Mary E. GREEN and Michael B. Green, Individually and as Parents, Next Friends and Natural Guardians of Michael Green During his Minority; and Michael Green, Individually *v.* ALPHARMA, INC.; Alpharma Animal Health Co.; George's Farms, Inc.; Peterson Farms, Inc.; Simmons Foods, Inc.; Simmons Poultry Farms, Inc.; and Tyson Foods, Inc.

07-382 284 S.W.3d 29

Supreme Court of Arkansas
Opinion delivered May 8, 2008

[Rehearing denied June 19, 2008.]

1. TORTS — APPLICATION AND EXTENSION OF *CHAVERS v. GENERAL MOTORS CORP.* — Although the supreme court adopted the *Chavers* test in an asbestos case, the court applied it to this toxic-tort case where the exposure involved a product other than asbestos; and the court extended the proximity prong to appellant's exposure to the product while at home or at school due to appellant's age during his exposure.
2. TORTS — EVIDENCE WAS SUFFICIENT TO SATISFY REQUIREMENTS OF *CHAVERS.* — Based upon its analysis of the *Chavers* test, the supreme court held that, in meeting proof with proof, the appellants submitted sufficient evidence to satisfy the *Chavers* requirements of (1) exposure, (2) frequency and regularity, (3) proximity, and (4) causation; viewing the first three prongs of the *Chavers* test in the light most favorable to the appellants, the court concluded that the appellants had satisfied the fourth prong by showing that the poultry-producers' chicken litter probably caused appellant's injury.

3. TORTS — SUMMARY JUDGMENT — GENUINE ISSUE OF MATERIAL FACT EXISTED ON THE ISSUE OF CAUSATION. — The circuit court erred in granting summary judgment; while the circuit court correctly announced the factors of the *Chavers* test, the circuit court failed to apply that test to the case *sub judice* either in its bench ruling or its order; in its review of the circuit court's grant of summary judgment, the supreme court noted that summary judgment was not designed for assessing the probative strength of conflicting proof or expert opinions; rather, that process is correctly done by the trier of fact after a trial on the merits; in applying the *Chavers* test, the supreme court held that the appellants demonstrated that there was a genuine issue of material fact on the issue of causation; accordingly, the court reversed the circuit court's grant of summary judgment in favor of the poultry producers and remanded the case for trial.

4. EVIDENCE — EXCLUSION OF EXPERT TESTIMONY — STANDARD OF REVIEW. — Following the well-established case law, the supreme court reviewed the exclusion of expert testimony under an abuse-of-discretion standard, rather than de novo.

5. EVIDENCE — EXPERT TESTIMONY — EXPERT'S THEORY HAD NEVER BEEN TESTED. — A primary factor for a trial court to consider in determining the admissibility of scientific evidence is whether the scientific theory can be or had been tested; based on the admissions of the appellants' expert, the supreme court agreed with the circuit court's finding that the expert's theory of using variables found in the lead formula to calculate arsenic levels had never been tested, and therefore did not meet a key consideration for admissibility as set out in *Daubert v. Merrell Dow Pharmaceuticals, Inc.*

6. EVIDENCE — EXPERT TESTIMONY — EXPERT'S THEORY HAD NOT BEEN SUBJECTED TO PEER REVIEW. — Another pertinent consideration in determining whether a theory or technique is scientific knowledge that will assist the trier of fact is whether the theory or technique has been subjected to peer review and publication; although the expert in this case stated that his "methods in this particular case have been peer reviewed and published," the study did not discuss the "inhalation exposure reconstruction" of Table 9 in his report.

7. EVIDENCE — EXPERT TESTIMONY — POTENTIAL ERROR RATE WAS NOT SHOWN. — Another factor to consider when reviewing a particular scientific technique is the known or potential rate of error;

here, the circuit court found that the potential error rate of the expert witness had not been shown, and the supreme court found nothing to refute that finding.

8. EVIDENCE — EXPERT TESTIMONY — EXPERT'S METHOD HAD BEEN CRITICIZED. — With regard to the existence and maintenance of standards factor, the circuit court noted in its ruling that the method used by appellants' expert in computing the average dust concentration for arsenic in the homes had been "severely criticized"; there was testimony from other experts to show that the method of appellant's expert in computing the average dust concentration for arsenic had been criticized.

9. EVIDENCE — EXPERT TESTIMONY — EXPERT'S FORMULA HAD NOT BEEN GENERALLY ACCEPTED WITHIN THE SCIENTIFIC COMMUNITY. — General acceptance within the scientific community can also have a bearing on the inquiry of the admissibility of expert testimony; in the present case, the circuit court found that the scientific community had not generally accepted the formula of the appellants' expert, and the supreme court found no evidence that the expert's use of the EPA formula to calculate arsenic levels has been generally accepted by the scientific community; because the EPA has only used the formula to determine lead levels, it could not be said that appellants' expert's use of the formula to determine arsenic levels has been generally accepted by the scientific community.

10. EVIDENCE — EXPERT TESTIMONY — LIMITATION OF. — Because the appellants' expert witness considered dust samples from the school to be unreliable, he tested nearby homes and used those homes to compute arsenic levels in the schools; the supreme court held that allowing the expert to take samples from the homes and present them as school samples would grossly mislead the jury, and the circuit court did not abuse its discretion in limiting that testimony.

11. EVIDENCE — EXPERT TESTIMONY — EXPERT GAVE OPINION ON DOSE CALCULATION — NO ABUSE OF DISCRETION. — Where one of appellants' experts testified at trial that the arsenic dust levels found in the filters of appellants' home constituted a dose; and at the close of the appellants' case, the circuit court acknowledged that there was testimony by the expert that the arsenic dust levels were sufficient to cause leukemia and partly relied on this testimony in denying appellee Alpharma's motion for directed verdict, the supreme court held that the circuit court did not abuse its discretion in excluding

certain data, and because the expert was not precluded from offering a dose opinion, and it affirmed the circuit court's ruling on that point.

Appeal from Washington Circuit Court; *Kim Smith*, Judge; affirmed in part; reversed and remanded in part.

Lundy & Davis, LLP (Lake Charles, LA), by: *Hunter W. Lundy*, *Clayton A.L. Davis*, and *Keith Prudhomme*; and *Lundy & Davis* (Fayetteville, AR), by: *Jason M. Hatfield*, for appellants.

