used to determine whether statistically significant occurrences of exposure and disease indicate the probability of causation.¹⁵

Because the length and amount of exposure is uncontrolled, and humans vary in genetics, age and health, all of these uncertainties must be taken into account when considering *post-hoc* studies done of human exposures. Methodologies generally accepted in the field of epidemiology and interpretive tools are used to account for these uncertainties.¹⁶ Just as the science of epidemiology has its uncertainties, toxicology has its own, albeit different, limitations.

III. TOXICOLOGICAL SCIENTIFIC EVIDENCE

The admission of toxicological animal studies must be determined on the basis of the testimony of scientific experts. Usually well before the trial a *Daubert* hearing may be held to consider the admissibility of scientific evidence, in order to avoid interruption of the flow of the trial and the jury participation time, especially where the trial will have a substantial amount of scientific evidence and testimony.¹⁷ Through depositions and production of documents, and motions *in limine*, these experts and studies may be

SCIENTIFIC EVIDENCE 333, 335 (2d ed. 2000) (citations and footnotes omitted).

¹⁴ *Id.* at 336.

¹⁵ *Id.* at 380 (meta-analysis and the combination of multiple studies), 384 (individual's relative risk), 385 (attributable risk parameters).

¹⁶ *See Id.*

¹⁷ *See Daubert v. Merrell Dow Pharmaceuticals*, 509 U.S. 579, 592 (1993).

excluded before the trial begins.¹⁸ However, if these studies survive the *in limine* motion for exclusion, then the court must decide how they will be considered.

These studies are typically presented as peer-reviewed articles, published in a scientific journal in the particular field of study in which it is being proffered. It may appear in a leading authoritative text on the subject, qualifying for admission based on the learned treatise exception to hearsay.¹⁹ A study and report performed by a government laboratory or agency, may be admissible on the basis of the hearsay exception for government records.²⁰ However, toxicological evaluations of studies can also be relied upon by an expert, but the court may independently review whether the studies can be reasonably relied upon by the expert.²¹

*Daubert v. Merrell Dow Pharmaceuticals, Inc.*²² is the U.S. Supreme Court opinion that defines the court's role in admitting scientific evidence. This role, referred to as a gatekeeping role, requires that the court consider six criteria for the admissibility of scientific evidence. In carrying out the court's gatekeeping role, the court should consider (1) a theory or technique's testability; (2) peer review and publication; (3) the potential rate of error; and (4) whether the theory or technique enjoys general acceptance within a relevant scientific field.²³ In a later case, *Kumho Tire Company v. Carmichael*, the court held that the *Daubert* factors should be applied flexibly, and not all factors are required to be met for admissibility.²⁴

A case which decided by the U.S. Supreme Court between *Daubert* and *Kumho Tire* spoke directly to the consideration of toxicological and epidemiological evidence. *General Electric Co. v. Joiner* involved Robert Joiner's exposure to polychlorinated

¹⁸ See, e.g. *Padillas v. Stork-Gamco, Inc.*, 186 F.3d 412, 417 (3d Cir. 1999) (holding that failure to hold an *in limine* hearing regarding admissibility of expert testimony was an abuse of discretion, and stressing "the importance of *in limine* hearings under Rule 104(a) in making the reliability determination required under Rule 702 and *Daubert*.")

¹⁹ Fed. R. Evid. 803(18).

²⁰ Fed. R. Evid. 803(8)(C).

²¹ See, e.g. *Padillas*, 186 F.3d at 417; *in re Paoli Railyard PCB Litigation*, 35 F.3d 717, 748 (3d Cir. 1994).

²² 509 U.S. 579 (1993).

²³ *Id.* at 593-94

²⁴ 526 U.S. 137, 141-42 (1999).

biphenyls (PCBs) and related PCB derivatives as an electrician working with transformers.²⁵ Joiner used animal studies, along with four epidemiological studies to establish that his exposure to PCBs caused his small cell lung cancer.²⁶ While the Supreme Court used this post-*Daubert* case to establish the appropriate standard of review concerning admissibility of scientific evidence, the Court also went into some detail in elaborating on the District Court's review of both the animal and epidemiological studies.²⁷ The primary contention by the petitioners in the case was that Joiner's expert testimony regarding causation was nothing more than speculation due to inadequate animal studies and inapplicable epidemiological studies.²⁸ The animal studies proffered by Joiner involved infant mice who developed alveogenic cancer after the administration of "massive" doses of PCBs injected directly into their stomachs.²⁹ The differences between the infant mice studies and Joiner's exposure and diagnosis were notable, as the dose, exposure and cancer noted in the infant mice study greatly differed from Mr. Joiner's symptoms and illness.³⁰ The fault found with the animal studies was due to the failure to establish scientific causation between the dose, exposure and cancer diagnosis, making extrapolation tenuous at best.³¹ Additionally, the four epidemiological studies that Mr. Joiner's experts relied upon were also too dissimilar. Each study contained some similarities, but not enough to adequately establish a causal link between PCB exposure and small cell lung cancer.³²

²⁵ 522 U.S. 136, 139 (1997).

²⁶ *Id.* at 143-44.

²⁷ *Id.* at 144-47.

²⁸ *Id.* at 143-44.

²⁹ *Id.* at 144.

³⁰ The infant mice were exposed to massive doses of PCBs, by peritoneal injection and developed alveogenic cancer, whereas Mr. Joiner was exposed to a much smaller PCB dose (approximately 0-500ppm), most likely through dermal and inhalational exposure, and developed small cell lung cancer. In essence, the dose, route of exposure and cancer diagnosis were not the same. *Id.* at 144.

³¹ *Id.*

³² The epidemiological studies consisted of: (1) Lung cancer deaths among workers at an Italian capacitor plant. The authors of the studies concluded that "there were apparently no grounds for associating lung cancer deaths (although increased above

The Court affirmed the District Court's decision to exclude the expert testimony based on animal studies because they were too "far-removed," noting that "whether animal studies can ever be a proper foundation for an expert's opinion was not the issue," but rather whether "these experts' opinions were sufficiently supported by the animal studies on which they purported to rely."³³ While the court, affirmed the District court holding that the animal studies were inadmissible because they were "far removed," they pointedly cautioned that they were not deciding the issue of "whether animal studies can ever be a proper foundation for an expert's opinion",³⁴ leaving the question of whether the entire science of toxicological animal studies was admissible for purposes of scientific evidence.

IV. THE JURISDICTIONALLY DISPARATE OPINIONS WITH REGARD TO TOXICOLOGICAL ANIMAL STUDIES AS SCIENTIFIC EVIDENCE

The majority of federal jurisdictions have written opinions regarding toxicological evidence which have had the effect of creating rules which exclude toxicological

expectations) and exposure in the plant." Bertrazzi, Riboldi, Pestori, Radice, and Zocchetti, *Cancer Mortality of Capacitor Manufacturing Workers*, 11 *American J. of Industrial Medicine* 165 (1987); (2) Employees at Monsanto's PCB production plant. The increase in lung cancer deaths was somewhat higher but the increase was not statistically significant. J. Zack & D. Munsch, *Mortality of PCB Workers at the Monsanto Plant in Sauget, Illinois* (Dec. 14, 1979); (3) The third study involved workers at a Norwegian cable manufacturing company who had been exposed to mineral oil. A statistically significant increase in lung cancer deaths was observed, but the study did not specifically mention PCBs. Ronenberf, Andersen, Skyberg. *Mortality and Incidence of Cancer Among Oil-Exposed Workers in a Norwegian Cable Manufacturing Company*, 45 *British J. of Industrial Medicine* 595 (1988); (4) The final study involved a PCB exposed population in Japan who did have a statistically significant increase in lung cancer deaths, however the group had been exposed to other potential carcinogens, including toxic rice oil. Kuratsune, Nakamura, Ikeda & Hirohata. *Analysis of Deaths Seen Among Patients with Yushp-A Preliminary Report*, 16 *Chemosphere*, Nos. 8/9, 2085 (1987). *Id.* at 145 (all descriptions of and citations to studies from case).

³³ *Id.* at 144 (emphasis in original).

³⁴ *Id.*

evidence when there are contradictory epidemiological studies, or when proffered without supporting epidemiological evidence.

Beginning with the D.C. Circuit in 1988, the court examined the plaintiff's evidence concerning Bendectin, and concluded that based on Federal Rule of Evidence 702 animal toxicology, even when supported by other non-epidemiological evidence, cannot prove causation where epidemiological studies disagree.³⁵ Then, in 1997, the U.S. Supreme Court raised the question of whether toxicological animal studies could ever be relied upon as scientific evidence in *General Electric Co. v. Joiner*.³⁶ The Court opined that they would not consider that question,³⁷ once again leaving open the question whether toxicological evidence might *ever* be relied upon.

A rule has emerged from the Circuits that epidemiological data should always trump toxicology data. The D.C. Circuit³⁸ and the Third Circuit³⁹ have each had such holdings; and in one Fifth Circuit case, the court held that the lack of epidemiological data was fatal to the case where only toxicological data was available.⁴⁰ Furthermore, the Eleventh Circuit has effectively created an absolute rule that toxicological data

³⁵ *Richardson v. Richardson Merrell*, 857 F.2d 823 (D.C. Cir. 1988).

³⁶ *General Electric Co. v. Joiner*, 522 U.S. 136 (1997)

³⁷ *Id.* at 144.

³⁸ *Compare Richardson*, 857 F.2d 823 (D.C. Cir. 1988) (excluding animal toxicology and other non-epidemiological evidence not supported by epidemiological studies) *with* *Abrosini v. Labarraque*, 101 F.3d 129 (D.C. Cir. 1996) (ruling animal toxicological reports were a sufficient basis for evidence regarding specific causation when supported by epidemiological evidence regarding general causation).w

³⁹ *In re Paoli R.R. Yard PCB Litigation*, 35 F.3d 717, 779-80 (3d Cir. 1994).

⁴⁰ *Brock v. Merrill-Dow Pharmaceuticals, Inc.*, 874 F.2d 307, 313 (5th Cir. 1989) (The court stated specifically that "we do not hold that epidemiologic proof is a necessary element in all toxic tort cases, it is certainly a very important element. This is especially true when the only other evidence is in the form of animal studies of questionable applicability to humans." Furthermore, the court noted that it was "not the first court to emphasize the importance of epidemiologic analysis.").

should never trump epidemiological data.⁴¹ The First Circuit has similarly held that toxicological data is simply incapable of proving causation without epidemiological data.⁴²

However, in one D.C. Circuit opinion, the court did not establish the same kind of presumption against the admissibility or reliability of toxicological animal studies.⁴³ The court there stated that “[o]f course epidemiological evidence does not always trump the nonepidemiological,”⁴⁴ but went on to “reiterate [the] holding in Richardson” that toxicological animal studies alone are not enough to surmount “overwhelming” evidence from epidemiological studies.⁴⁵ Taking an even more positive view of toxicological animal studies, the Ninth Circuit held in 1995, that toxicological animal studies can be relied upon, independent of epidemiological studies,⁴⁶ making this the only Circuit court with a rule which could be characterized as a *de facto* presumption that toxicological studies were reliable.