Shook, Hardy & Bacon, LLP, by: *Robert T. Adams*, *John S. Johnston*, and *Steven D. Soden*; and *Taylor Law Firm*, by: *Timothy Brooks*, for appellees Alpharma Inc. and Alpharma Animal Health.

Bassett Law Firm, LLP, by: *Gary V. Weeks*, *Vincent O. Chadick*, and *Paul E. Thompson*, for appellees George's Farms, Inc., and George's Processing, Inc.

Mitchell, Williams, Selig, Gates & Woodyard, PLLC, by: *Sherry P. Bartley*; and *McDaniel, Hixon, Longwell & Acord, PLLC*, by: *A. Scott McDaniel*, for appellee Peterson Farms, Inc.

Conner & Winters, LLP, by: *Vicki Bronson*, for appellees Simmons Foods, Inc. and Simmons Poultry Farms, Inc.

Kutak Rock LLP, by: *Robert W. George* and *Michael R. Bond*, for appellee Tyson Foods, Inc.

JIM GUNTER, Justice. This appeal arises from an order of the Washington County Circuit Court granting summary judgment in favor of Appellees George's Farms, Inc.; George's Processing, Inc. (collectively "George"); Simmons Foods, Inc.; Simmons Poultry Farms, Inc. (collectively "Simmons"); Peterson Farms, Inc. ("Peterson"); and Tyson Foods, Inc. ("Tyson"). The circuit court denied summary judgment in favor of Appellees Alpharma, Inc. and Alpharma Animal Health Co. (collectively "Alpharma"), and the case proceeded to trial. On appeal, Appellants Mary E. Green and Michael B. Green, individually and as parents, next friends, and natural guardians of Michael Green during his minority (collectively "the Greens"), and Michael Green individually ("Green"), argue that the circuit court erred in granting summary judgment to the poultry-

company appellees ("the poultry producers") and in limiting and excluding doctors' testimony at trial. We reverse the circuit court's grant of summary judgment and remand for trial as to the poultry producers. We affirm the circuit court's rulings on the exclusion of expert testimony.

Michael "Blu" Green, a lifelong resident of Prairie Grove, lived with his mother and father, Mary and Michael Green, Sr., in their family residence located about one block from the Prairie Grove schools where Green attended from 1991 to 2003. In the fall of 1999, Green was diagnosed with a rare form of leukemia known as chronic myelogenous leukemia. In April 2000, Green received a bone-marrow transplant in Seattle, Washington. Following a sixty-day hospital stay plus follow-up care in Seattle, Green administered his medication through a shunt with a direct line to his heart for two years. While in remission, he suffers permanent side effects, including cataracts, nail- and hair-growth problems, sterility, and an increased risk of skin cancers.

Since 1991, Appellee Alpharma has sold the animal-feed additive, 3-Nitro 20 ("3-Nitro"), which contains twenty-percent of the active ingredient, roxarsone, an organic arsenical compound. 3-Nitro is said to improve growth efficiency and to prevent certain intestinal diseases in chickens. The 3-Nitro label warns that it is poisonous, toxic, and the dust should not be inhaled.

The poultry producers have purchased and used 3-Nitro as an additive in their chicken feed over the past few decades. The arsenic contained in 3-Nitro then passes through the chickens into the litter. In the litter, the arsenic breaks down into a more toxic, inorganic arsenic. The poultry producers require their growers to clean out caked litter after each flock is removed. According to deposition testimony, the caked litter, which contains the inorganic arsenical compound, causes noxious odors and harbors viruses, bacteria, and fungi. As a part of their normal husbandry practices in raising chickens, the growers clean out the houses and spread the dry chicken litter as fertilizer on fields in and around Prairie Grove. According to the spreaders, as well as Prairie Grove residents, the spreading process caused dust clouds around Prairie Grove.

On December 16, 2003, the Greens and other named plaintiffs ("the plaintiffs") filed a complaint against Alpharma, Cal-Maine Farms, Inc., Cargill, Inc., George, Peterson, Simmons,

and Tyson, alleging that the arsenic-laden chicken litter, which was produced by their 3-Nitro-fed chickens, polluted the air surrounding Prairie Grove and infiltrated their homes, schools, and places of business, thereby causing Green's leukemia and the other plaintiffs' injuries.[1] Specifically, the plaintiffs alleged that they had "been exposed to the byproducts of the poultry industry while living in Washington County, Arkansas, including but not limited to, chicken waste, known as litter, through the air, soil, and water," and that "[s]uch exposures led and/or contributed to the plaintiff's injuries and damages," including a high risk of cancer from the level of exposure to the chicken-litter pathogens, causing a "cancer cluster" in and around Prairie Grove. In their complaint, they alleged the following counts: (1) negligence, (2) negligence per se, (3) intentional failure to warn, concealment, and/or misconduct, and (4) strict liability/product liability. They sought injunctive relief, compensatory damages, and punitive damages.

Motions for summary judgment were filed by separate appellees. On January 25, 2006, Tyson filed a motion for summary judgment, arguing that there was no genuine issue of material fact as to the causation requirement or Tyson's liability. Tyson further claimed that "[t]he medical conditions involved in this case [were] not the type of conditions for which the scientific community has recognized a causal connection with poultry litter and/or arsenic." Tyson claimed that the plaintiffs' exposure to the trace amounts of arsenic could not have proximately caused their injuries. Simmons filed a similar summary-judgment motion on January 30, 2006, claiming that the plaintiffs could not meet their burden of proof of causation against Simmons. On January 31, 2006, Peterson filed its separate motion for summary judgment and argued inter alia that the plaintiffs failed to produce evidence that their injuries were caused by the poultry-litter substances and that the plaintiffs admitted their inability to produce evidence that Peterson's acts were the specific cause of injuries occurring prior to Peterson's first poultry contract in Washington County in 2002. On February 2,

[1] The circuit court granted Alpharma's and the poultry producers' motions to sever the claims arising from the injuries to the eleven plaintiffs on January 19, 2006, stating that the individual plaintiffs' claims were "improperly joined and [did] not meet the standard for permissive joinder set forth in Arkansas Rule of Civil Procedure 20(a)." The other claims are still pending in Washington County Circuit Court.