In lower courts, inconsistent treatment of toxicological studies is evident as well. The federal district court in the Virgin Islands held that toxicological studies could not be relied upon as scientific evidence or for reliance by an expert.⁴⁷ The court stated

Although plaintiff's expert witnesses purport to hail from different disciplines, such as toxicology, pharmacology and pediatric pathology, each is offering an opinion with respect to human birth defects and their causes- i.e., the field of teratology.

⁴¹ *Allison v. McGhan Medical Corp.*, 184 F.3d 1300, 1313, 1316-17 (11th Cir. 1999).

⁴² *Lynch v. Merrell-Nat'l Lab, Div. of Richardson-Merrell, Inc.*, 830 F.2d 1190, 1194 (1st Cir. 1987) (“Studies of this sort, singly or in combination, do not have the capability of proving causation in human beings in the absence of any confirmatory epidemiological data.”)

⁴³ *Raynor v. Merrell Pharm., Inc.* 104 F.3d 1371 (D.C. Cir. 1997).

⁴⁴ *Id.* at 1375.

⁴⁵ *Id.* at 1376.

⁴⁶ *Auvil v. 60 Minutes*, 67 F.3d 816, 821 (involving a product disparagement claim, the court stated in part that “animal laboratory tests are a legitimate means for assessing cancer risks to humans,” relying in part on the pre-*Daubert* D.C. Cir. case *Envtl. Def. Fund v. EPA*, 548 F.2d 998, 1006 (D.C.Cir.1976)).

⁴⁷ *Wade-Greaux v. Whitehall Laboratories, Inc.*, 874 F .Supp. 1441 (D. Virgin Islands, 1994)

Accordingly, the methodologies they employ must be compared with the methodology generally accepted by the community of teratologists....

Each of plaintiff's expert witnesses is able to draw his or her respective conclusions only by ignoring the basic requirements of the relevant scientific community's methodology. In particular, an essential element of the generally accepted methodology is that exposure during pregnancy should be associated with an increased frequency of a distinctive pattern of birth defects, as shown through repeated, consistent human epidemiological studies. This essential element is absent from the respective methodologies of each of plaintiff's experts.⁴⁸

In the most dismissive of the rules against the admission or reliance upon toxicological evidence, the highest appeals court in Michigan ruled that toxicological data is simply invalid.⁴⁹

⁴⁸ *Id.* at 1478.

⁴⁹ *Nelson v. Am. Sterilizer Co.*, 223 Mich. App. 485, 493-94 (1997). The Court also made an informative survey of the cases in the field: "There is no Michigan appellate case that addresses whether medical causation testimony premised solely on the reported findings of in vivo animal studies possesses sufficient evidentiary reliability to warrant its admission under MRE 702. The federal courts have addressed this question, however, in the context of FRE 702 and 703. As a general rule, the federal courts have found expert opinion testimony concerning the medical causation of disease to be admissible where the testimony is supported by statistically valid epidemiological studies. *Allen v. Pennsylvania Engineering Corp.*, 102 F.3d 194, 197 (C.A.5, 1996); *Wade-Greaux*, 874 F.Supp. at 1483; *Lynch*, 646 F.Supp. at 863-864. Additionally, because appropriately conducted animal studies can be helpful in determining human outcomes, *Turpin v. Merrell Dow Pharmaceuticals, Inc.*, 959 F.2d 1349, 1360 (C.A.6, 1992), some federal courts have determined that expert opinion testimony is admissible if supported only by animal studies. *In re Paoli Railroad Yard PCB Litigation*, 35 F.3d 717, 781 (C.A.3, 1994); see *Bell v. Swift Adhesives, Inc.*, 804 F.Supp. 1577, 1579 (S.D.Ga., 1992). Other federal courts tend to view animal studies with suspicion, however, and therefore exclude expert opinion testimony based on animal studies in the absence of confirmatory epidemiological data or in the face of an overwhelming body of contrary epidemiological evidence. *Raynor v. Merrell Pharmaceuticals, Inc.*, 323 U.S.App. D.C. 23, 26, 104

V. JURISDICTIONS ARE DIVIDED IN THEIR TREATMENT OF TOXICOLOGICAL ANIMAL STUDIES

This section will examine courts' reasoned opinions regarding why they chose to admit or not to admit toxicological animal studies. The trend toward exclusion may have been influenced by the U.S. Supreme Court decision, *General Electric Co. v. Joiner*, where the Court left open the question as to whether toxicological animal studies would ever be admissible.⁵⁰ Courts have excluded toxicological animal studies for a variety of reasons: (1) epidemiological studies were unavailable; (2) epidemiological studies were contrary to the toxicological animal studies; (3) the toxicological animal studies did not meet Daubert criteria for fitness; (4) the toxicological animal studies did not meet the Daubert criteria for reliability; (5) the toxicological animal studies were "confusing" under Federal Rule of Evidence (FRE) 402; (6) the toxicological animal studies were "confusing" under FRE 403; (7) the toxicological animal studies were problematic because of extrapolation problems; (8) the toxicological animal studies were invalid and unreliable for proving causation; and (9) the toxicological animal studies were unduly prejudicial to the jury.

This section will also include a contrasting analysis of courts' reasoning in opinions where toxicological animal studies were admitted because: (1) toxicological animal studies were the only available evidence before the court; (2) the Environmental Protection Agency relied on them for regulatory decisions; (3) conducting epidemiological studies was impossible and unethical; and (4) the toxicological animal studies met Daubert criteria for admissibility.

F.3d 1371, 1374 (1997); *In re Paoli*, supra at 780-781; *Wade-Greaux*, 874 F.Supp. at 1483; *Bell*, supra at 1579. This suspicion arises because it is scientifically invalid to extrapolate observations in animal experiments directly to human beings to determine human outcomes, *Raynor*, 323 U.S.App.D.C. at 27, 104 F.3d at 1375; *Allen*, supra at 197; *Wade-Greaux*, 874 F.Supp. at 1484; *Lynch*, 646 F.Supp. at 865, in part, in light of the recognized biological fact that some agents may cause disease occurrence in one species and not in another, *Allen*, supra at 197; *Wade-Greaux*, 874 F.Supp. at 1454; *Viterbo v. Dow Chemical Co.*, 826 F.2d 420, 424 (C.A.5, 1987)."

⁵⁰ 522 U.S. 136, 139 (1997).

A. COURTS HAVE BEEN DIVIDED ON WHETHER TO EXCLUDE TOXICOLOGICAL ANIMAL STUDIES WHERE EPIDEMIOLOGICAL STUDIES WERE UNAVAILABLE OR INCONCLUSIVE, OR WHEN THEY CONTRADICTED THE TOXICOLOGICAL STUDIES

1. WHERE THE EPIDEMIOLOGICAL STUDIES ARE EITHER UNAVAILABLE OR INCONCLUSIVE.

In these cases, toxicological animal studies were not admitted, even when epidemiological studies were unavailable or inconclusive.

Before *Daubert*, the Fifth Circuit, in the 1989 case *Brock v. Merrell Dow Pharmaceuticals, Inc.*, held that the lack of epidemiological studies is “fatal” where the only other evidence is toxicological animal studies.⁵¹

In a post-*Daubert* case in 1996, the Fifth Circuit in *Allen v. Pennsylvania Eng'g Corp.*, similarly held that expert testimony based on animal studies, paired with inconclusive epidemiological evidence, was inadmissible.⁵² The court stated “[w]e are also unpersuaded that the ‘weight of the evidence’ methodology these experts use is scientifically acceptable for demonstrating a medical link between Allen’s EtO exposure and brain cancer.”⁵³

In the Federal District Courts, in 1994, in the District Court of the Virgin Islands, in *Wade-Greaux v. Whitehall Laboratories No.*, the plaintiff’s expert witness attempted to base her opinion on chick embryo studies.⁵⁴ The court noted that the embryo study was used to mimic human fetus exposure.⁵⁵ “Such chick embryo studies are an in vitro, not an in vivo, animal model, and do not replicate a mammalian, let alone human exposure.”⁵⁶ The court excluded the expert testimony because the expert relied upon animal studies, without also relying upon statistically significant epidemiological evidence. Basing its ruling on FRE 403 (as well as FRE 702 and *Daubert*), the court

⁵¹ *Brock v. Merrell Dow Pharmaceuticals, Inc.*, 874 F.2d 307, 313 (5th Cir.1989) (see *supra* note 40 for more discussion on this case).

⁵² *Allen v. Pennsylvania Eng'g Corp.*, 102 F.3d 194 (5th Cir. 1996).

⁵³ *Id.* at 198.

⁵⁴ *Wade-Greaux v. Whitehall Laboratories*, 874 F.Supp. 1441, 1456. (D. USVI 1994)

⁵⁵ *Id.*

⁵⁶ *Id.* at 1456-1457.

held that because the testimony would confuse, mislead, and overwhelm a jury, the expert's testimony must be inadmissible.

In the Superior Court of Pennsylvania, in 2009, in *Pauley v. Bayer Corp.*, the court opined that “animal studies without epidemiological studies cannot prove causation in humans because drugs do not have the same effect on humans as they do on animals; the doses given to animals in animal studies are very different from those given to humans.”⁵⁷

Despite a trend toward rejecting animal studies when epidemiological evidence is unavailable or inconclusive, other courts have held, however, that animal studies are not *per se* inadmissible. In *Longmore v. Merrell Dow Pharmaceuticals, Inc.*, the district court held that the results of chemical analysis and animal studies raised questions of fact on the issue of causation.⁵⁸ In this particular Bendectin case, where the plaintiffs were alleging birth defects associated with the ingestion of the drug, the court explained that, “animal studies are generally relied upon by experts determining the link between a drug and birth defects and the same is true for chemical analysis. While the Court will leave open the question of the admissibility of particular studies during the trial of this matter, the Court cannot preclude all such studies under Rule 703.”⁵⁹

2. COURTS ARE DIVIDED ON THE ADMISSION OF TOXICOLOGICAL EVIDENCE WHEN IT IS CONTRARY TO EPIDEMIOLOGICAL STUDIES

There are some courts which have formulated a rule that toxicological animal studies cannot be admitted into evidence where epidemiological studies contradict them.

Even before the U.S. Supreme Court addressed the question of the admission of scientific evidence in *Daubert*, the Second Circuit, in the 1987 case of *In re Agent Orange*, set in motion the idea that toxicological animal studies were suspect. The district court had held that “laboratory animal studies . . . are generally viewed with more suspicion than epidemiological studies, because they require making the assumption

⁵⁷ *Pauley v. Bayer Corp.*, No. 2681 EDA 2005, 2009 WL 1654592, at *12 (Pa.Super.) (not reported in A.2d).

⁵⁸ *Longmore v. Merrell Dow Pharmaceuticals, Inc.* 737 F.Supp. 1117 (D. Idaho 1990).