2006, George filed its motion for summary judgment, adopting Tyson's argument set forth in Tyson's motion for summary judgment.

The Greens and the other plaintiffs filed their separate responses to the poultry producers' motions for summary judgment on February 17, 2006, claiming that there were remaining issues of fact relevant to Alpharma and the poultry producers' liability. In support of their response, they offered sixty-one exhibits, which consisted of deposition testimony primarily from growers and spreaders in the area. Citing various depositions, the Greens claimed that George had used roxarsone since 1958; Peterson had used 3-Nitro since 1981; Simmons had used roxarsone since 1985; and Tyson admitted to using roxarsone since the 1970s. On August 2, 2006, the circuit court granted summary judgment in favor of the poultry producers and denied a motion for summary judgment filed by Alpharma.

On March 14, 2006, Alpharma and the poultry producers filed a *Daubert* motion to exclude the trial testimony of Dr. Rod O'Connor regarding the "alleged environmental conditions in the Prairie Grove area, the alleged contamination of certain properties with arsenic, the alleged source of the arsenic[,] and the alleged exposures of plaintiffs to arsenic in air or house dust." On March 16, 2006, Alpharma and the poultry producers filed a motion to exclude the testimony of Dr. William Sawyer, particularly those opinions relating to his calculations of the plaintiffs' arsenic ingestion, any corresponding cancer risks, and causation.

On April 4, 2006, the circuit court held a hearing on the issue of the Dr. O'Connor *Daubert* motion. On June 19, 2006, the court announced its *Daubert* rulings from the bench. In an order filed on August 2, 2006, the circuit court, in considering numerous motions in limine to exclude limited portions of opinions and testimony of Dr. Rod O'Connor, Dr. Sawyer, Dr. James Dahlgren, and Dr. Michael Wolfson, excluded both Table 9 and the opinions of Dr. O'Connor and any other expert regarding Table 9 of his August 25, 2005 report, which discussed the arsenic levels in the dust and air to which the plaintiffs were allegedly exposed. The circuit court also excluded the opinions of Dr. O'Connor and any other expert concerning the level of arsenic present in the Prairie Grove schools. The court reasoned that, in either instance, Dr. O'Connor's methodology did not meet the standards set forth in *Daubert v. Merrell Dow Pharmaceuticals, Inc.*, 509 U.S. 579 (1993), *Farm Bureau Mutual Insurance Co. v. Foote*, 341 Ark. 105, 14 S.W.3d

512 (2000), or Ark. R. Evid. 702 (2007). The court further excluded the expert opinions and testimony of Dr. Sawyer regarding the issues of Table 9 and the arsenic levels at the Prairie Grove schools. Finally, the circuit court excluded the opinion and testimony of Dr. Dahlgren and Dr. Wolfson with respect to Table 9, as well as the arsenic levels at the Prairie Grove schools.

On August 2, 2006, the circuit court held a hearing on the poultry producers' separate motions for summary judgment. At the end of the hearing, the circuit court ruled:

> The burden is on the plaintiff to prove that the exposure of the plaintiff to the product applied was a substantial factor applied by a specific defendant.... [U]nfortunately for the plaintiffs in this case, Arkansas has not adopted the market share theory of liability, but has retained the traditional requirement of proximate cause to each defendant. I understand that's a difficult proposition sometimes, but that still doesn't mean that's not what the law requires. As I read the law the best I can, each plaintiff must prove that each defendant's product was a substantial factor in causing their particular disease.
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> [T]his court is bound by the law that requires that proof and exposure of a particular defendant's litter be proven and not just speculated that, well, it must have been because they were the ones doing a lot of it by the school. Therefore, on that basis, concerning the poultry companies, this court is going to grant summary judgment on the poultry companies only, and it's going to be denied as to the separate defendant, Alpharma, who was the supplier of the Roxarsone for many of the years. The plaintiff's objection to my ruling as to the poultry companies will be noted, and also Alpharma's objection to my ruling that their motion for summary judgment will be rejected as I said.

The circuit court granted the poultry producers' motion for summary judgment and dismissed those parties from the case. The case proceeded to trial by jury in Washington County Circuit Court over the course of three weeks. On September 26, 2006, the jury found in favor of Alpharma, and the circuit court entered a judgment reflecting the jury's verdict on September 28, 2006.

The Greens filed a timely notice of appeal on October 13, 2006, and an amended notice of appeal on October 24, 2006. On February 8, 2007, the circuit court entered an amended judgment

to reflect the Rule 54(b) certification. The Greens filed a third notice of appeal on March 9, 2007, appealing the circuit court's September 28, 2006, and February 8, 2007, judgments. From these orders, the Greens bring the present appeal.

I. Summary judgment

For their first point on appeal, the Greens argue that the circuit court erred in granting summary judgment in favor of the poultry producers. Specifically, the Greens contend that the circuit court misapplied the doctrine of joint-and-several liability, which is the controlling legal standard for proximate cause in cases involving joint tortfeasors. Citing *Chavers v. General Motors Corp.*, 349 Ark. 550, 79 S.W.3d 361 (2002), they assert that they produced ample evidence to meet the "frequency, regularity, and proximity" test to show exposure to chicken litter. They argue that "Blu Green met the burden of showing that each poultry defendant's conduct constituted a substantial factor in causing his injuries by showing the frequency, regularity, and proximity of and to the exposure."

In response, the poultry producers argue that the circuit court properly granted summary judgment to George, Peterson, Simmons, and Tyson. Specifically, they contend that the circuit court's award of summary judgment should be affirmed based upon the Greens' failure to demonstrate a question of material fact on the issue of proximate causation—that the constitution of the chicken litter was the proximate cause of Green's injuries.