⁵⁹ *Id.* at 1121.

that chemicals behave similarly in different species.”⁶⁰ The Circuit Court affirmed.⁶¹ Also in 1987, the First Circuit held in *Lynch v. Merrell-Nat'l Labs* that toxicological animal studies were incapable of proving causation without confirming epidemiological studies.⁶²

The D.C. Circuit Court in *Richardson*, in 1988, using FRE 703, held that “Studies of this kind [toxicological animal studies], singly or in combination, are not capable of proving causation in human beings in the face of the overwhelming body of contradictory epidemiological evidence.”⁶³

Several Federal Circuits have addressed the admission of toxicological evidence contradicted by epidemiological studies. The year after *Daubert*, the Sixth Circuit in *Conde v. Velsicol Chem. Corp.* found proffered toxicological animal studies unable to show causation in light of contradictory epidemiological evidence.⁶⁴ The D.C. Circuit, in *Raynor v. Merrell Pharmaceuticals, Inc.*, cited *Richardson*, and used FRE 702 to exclude the expert testimony concerning the toxicological animal studies evidence, finding that it would not “assist the trier of fact to understand the evidence or to determine a fact in issue.”⁶⁵ In *Raynor*, the court found toxicological animal studies inadmissible based solely on the existence of contrary epidemiological evidence, and allowed the admission of the epidemiological studies. Donald Raynor, Jr. and his parents, filed a personal injury claim against Merrell Dow alleging that the anti-nausea drug, Bendectin, had caused his birth defects.⁶⁶ The court concluded that, based on Fed. R. Evid. 702, the plaintiff’s expert testimony was inadmissible, stating that it was

⁶⁰ *In re Agent Orange Product Liab. Litig.*, 611 F.Supp. 1223, 1241 (E.D.N.Y. 1985), *qtg.* Hall & Silbergeld, *Reappraising Epidemiology: A Response to Mr. Dore*, 7 Harv.Envntl.L.Rev. 441, 442-43 (1983).

⁶¹ 818 F2d 187 (2d Cir.1987), cert denied, 487 U.S. 1234, 108 S.Ct. 2898, 101 L.Ed.2d 932 (1988).

⁶² *Lynch v. Merrell-Nat'l Labs*, 830 F2d 1190, 1194 (1st Cir.1987).

⁶³ *Richardson v. Richardson Merrell*, 857 F.2d 823, 830 (D.C. Cir. 1988).

⁶⁴ *Conde v. Velsicol Chem. Corp.*, 24 F3d 809, 813-14 (6th Cir.1994).

⁶⁵ 104 F.3d 1374, 1375-76 (D.C. Cir. 1997).

⁶⁶ *Id.* at 1371.

not methodologically sound to draw inferences from in vitro, chemical structure, and in vivo studies in the presence of contrary epidemiological evidence.⁶⁷

A similar conclusion was reached by the Eleventh Circuit in *Allison*, which stated that expert testimony was inadmissible when the expert failed to explain the correlation of the results of rat studies in which the rats were directly injected with silicone to symptoms in a human patient where the inner lumen of the implants had remained intact.⁶⁸ “Furthermore, [the expert] does not explain why the results of these animal studies should trump more than twenty controlled epidemiological studies of breast implants in humans which have found no valid increased risk of autoimmune disease.”⁶⁹ Thus the Court held that contrary epidemiological studies in fact trump toxicological studies.

In the Federal District Courts’ post-*Daubert* analyses, there has been consistent rejection of toxicological animal studies. The Southern District of West Virginia held in 2002 that toxicological animal studies would be excluded where one contrary epidemiological study existed.⁷⁰ The court decided the expert’s testimony would not “assist the trier of fact to understand the evidence or to determine a fact in issue.”⁷¹

In contrast to the above courts, several courts have opined that toxicological animal studies were not always trumped by epidemiological studies, and could be admitted without epidemiological support, or even in the face of contradictory epidemiological studies.

In the 1994 Third Circuit case *In re Paoli Railroad Yard PCB Litigation* the plaintiffs lived in the vicinity of a railyard where railcars were repaired and PCBs were used for many years.⁷² The plaintiffs sued for physical ailments, as well as for property damage. The Third Circuit reversed in part the District Court opinion, which held that

⁶⁷ *Id.* at 1371.

⁶⁸ *Allison v. McGhan Med. Corp.*, 184 F.3d 1300, 1313-14 (11th Cir. 1999).

⁶⁹ *Id.* at 1314.

⁷⁰ *Bourne ex. rel. Bourne v. E.I. Dupont de Nemours and Co., Inc.*, 189 F.Supp.2d 482 (S.D.W.Va., 2002).

⁷¹ Fed. R. Evid. 702.

⁷² 35 F.3d 717, 732 (3rd Cir. 1994).

the animal studies introduced in the case were “irrelevant”⁷³ under FRE 402, “confusing”⁷⁴ under FRE 403 and “unreliable”⁷⁵ under FRE 702 and 703.⁷⁶ The court distinguished this case from others where animal studies were excluded based on the presence of contrary epidemiological evidence:

[h]ere, where the EPA has relied on animal studies to conclude that PCBs are a probable human carcinogen, where there is reason to think that animal studies are particularly valuable because animals react similarly to humans with respect to the chemical in question, and where the epidemiological data is inconclusive and some of it supports a finding of causation, we think that the district court abused its discretion in excluding the animal studies.⁷⁷

Additionally, even the D.C. Circuit Court in *Raynor* noted that “[o]f course, epidemiological evidence does not always trump nonepidemiological.”⁷⁸

Compare the Ninth Circuit opinion, *Auvil v. CBS 60 minutes*, in which the court upheld summary judgment for CBS against plaintiff apple growers in a defamation suit, where plaintiffs failed to convince the court of the falsity of the allegations of CBS about the dangers of the chemical plant regulator for apples, Alar.⁷⁹ The court opined that

[t]he growers' only challenge to the scientific studies is their claim that animal studies cannot be relied on to indicate cancer risk for humans. Because animal studies can be relied upon, their evidence that no studies have been conducted on the effects of daminozide on humans does not create a genuine issue for trial on the falsity of the broadcast's assertions regarding daminozide's carcinogenicity.⁸⁰

The Tenth Circuit stated in *Norris v. Baxter Healthcare Corp* that

[w]e are not holding that epidemiological studies are always necessary in a toxic tort case. We are simply holding that where there is a large body of contrary epidemiological evidence, it is

⁷³ Fed. R. Evid. 402.

⁷⁴ Fed. R. Evid. 403.

⁷⁵ Fed. R. Evid. 702 and 703.

⁷⁶ *In re Paoli*, 35 F.3d at 741-47, 758-70.

⁷⁷ *Id.* at 734.

⁷⁸ *Raynor v. Merrell Pharm., Inc.* 104 F.3d 1371, 1375 (D.C. Cir. 1997).

⁷⁹ 67 F.3d 816 (9th Cir. 1995).

⁸⁰ 67 F.3d at 82.

necessary to at least address it with evidence that is based on medically reliable and scientifically valid methodology.⁸¹

In a recent case in the Federal District Court for the District of Oregon, *McClellan v. I-Flow Corp.*, the court decided that the “the lack of epidemiological evidence is not fatal to the admission of plaintiffs' experts' testimony.”⁸² “Therefore,” the court held that “while epidemiological evidence is significant and can be helpful, it is not necessary to establish general causation.”⁸³

B. COURTS HAVE DISAGREED IN THE APPLICATION OF DAUBERT CRITERIA AND WHETHER TOXICOLOGICAL ANIMAL STUDIES MET DAUBERT CRITERIA

The D.C. Circuit Court in *Raynor*, explained the application of *Daubert's* criteria to the case:

The Court in *Daubert* directed federal courts first to determine whether the proffered expert's evidence is “scientific knowledge,” which it said required consideration of the following: (1) whether the theory or technique can be (or has been) tested; (2) whether the theory or technique has been subject to peer review and publication; (3) the known or potential rate of error of the methodology; and (4) the general acceptance of the methodology. In addition, the court must conclude that the expert testimony will “assist the trier of fact to understand or determine a fact in issue.”⁸⁴

Here, the court applied what they identify as “factor #2” correctly, when the court is the gatekeeper for peer-reviewed studies:

None of the plaintiffs' experts had published their conclusions regarding Bendectin, nor had their work been subject to peer review (factor # 2). See *Daubert v. Merrell Dow Pharmaceuticals, Inc.*, 43 F.3d 1311, 1317 (9th Cir.1995) (noting that this factor may be particularly important where conclusions have been drawn solely for purpose of litigation: “a scientist's normal workplace is the lab or the field, not the courtroom or the lawyer's office”); cf. *Ambrosini II*, 101 F.3d at 139 (noting concern about risk of “gun for hire” testimony).

⁸¹ 397 F.3d 878, 882 (C.A.10, Colo., 2005).

⁸² 710 F. Supp. 2d 1092, 1108 (D. Or 2010).

⁸³ *Id.* at 1109/

⁸⁴ *Raynor v. Merrell Pharm., Inc.* 104 F.3d 1371, 1375 (D.C. Cir. 1997).

However, the court's consideration of "factor #1" deviates from the intended meaning and use of the Daubert criteria for "testing". The court compared the "testing" required in toxicology to be put to the test and to see if an epidemiological study reveals the same results.⁸⁵ This is an incorrect application of the "testing" factor, which was intended to ascertain that the toxicological study could be capable of repetition, or testing to see that it yields the same results time and time again, as a test of its reliability of method.⁸⁶ This is the meaning of "testing" in the Daubert criteria, and not that applied by the court, to mean a test of its power in another field of study, epidemiology:

The experts' methodology also suffers from "testing" problems (factor # 1). The only way to test whether data from non-human studies can be extrapolated to humans would be to conduct human experiments or to use epidemiological data. In fact, the experts' conclusions have been tested by the latter method and have been found wanting. We do not believe that when the Daubert opinion directed courts to consider whether the "theory or technique...can be (and has been) tested," 509 U.S. at 593, it meant that a "theory or technique" that has been contradicted is on that account more likely to qualify as "scientific knowledge." Rather the reverse.⁸⁷

The court repeats the same error in applying the Daubert criteria in what the court identifies as "factor #3". Here the court uses "rate of error" which is a scientific term of art to describe the reliability of the results of the study⁸⁸, incorrectly. The court attempts to assess the rate of error in toxicological studies by observing whether epidemiological studies yield different results -- ignoring the fact that different questions are being asked in each of these fields of study. Here is the court's erroneous analysis: "Similarly, where

⁸⁵ *Id.*

⁸⁶ *Daubert v. Merrell Dow Pharmaceuticals, Inc.*, 509 U.S. 579, 593 (1993).

⁸⁷ *Raynor*, 104 F.3d at 1375.