The issue then is whether the circuit court erred in granting summary judgment in favor of the poultry producers. Summary judgment is to be granted by a circuit court only when it is clear that there are no genuine issues of material fact to be litigated, and the party is entitled to judgment as a matter of law. *Bennett v. Spaight*, 372 Ark.446, 277 S.W.3d 182 (2008). Once the moving party has established a prima facie entitlement to summary judgment, the opposing party must meet proof with proof and demonstrate the existence of a material issue of fact. *See id.* On appellate review, we determine if summary judgment was appropriate based on whether the evidentiary items presented by the moving party in support of the motion leave a material fact unanswered. *See id.* We view the evidence in a light most favorable to the party against whom the motion was filed, resolving all doubts and inferences

against the moving party. *See id.* Our review focuses not only on the pleadings, but also on the affidavits and other documents filed by the parties. *See id.*[2]

A. The Chavers *test and the applicable law*

The Greens cite *Chavers*, *supra*, for the proposition that the circuit court erred in finding that they did not satisfy the "frequency, regularity, and proximity" test. In *Chavers*, an asbestos case, the widow of Chavers, a "shade tree" mechanic, filed a wrongful-death action against the manufacturers and distributors of asbestos-containing friction products. The decedent's deposition testimony revealed that he had on-the-job exposure to asbestos four times before using the products at issue. We described the "frequency, regularity, and proximity" test as having its origins in *Lohrmann v. Pittsburgh Corning Corp.*, 782 F.2d 1156 (4th Cir. 1986), and stated:

> There [in *Lohrmann*], the appellants appealed a district court's grant of directed verdicts in favor of the manufacturers of asbestos-containing products. The appellants requested that the court adopt a rule that would find a jury question had been established as to whether that product contributed to the plaintiff's disease where the plaintiffs present any evidence that a company's asbestos-containing product was at the workplace while the plaintiff was at the workplace. In declining to adopt such a broad standard, the Fourth Circuit noted that such a standard would be contrary to Maryland's law on substantial causation. Instead, the court adopted the district court's enunciated standard: "Whether a plaintiff could successfully get to the jury or defeat a motion for summary judgment under such a theory would depend upon the frequency of the use of the product and the regularity or extent of the plaintiff's employment in proximity thereto." *Id.* at 1162. The *Lohrmann* court further noted

[2] Citing *Rodgers v. City of Des Moines*, 435 F.3d 904, 908 (8th Cir. 2006), Tyson argues in its brief that appellants make "broad references to the sprawling record," thereby forcing our court to "guess as to the evidence" that creates a genuine issue of material fact. Tyson's argument is misplaced for the following reasons. First, the Greens, in their motion in response to summary judgment, make specific references to the exhibits in their brief in support and provide a list of deposition testimony and exhibits which they produced in response to the poultry producers' motions. Second, under our standard of review, we conduct a review of the pleadings, affidavits, and "other documents filed by the parties." *Bennett*, *supra*.

> that such a rule was in effect a *de minimis* rule in that a plaintiff is required to prove more than a casual or minimal contact with the product.

Chavers, 349 Ark. at 559-60, 79 S.W.3d at 367-68.

We further cited *Jackson v. Anchor Packing Co.*, 994 F.2d 1295 (8th Cir.1993), where the Eighth Circuit Court of Appeals, in reviewing a grant of summary judgment, affirmed the district court and stated:

> [P]laintiffs in Arkansas must introduce sufficient evidence to allow a jury to find that *more likely than not their exposure to a particular defendant's product was a substantial factor in producing their injuries*. . . . Consequently, to survive a motion for summary judgment under Arkansas law, an asbestos plaintiff must show that the defendant's asbestos products were used with sufficient frequency and regularity in locations from which asbestos fibers could have traveled to the plaintiff's work areas that it is probable that the exposure to the defendant's asbestos products caused the plaintiff's injuries.

Id. at 1303 (emphasis added). In *Jackson*, the Eighth Circuit determined that the plaintiff's expert's affidavit regarding the asbestos exposure was conclusory and did not provide a basis for denying summary judgment. *Chavers*, 349 Ark. at 561, 79 S.W.3d at 368.

Citing these two cases, we adopted the *Chavers* test, often called the "frequency, regularity, and proximity" test, and stated:

> Under this test, to survive a motion for summary judgment, Appellant was required to prove the following elements: (1) Mr. Chavers was *exposed* to a particular asbestos-containing product made by Appellees, (2) with sufficient *frequency and regularity*, (3) in proximity to where he actually worked, (4) such that it is probable that the exposure to Appellees' products *caused* Mr. Chavers's injuries.

Chavers, 349 Ark. at 562, 79 S.W.3d at 369 (citation omitted) (emphasis added). We held that the estate could not recover against two manufacturers because there was no evidence that the mechanic had used the products, and we further held that Chavers did not meet his burden of proof because there was insufficient evidence to satisfy the "frequency and regularity" requirement by his one-time exposure to the asbestos-containing product. *Id.* at 562-64, 79 S.W.3d at 369-70.

B. Analysis of the Chavers *test*

[1] We now turn to the present case to determine whether the circuit court should have awarded summary judgment to the poultry producers. At the outset, we note that we adopted the *Chavers* test in an asbestos case, but we apply it to this toxic-tort case where the exposure involved a product other than asbestos. *See, e.g., James v. Bessemer Processing Co., Inc.*, 714 A.2d 898 (N.J. 1998) (applying frequency, regularity, and proximity test to exposure to benzene). Under the *Chavers* test, the Greens were required to prove that: (1) Green was *exposed* to the arsenic-laced chicken litter spread by the poultry producers, (2) with sufficient *frequency and regularity*, (3) in *proximity* to where he actually worked (or, in this case, where he lived and went to school), (4) such that it is probable that the exposure to the arsenic-laced chicken litter *caused* Green's injuries. We will analyze each *Chavers* element separately by reviewing only that proof which was properly before the circuit court at the summary-judgment phase of the litigation. We further note that, in meeting proof with proof, the Greens submitted to the circuit court sixty-one exhibits attached to their response to the poultry producers' motions for summary judgment.[3]

1. Exposure

Under the first prong of the *Chavers* test, the Greens were to provide evidence of Green's exposure to the arsenic-laced chicken litter. Specifically, in opposition to the poultry producers' motions for summary judgment, the Greens submitted the following affidavits and deposition testimony to support the exposure prong of the *Chavers* test. The Greens included the affidavit of Dr. Rod O'Connor in which he opined that "arsenic in Plaintiffs' homes [including the Greens' home] originat[ing] from poultry operations is evidenced by the finding of roxarsone" and that "sufficient information has been obtained from poultry litter spreaders, landowners, growers, and persons in the area to establish a reasonable degree of scientific certainty that poultry litter from [Tyson, Simmons, George, and Peterson] was frequently and regularly applied, over a period of at least twenty years, at locations in such a manner as to harmfully impact Plaintiffs." Attached to the

[3] In our analysis, we do not consider, as the Greens suggest in their brief, the testimony, such as any trial testimony, made after the summary-judgment hearing.

affidavit was a table of the sampled homes with peak arsenic concentrations in dusts above 10 parts per million ("ppm"). The Greens' home included 66.9 ppm of arsenic found in the house dust. Les Childress produced as an exhibit certain studies performed in 1963, which revealed that a maximum dose of 50 ppm killed half a dog population in less than three days.