⁸⁸ An example of the meaning of a high "rate of error" would be a pregnancy test that gave the wrong answer frequently, (i.e., showing pregnancy when there was no pregnancy) would have a high "rate of error".

sound epidemiological studies produce opposite results from nonepidemiological ones, the rate of error of the latter is likely to be quite high (factor # 3). . . .”⁸⁹

In other courts, correctly applying the Daubert criteria, toxicological studies were still found to be inadmissible. In *Sorensen v. Shaklee Corp.*, the Eight Circuit held that expert witness testimony concerning the application of toxicological studies involving *animals* showing mutagenicity and teratogenicity from *inhalation* of ETO, to show that *human ingestion* of ETO or ECH caused mental retardation in offspring, was not admissible. It had not been tested, subjected to peer review or publication, and no evidence of its general acceptance has been offered.⁹⁰

However, in a Third Circuit case in 1994, one year after *Daubert*, an opposite conclusion was reached in *In re Paoli*, where the court stated “[w]e therefore hold that the animal studies pass *Daubert* muster, are admissible, and are one source by which plaintiffs can prove the harmful effects of PCBs.”⁹¹

C. THE TOXICOLOGICAL ANIMAL STUDIES DID NOT MEET THE *DAUBERT* CRITERIA FOR “FIT” WHICH GOES TO RELIABILITY IN FRE 702.

The year following *Daubert*, the Third Circuit established that it was the court, and not the expert who would determine whether testimony was admissible, based upon its “fit” or reliability, in *In Re Paoli*. The court opined that

expert testimony that uses animal studies must, to be admissible for the purpose of drawing conclusions about humans, meet Rule 702's requirement of “fit.” This requires the court to assess whether there are good grounds for concluding that the animal studies demonstrate causation in humans. But for an expert to rely on animal studies (if their admissibility in evidence is not independently established), these studies must also meet the requirements of Rule 703—the conclusions of these studies must be data which must be of a type reasonably relied upon by experts to analyze causation in humans.⁹²

The Federal District Courts have also used *Daubert* criteria to exclude animal studies. The Western District of Pennsylvania in 2005 held in *Wicker v. Consol. Rail*

⁸⁹ 104 F.3d at 1375.

⁹⁰ 31 F.3d 638, 645 (1994).

⁹¹ *In re Paoli*, 35 F3d 717, 781 (3rd Cir. 1994).

⁹² *Id.* at 748.

Corp., that the toxicological animal studies must “fit” to meet the requirement of Rule 702 for reliability.⁹³

D. DISMISSING TOXICOLOGICAL ANIMAL STUDIES AS INVALID AND UNRELIABLE BASED ON FRE 702 AND 703 FOR PROVING CAUSATION.

FRE 703 requires that the expert rely on facts and data “of a type reasonably relied upon by experts in the particular field in forming opinions or inferences upon the subject,”⁹⁴ that underlie his testimony. In 1988, the D.C. Circuit Court in *Richardson* held based on FRE 703 that toxicology animal studies were excluded and cannot prove causation where epidemiological studies disagree, holding that “[S]tudies of this kind, singly or in combination, are not capable of proving causation in human beings in the face of the overwhelming body of contradictory epidemiological evidence.”⁹⁵

Then in 1997, the U.S. Supreme Court in *General Electric Co. v. Joiner*, raised the question of whether toxicological animal studies could ever be relied upon as scientific evidence, when they opined that they would not consider that question, leaving open the possibility that toxicological evidence might possibly *never* be relied upon.⁹⁶

In another interesting district court case from the District of Vermont in 1990, a claim was made for toxicological damage to the plaintiff’s cattle. The court in *Graham v. Canadian National Railway Co.*, did not rule on the admissibility of animal toxicological data from the actual cattle which was basis of the claim in the case; but found the case to fail on proximate cause, although veterinary studies of the farm animals indicated their symptoms were consistent with the herbicides sprayed near the residence of the plaintiffs.⁹⁷ This case seems to suggest that the science of toxicology was so discredited, as to be discounted when the subject of the case was animals, not humans; and no epidemiological data was needed.

However, establishing that toxicological animal studies are useful to the court where no epidemiological studies can be conducted the District of Oregon in 2010, in *McClellan v. I-Flow Corp.*, recognized that “ethical considerations preclude randomized,

⁹³ 371 F. Supp. 2d 702, 710-711.

⁹⁴ Fed. R. Evid. 703

⁹⁵ *Richardson*, 857 F2d at 830.

⁹⁶ 522 U.S. 136, 144 (1997).

⁹⁷ 749 F.Supp. 1300 (1990).

controlled epidemiological studies of continuous infusion given the potential for irreversible harm. Therefore, while epidemiological evidence is significant and can be helpful, it is not necessary to establish general causation.”⁹⁸

E. COURTS DIFFERED IN THEIR TREATMENT OF THE EXTRAPOLATION FACTOR IN TOXICOLOGICAL ANIMAL STUDIES

The Fifth Circuit in *Allen v. Pennsylvania Eng'g Corp.*, in 1996 opined that, “[w]e are also unpersuaded that the ‘weight of the evidence’ methodology these experts use is scientifically acceptable for demonstrating a medical link between Allen's EtO exposure and brain cancer.”⁹⁹

In *Allen*, the court notes that

experts rely on two studies that found brain tumors in F-344 rats exposed to inhaled EtO [Ethylene Oxide], and on other animal studies that have found EtO-associated increases in the rodents' various solid and hematopoietic cancers...although in these particular studies, F-344 rats contracted brain cancer after being exposed to EtO, Allen's experts concede that the same effect did not occur in mice studies. As an expert for appellee concludes: “Thus, the lack of capacity for the F-344 rat to predict how even the mouse model responds necessarily undercuts confidence that the rat will predict accurately how other species including humans will respond [to EtO exposure].” Reliance on these animal studies furnishes at best speculative support for appellants' causation theory.¹⁰⁰

In the Federal District courts, in 1994, in *Wade-Greaux v. Whitehall Laboratories No.*,¹⁰¹ the plaintiff's expert based her testimony on chick embryo studies.¹⁰² The court noted that the embryo study was used to mimic human fetus exposure.¹⁰³ “Such chick embryo studies are an in vitro, not an in vivo, animal model, and do not replicate a mammalian, let alone human exposure.”¹⁰⁴

⁹⁸ 710 F. Supp. 2d 1092, 1109.