Additionally, Dr. Devraj Sharma, a scientist and engineer with thirty-four years of experience, demonstrated "proper scientific methods" of "how Plaintiffs in this matter were routinely and regularly exposed to arsenic from Roxarsone that was used and discharged by Defendants." Specifically, Dr. Sharma "establishe[d] facts concerning the longevity, durations, frequency and regularity of Plaintiffs' exposures at locations that [were] in close proximity to areas where arsenic from Roxarsone was regularly discharged into the atmosphere by the practice of spreading of poultry-litter." Dr. Sharma further established that "very significant quantities of poultry manure containing Roxarsone from poultry houses operated on behalf of [Tyson, George, Simmons, and Peterson] were generated in the vicinity of Prairie Grove, and applied to farm lands in the same vicinity." In conclusion, Dr. Sharma claimed that he demonstrated the exposure of Green and other plaintiffs "to arsenic result from the poultry growing operations conducted by Defendants Tyson, Simmons, George's and Peterson and by the poultry litter spreading operations conducted on their behalf in the vicinity of Prairie Grove at locations where Plaintiffs in this matter were regularly and frequently exposed."

With regard to exposure, Tyson argues in its brief that (1) if defendants' products were used in the general vicinity of a large area, then plaintiff's presence may be deemed as "insufficient evidence of exposure to withstand summary judgment"; and (2) expert testimony cannot contain "broad and conclusory allegations" or that testimony would be insufficient to raise a general issue of material fact. *See McDonald v. Eubanks*, 292 Ark. 533, 731 S.W.2d 769 (1987). Tyson's argument fails to apply to the present case. Here, Dr. O'Connor's testimony regarding the level of Green's exposure was based upon his samplings, his exposure-reconstruction methodology, and his research of the appropriate literature. Dr. Sharma's testimony was based upon his "scientific investigations of data," reports, and "analyses of data." We have held that the affidavit of an expert, introduced in response to a motion for summary judgment, demonstrates the existence of a

material question of fact. *Benton County v. Overland Dev. Co., Inc.*, 371 Ark. 559, 268 S.W.3d 885 (2007). These two affidavits have done precisely that.

Further, the Greens submitted numerous affidavits and deposition testimony of spreaders, property owners, teachers, and medical personnel that support these experts' contentions that Green was exposed to the poultry producers' chicken litter. That testimony, while discussed under the following analysis of the *Chavers* requirements, also applies to Green's exposure as well. Unlike the appellant in *Chavers*, who was repeatedly exposed to asbestos-containing products in four previous jobs before his on-the-job exposure as a shade-tree mechanic, the Greens have submitted proof that Green was exposed to the poultry producers' chicken litter on a long-term basis.

Additionally, in refuting the poultry producers' evidence to support their motions for summary judgment, the Greens have countered by providing ample scientific and medical evidence suggesting there may be a causal link between the chicken litter, which contained the arsenic compound from the chicken feed, and Green's injury. Specifically, the Greens submitted the affidavit of Dr. James Dahlgren, a board-certified internist with thirty-four years' experience in toxicology. Dr. Dahlgren stated:

> With reference to general causation, arsenic is a potent cancer promoter in adults and a complete carcinogen in the fetus (Waalkes 2004). There is no safe level of exposure to a carcinogen. The difference between a low dose of arsenic and a high dose is the amount of cancer it causes in the exposed population. The acute short-term exposure to arsenic overwhelms the body's defense systems and there is resulting injury to the body. The arsenic leaves the body but only after the damage is done.
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> . . . .
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> I analyzed the [Prairie Grove] childhood cancers for a time period 1998 to 2002, using strict statistical methods. This analysis confirms a significantly elevated incidence of cancer in children year after year. Based on the fact that we are seeing additional cases every few months indicates a continuing epidemic of childhood cancer in this community. The data supporting the conclusion of a significant excess of childhood cancer and that arsenic is the cause is rock solid. The defendants cannot deny the excess of cancer here. They cannot deny that the arsenic levels in the house dust are high.

Additionally, the Greens submitted the affidavit of Dr. William R. Sawyer, a board-certified toxicologist, in which he refuted the poultry producers' claim that the arsenic levels were too insignificant to cause Green's injury. In his affidavit, Dr. Sawyer alludes to numerous studies regarding the rates of arsenic-related exposures and malignancies and concluded:

> The above studies which have revealed statistically significant residential arsenic related cancers and neurotoxicological effects are within a reasonable range of that encountered among the Prairie Grove residents impacted by Roxarsone-laced chicken litter spreading. I am certain to within a high degree of toxicological certainty that plaintiffs were exposed to excessive arsenic through household dust ingestion on a chronic and regular daily exposure basis. The arsenic doses sustained by the plaintiffs in this matter were within range of that demonstrated above to be associated to within the generally accepted 95th percent level of confidence to induce both cancer and non-cancer toxicological endpoints associated with arsenic.

Finally, the Greens submitted the affidavit of Dr. Michael A. Wolfson, who specifically discussed Green's diagnosis "to rule out or exclude [alternate] causes of [Green's] medical conditions/diseases." In his affidavit, Dr. Wolfson noted that "[t]he medical literature contains numerous studies detailing the causative links between inorganic arsenic exposure in humans and the development of lymphohemotopoietic diseases, including leukemia." Dr. Wolfson concurred with Dr. Sawyer's opinion "regarding these calculated cancer risk levels resulting from [Green's] inorganic arsenic exposures from chicken litter." Dr. Wolfson concluded "with a reasonable degree of medical certainty, that these exposures caused or substantially contributed to the development of [Green's] CML [chronic myelogic leukemia]."