⁹⁹ *Allen v. Pennsylvania Eng'g Corp.*, 102 F.3d 194, 198 (5th Cir. 1996).

¹⁰⁰ *Id.* at 198.

¹⁰¹ *Wade-Greaux v. Whitehall Laboratories*, 874 F.Supp. 1441 (D.V.I., 1994).

¹⁰² *Id.* at 1456.

¹⁰³ *Id.*

¹⁰⁴ *Id.* at 1457.

The most dismissive view of toxicological evidence utilizing extrapolation was expressed in a Michigan state court, where the court ruled in *Nelson v. American Sterilizer Co.*,¹⁰⁵ that it is "scientifically invalid to extrapolate observations in animal experiments directly to human beings to determine human outcomes, in part, in light of the recognized biological fact that some agents may cause disease occurrence in one species and not in another."¹⁰⁶

In a different result in considering the extrapolation factor, the Southern District of New York, Federal District Court in *In re Ephedra Products Liability Litigation*, opined that "analogy, inference and extrapolation can be sufficiently reliable" when the expert's opinion is the kind that a reasonable scientist or physician would make in a decision of importance arising in the exercise of his profession outside the context of litigation."¹⁰⁷

F. OTHER REASONS FOR NOT ADMITTING OR ADMITTING TOXICOLOGICAL ANIMAL STUDIES.

Courts have referred to the use of toxicological animal studies by the U.S. Environmental Protection Agency as a basis for reliance on them. The Third Circuit relied on the U.S. Environmental Protection Agency's reliance on animal studies for assessing the toxicity of PCBs *In Re Paoli* in 1994:

Here, where the EPA has relied on animal studies to conclude that PCBs are a probable human carcinogen, where there is reason to think that animal studies are particularly valuable because animals react similarly to humans with respect to the chemical in question, and where the epidemiological data is inconclusive and some of it supports a finding of causation, we think that the district court abused its discretion in excluding the animal studies.¹⁰⁸

The opposite conclusion was reached in a Federal District Court, Southern District of West Virginia, in 2002, in *Bourne v. E.I. Dupont de Nemours & Company, Inc.*,¹⁰⁹ where the court held that the mere fact that the Environmental Protection Agency had relied on

¹⁰⁵ 223 Mich. App. 485 (1997).

¹⁰⁶ *Id.* at 494-95.

¹⁰⁷ *McClellan v. I-Flow Corp.*, quoting *In re Ephedra*, 393 F.Supp.2d 181, at 189 (S.D.N.Y. 2005).

¹⁰⁸ *In re Paoli R.R. Yard PCB Litigation*, 35 F.3d 717, 781 (3rd Cir.1994).

¹⁰⁹ *Bourne ex. rel. Bourne v. E.I. Dupont de Nemours and Co., Inc.*, 189 F.Supp.2d 482, 500 (S.D.W.Va., 2002).

toxicological animal studies was not sufficient to establish causation, and therefore was not a reason for admitting the animal studies.

G. DISMISSING TOXICOLOGICAL ANIMAL STUDIES BECAUSE THEY WERE UNDULY PREJUDICIAL TO THE JURY.

In one of the more astonishing exclusions of toxicological animal studies by a court, the Pennsylvania Superior Court in *Pauley v. Bayer Corp.*,¹¹⁰ in 2009 upheld the exclusion of toxicological animal studies in part because,

the data from the animal studies were highly prejudicial in light of the strong tendency to evoke the jury's natural sympathy for animals. Absent an offer of proof as to the probative value of the data from the animal studies, combined with the unduly prejudicial nature of the proposed evidence, we conclude Appellant's final claim fails.¹¹¹

VI. CONCLUSION AND RECOMMENDATION

Toxicological animal studies, have been treated disparately in different courtrooms, with regard to some of the basic concepts in the science of toxicology. Courts' rejection of toxicological animal studies has occurred most often where epidemiological studies are contradictory, but also frequently where epidemiological studies are absent or incomplete. Here, the court may find the toxicological evidence to be "irrelevant" under FRE 402, "confusing" under FRE 403 and "unreliable" under FREs 702 and 703.

In reaching these determinations the courts have applied the *Daubert* criteria with divided results. One court applied the criteria erroneously by using the science of epidemiology to test the science of toxicology.

The FRE 403 determination of inadmissibility due to confusion can be addressed sufficiently by clearly addressing the limitations of animal studies. Extrapolation from animals to humans is the most commonly cited weakness in epidemiological studies, yet the courts do not address similar but different weaknesses inherent in epidemiological studies. Using the reliance of the U.S Environmental Protection Agency

¹¹⁰ *Pauley v. Bayer Corp.*, A.2d, 2009 WL 1654592 (Pa.Super.) (I.O.P.65) Non-Precedential Decision.

¹¹¹ *Pauley v. Bayer Corp.*, A.2d, 2009 WL 1654592 at *12 (Pa.Super.) (I.O.P.65) Non-Precedential Decision.

as a basis for admission of toxicological animal studies has also produced divided results.

Toxicology and epidemiology are both recognized, established fields of study with well-established scientific methodologies. Courts should recognize both the value and limitations of both fields without relying more on one form of scientific evidence than another, without a solid scientific basis for doing so, as has become the practice in some jurisdictions.

The last time that the U.S. Supreme Court considered the admission of toxicological and epidemiological evidence was in the landmark case, *General Electric v. Joiner* in 1993, eighteen years ago. The consideration of the admission of toxicological animal studies and epidemiological studies and the criteria used to do so, would be a welcome development in scientific evidence, should the United States Supreme Court decide to accept such a case when presented to it for review.