2. Frequency and regularity

Under the second prong in *Chavers*, the Greens were required to prove that Green was exposed to the chicken litter with "sufficient frequency and regularity." Here, the Greens submitted evidence supporting the proposition that the poultry producers had used the arsenic compound in the chicken feed for a period of years. According to the deposition testimony of Les Childress, George used roxarsone since 1958 with a six-month exception in 2002 or 2003, but George withdrew it from the feed recipe in

2004. Kerry Kinyon testified that Peterson used 3-Nitro on and off since 1981. Gary Murphy testified that Simmons fed roxarsone, which it purchased from Alpharma, to its chickens for the thirteen-and-one-half years that he had been employed with Simmons. Tyson admitted in its answer to interrogatories that it first began using 3-Nitro in chicken feed as early as the 1970s.

Next, the Greens submitted numerous spreaders' deposition testimony concerning the frequency and the regularity of the poultry producers' poultry-litter spreading activities. Robert J. Lee, Jr., a grower and spreader for Tyson, testified in a deposition that he, his son, and other spreaders spread chicken litter on his property on the western side of Prairie Grove "once per year" for twenty-five to thirty years. Ron Reed, a property owner and a grower for Tyson, testified that he or Mike Traylor spread chicken litter on his 73-acre Prairie Grove farm at least once per year for twenty-five years. Clifford C. Brown, a local spreader who owns Charlie's Spreading Service, testified that he spread litter "west and maybe a little bit north of Prairie Grove" at least once or twice per year for approximately fifteen or sixteen years. Brown further testified that he spread for growers working for George, Simmons, and Tyson. Mike Traylor, the owner of a spreading, shaving, and poultry-bedding business, testified that most farmers for whom he worked, including those individuals contracting with George, Peterson, Simmons, and Tyson, spread once or twice a year since 1977 when he began his business. Traylor added that, three or four years prior to the litigation when a "litter management plan" was established, he spread chicken litter on grass fields within five miles of the chicken houses in the Prairie Grove area. James Cooksey admitted in his deposition testimony that he had spread litter once or twice per year over the past fifteen to twenty years. Cooksey testified that he had spread for Tyson, Peterson, George, and Simmons in the Prairie Grove area. According to an annual spreader record attached to Dr. Sharma's affidavit, spreaders dumped up to 1712 loads of chicken litter per year between 1979 to 1999.

Peterson argues that it could not have contributed to the exposure because it had no contractual relationship with any independent poultry grower in Washington County until March 2002. However, Traylor testified in his deposition that he brought litter from Decatur, Gentry, and Gravette and spread it in the Prairie Grove area. He admitted that this included litter from Peterson Farms.

Further, the Greens also established that there was frequent-and-regular spreading around the Prairie Grove school. Gary Stearman testified that he contracted to have litter spread on his properties around the school in Prairie Grove from the late 1970s "until now." Cooksey testified that he spread chicken litter for Stearman for the past fifteen to twenty years. A Prairie Grove teacher, Kaci Crews, testified that she remembered spreader trucks spreading litter in the fields close to the school "[a]t least once a month between 1994 and 1999."

3. Proximity

Under the third prong in *Chavers*, the Greens were required to prove that the chicken litter was in proximity to work. The *Chavers* test, which was developed in cases involving plaintiffs' on-the-job exposure to asbestos products, originated in *Lohrmann*, *supra*, a workers' compensation case involving asbestos products, and was later implemented in *Jackson*, *supra*, another asbestos-exposure case. Similarly, in *Chavers*, we applied the test to Chavers's exposure to asbestos-containing products at work. However, in this case, the plaintiff was not exposed to the chicken litter at work, but rather, he was exposed at home and at school. Thus, because of Green's age during his exposure, we extend the applicability of the proximity prong to Green's exposure to the product while at home or at school.

Here, certain landowners and spreaders testified that they spread the chicken litter near the Prairie Grove school, which was located one block from the Greens' home. In his deposition testimony, Stearman stated that he owned property around Prairie Grove schools, and he paid to have litter spread on his property for twenty to twenty-five years. Traylor testified that he spread approximately two to three tons of chicken litter per acre on the Stearman property each year for a period of years. Cooksey testified that he spread litter on the Stearman property around the school for years. Traylor, who also spread on the Stearman property, stated, "I can't say that I've spread Tyson litter any more than Peterson's or Simmons or anybody else. I mean, it just depends on the area." Randy West, a grower and spreader, stated that he had been spreading chicken litter for approximately twenty-nine years on his property adjacent to the school.

Additionally, the Greens submitted deposition testimony from the teachers of Prairie Grove. Stacy Ferguson, who taught in Prairie Grove from 1994 to 1997, and Crews, who taught between

1994 to 1999, swore in an affidavit that they witnessed spreader trucks, which produced dust clouds near the school. Ferguson stated that, on the days of spreading, the children did not go outside for recess because the odor was so bad. Another teacher, Elizabeth Smith, stated that "you could hardly breathe at recess" because the smell was so bad. Crews stated that, because there was no air conditioning at the school and the doors were left open for ventilation, there was a "hazy cloud of dust and chicken feathers in the hallways of the school" while the chicken litter was spread in nearby fields. Green attended the Prairie Grove schools from 1991 to 2003.

4. Causation

Based upon our analysis of the *Chavers* test, we conclude that, in meeting proof with proof, the Greens submitted sufficient evidence to satisfy the *Chavers* requirements of (1) exposure, (2) frequency and regularity, (3) proximity, and (4) causation. In *Chavers*, we cited with approval the *Lohrmann* test on which the *Chavers* test is based, noting that the *Chavers* test itself "establish[es] causation." *Chavers*, 349 Ark. at 561, 79 S.W.3d at 368. As such, this fourth element considers the application of the first three elements in deciding whether a causal connection exists between Green's exposure and his injuries. Our case law is replete with the proposition that causation is almost always a question of fact for the jury and not appropriate for summary judgment. *See Se. Distrib. Co. v. Miller Brewing Co.*, 366 Ark. 560, 237 S.W.3d 63 (2006); *Miller Brewing Co. v. Ed Roleson, Jr., Inc.*, 365 Ark. 38, 223 S.W.3d 806 (2006); *Coca-Cola Bottling Co. v. Gill*, 352 Ark. 240, 100 S.W.3d 715 (2003); *Wal-Mart Stores, Inc. v. Lee*, 348 Ark. 707, 74 S.W.3d 634 (2002).

[2] Here, the Greens submit that 3-Nitro containing an arsenic compound was toxic, and provide deposition testimony that there is no safe level of exposure. The Greens have provided testimony that the 3-Nitro had been used by Tyson, George, Peterson, and Simmons as frequently as monthly over many years. Further, the Greens have shown that litter from poultry houses operated on behalf of the poultry producers was spread on property around the schools, leaving dust in the Greens' home and clouds of dust and chicken feathers in the hallways of the school. Viewing the first three prongs of the *Chavers* test in the light most favorable to the Greens, we conclude that the Greens have satisfied

the fourth prong by showing that the poultry-producers' chicken litter probably caused Green's injury.

5. Conclusion

[3] In conclusion, we hold that the circuit court erred in granting summary judgment. While the circuit court correctly announced the factors of the *Chavers* test, the circuit court failed to apply that test to the case *sub judice* either in its bench ruling or its order. In our review of the circuit court's grant of summary judgment, we note that summary judgment is not designed for assessing the probative strength of conflicting proof or expert opinions. Rather, that process is correctly done by the trier of fact after a trial on the merits. In applying the *Chavers* test, we hold that the Greens have demonstrated that there is a genuine issue of material fact on the issue of causation. Accordingly, we reverse the circuit court's grant of summary judgment in favor of the poultry producers and remand the case for trial.

II. Expert testimony at trial

For their second point on appeal, the Greens argue that the circuit court abused its discretion by limiting Dr. O'Connor's testimony and excluding essential facts supporting his opinions. Specifically, the Greens contend that the circuit court abused its discretion in excluding Table 9 of Dr. O'Connor's report, "Exposures to Carcinogenic Arsenicals and Other Toxic Substances in Washington County, Arkansas" and any testimony concerning Table 9.

Alpharma responds, arguing that the circuit court did not abuse its discretion in limiting Dr. O'Connor's testimony and excluding Table 9.[4] Specifically, it asserts that the circuit court properly applied the admissibility factors set forth in *Daubert v. Merrell Dow Pharmaceuticals, Inc.*, 509 U.S. 579 (1993), and *Farm Bureau Mutual Insurance Co. of Arkansas, Inc. v. Foote*, 341 Ark. 105, 14 S.W.3d 512 (2000), to Dr. O'Connor's methodology in constructing Table 9 and in excluding Table 9 and any testimony or opinions concerning or relying on it.

[4] The poultry producers adopt and incorporate Alpharma's arguments on the expert-testimony issues.

A. Standard of review

The Greens contend that we should review the exclusion of expert testimony under a de novo standard, while Alpharma asserts that an adoption of a de novo standard for evidentiary rulings, including the admissibility of expert testimony, would result in a significant break with well-established, longstanding precedent in Arkansas law. Our case law clearly states that we review the admission of expert testimony under an abuse-of-discretion standard. *Crowell v. Barker*, 369 Ark. 428, 255 S.W.3d 858 (2007) (citing *Collins v. Hinton*, 327 Ark. 159, 937 S.W.2d 164 (1997)). In discussing our standard of review for evidentiary rulings, we have said that circuit courts have broad discretion and that a circuit court's ruling on the admissibility of evidence will not be reversed absent an abuse of that discretion. *Advanced Envtl. Recycling Techs., Inc. v. Advanced Control Solutions, Inc.*, 372 Ark. 286, 275 S.W.3d 162 (2008).

[4] The Greens rely on the United States Court of Appeals, Eighth Circuit decision in *United States v. Blue Bird*, 372 F.3d 989 (2004), which states:

> There is some confusion in our cases on the proper standard of review with respect to evidentiary issues. We have sometimes said that in reviewing a district court's admission of evidence we review for an abuse of discretion. *See, e.g., United States v. Salcedo*, 360 F.3d 807, 809 (8th Cir. 2004). Strictly speaking, however, this is not correct. Some rules require a balancing of how particular evidence might affect the jury, and we properly accord deference to the trial judge on such questions. *See, e.g.*, Fed. R. Evid. 403. But a district court's interpretation and application of most rules of evidence are matters of law. Of course, an error of law can always be characterized as "an abuse of discretion," *United States v. Weiland*, 284 F.3d 878, 882 (8th Cir. 2002), but our review in cases like the present one is more accurately characterized as *de novo*.

Id. at 991. However, this holding was implicitly overruled by *United States v. Pirani*, 406 F.3d 543, 555 (8th Cir. 2005). "*Pirani*'s holding on this issue implicitly overruled our holding in *United States v. Blue Bird*, 372 F.3d 989, 991 (8th Cir. 2004), that we review de novo a district court's admission of evidence." *Harris v. Chand*, 506 F.3d 1135, 1139 n.2 (8th Cir. 2007) (citing *United States v. Chase*, 451 F.3d 474, 479 n.3 (8th Cir. 2006)). Further, the United States Supreme Court has held that abuse of discretion is the proper standard by which to review

a district court's decision to admit or exclude scientific evidence. *See Gen. Elec. Co. v. Joiner*, 522 U.S. 136, 146 (1997). In *Joiner*, the Court held that in applying an overly "stringent" standard, the Eleventh Circuit failed to give the trial court the deference that is the hallmark of abuse-of-discretion review. *Id.* at 143. Therefore, following the well-established case law, we will review the exclusion of expert testimony under an abuse-of-discretion standard.

B. Dr. O'Connor

Arkansas Rule of Evidence 702, which governs expert testimony, states that 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." In *Daubert, supra*, the United States Supreme Court held that the test established in *Frye v. United States*, 293 F. 1013 (D.C. Cir. 1923), providing that "expert opinion based on a scientific technique is inadmissible unless the technique is 'generally accepted' as reliable in the relevant scientific community," 509 U.S. at 584, had been superceded by the Federal Rules of Evidence. The Court established the following inquiry to be conducted by the trial court:

> Faced with a proffer of expert scientific testimony, then, the trial judge must determine at the outset, pursuant to Rule 104(a), whether the expert is proposing to testify to (1) scientific knowledge that (2) will assist the trier of fact to understand or determine a fact in issue. This entails a preliminary assessment of whether the reasoning or methodology underlying the testimony is scientifically valid and of whether that reasoning or methodology properly can be applied to the facts in issue.

Id. at 592-93; *see also Foote, supra*. In *Foote*, we adopted the United States Supreme Court's interpretation of Federal Rule of Evidence 702 in *Daubert*, stating:

> The Court concluded that a key consideration is whether the scientific theory or technique can be or has been tested. Other considerations include whether the theory or technique has been subjected to peer review and publication, the potential rate of error, and the existence and maintenance of standards controlling the technique's operation. Additionally, the Court recognized that

> general acceptance in the scientific community can have a bearing on the inquiry. The Court emphasized that the inquiry envisioned by Federal Rule of Evidence 702, which is identical to our Rule 702, is a flexible one: Its overarching subject is the scientific validity-and thus the evidentiary relevance and reliability-of the principles that underlie a proposed submission. The focus, of course, must be solely on principles and methodology, not on the conclusions that they generate.

Foote, 341 Ark. at 116, 14 S.W.3d at 519. Under *Foote* and *Daubert*, the trial court must make a preliminary assessment of whether the reasoning or methodology underlying expert testimony is valid and whether the reasoning and methodology used by the expert has been properly applied to the facts in the case. *See Miller Brewing Co. v. Roleson, Jr., Inc.*, 365 Ark. 38, 223 S.W.3d 806 (2006) (citing *Coca-Cola Bottling Co. v. Gill*, 352 Ark. 240, 100 S.W.3d 715 (2003)).

In *Kumho Tire Co. v. Carmichael*, 526 U.S. 137 (1999), the United States Supreme Court set out the objective of *Daubert*'s gatekeeping requirement, stating:

> The objective of that requirement is to ensure the reliability and relevancy of expert testimony. It is to make certain that an expert, whether basing testimony upon professional studies or personal experience, employs in the courtroom the same level of intellectual rigor that characterizes the practice of an expert in the relevant field. Nor do we deny that, as stated in *Daubert*, the particular questions that it mentioned will often be appropriate for use in determining the reliability of challenged expert testimony. Rather, we conclude that the trial judge must have considerable leeway in deciding in a particular case how to go about determining whether particular expert testimony is reliable. That is to say, a trial court should consider the specific factors identified in *Daubert* where they are reasonable measures of the reliability of expert testimony.

Id. at 152.

Turning to the present case, the circuit court found in its August 2, 2006 order that "Dr. O'Connor's methodology in arriving at each of these opinions does not meet the *Daubert*, *Foote*, or Rule 702 standards for the reasons set forth during the July 19, 2006 ruling and in Defendants' motions and supporting briefs." In its July 19, 2006, ruling, the circuit court analyzed Table 9 under the five *Daubert* factors, stating:

> The formula that he uses, this court has no faith in the validity of those numbers. And it's not been peer-reviewed. When you look at the test that we're supposed to apply to this testimony, has this theory ever been tested? No. Can it be? I guess it could by other scientists. Has it been subjected to peer review? No. The potential error rate, we have no idea. That has not been shown. The existence in maintenance of standards controlling the technique's operation, I guess arguably that may have been met, although there's been severe criticism of the manner in which these samples were taken. There was severe criticism of the fact that when they got a zero reading, they just threw those out instead of putting them in to average out in this formula. That's been severely criticized.
>
> And, number five, whether the scientific community has generally accepted this formula. And it has not. This formula, or one very similar to it, in fact, he got it from lead, from analyzing lead data. And, in fact, I read in the literature that accompanied it said don't use this for other metals. Well, what does Dr. O'Connor do? He uses it for arsenic, when it's got a warning on there, don't use it for any other metals. But, the bottom line is that he cannot pass–the plaintiffs have not shown to this court that this table from Dr. O'Connor has any validity. It's not shown to this court to be reliable. The methodology is not shown to be valid, and the reasoning is not shown to this court to be valid, and, therefore, this court's going to exclude Table 9, as prepared by Dr. O'Connor, and also any other testimony by experts that uses Table 9 to come up with their figure.

The Greens contend that Dr. O'Connor is a well-qualified expert in this area based on his knowledge, skill, experience, training, and education pursuant to Ark. R. Evid. 702. However, Rule 702 does not condition the admissibility of an expert's testimony solely on the expert's professional accolades or lack thereof. *See Coca-Cola*, *supra*. Here, the circuit court found that Dr. O'Connor was well-credentialed and qualified. The circuit court ruled that he was only prohibited from testifying about Table 9 and from testifying that the dust he found in homes was dust found in Prairie Grove schools. Our inquiry as to whether his testimony should have been admitted does not rest solely on the issue of whether Dr. O'Connor was well-qualified. The issue here is whether the circuit court abused its discretion in finding that Dr. O'Connor's methodology did not meet the *Daubert* and *Foote* standards for the admissibility of expert testimony.

A primary factor for a trial court to consider in determining the admissibility of scientific evidence is whether the scientific theory can be or has been tested. *Ridling v. State*, 360 Ark. 424, 442, 203 S.W.3d 63, 75 (2005). Here, Dr. O'Connor used the formula $D = c_0 + c_1 A$ to reconstruct the amount of arsenic in the air based upon the dust level measurements of the homes in Prairie Grove. According to his August 25, 2005 report, "D" is the dust arsenic concentration estimated as deposited from the air; "c_0" is the initial site-specific dust arsenic concentration; "c_1" is a conversion factor; and "A" is the average air arsenic concentration during the period of dust deposition.

Dr. O'Connor's results and opinions on these arsenic levels were reflected in Table 9 of his report. Dr. O'Connor testified in his deposition that the formula he used to arrive at these results came from the California EPA, which was using the formula to find new sources of lead. Dr. O'Connor took this formula for lead and applied it to arsenic. He testified that he did not know whether anyone had ever before applied this formula to calculate arsenic levels. It was later revealed that this formula actually came from the national USEPA's 1989 review of the EPA document entitled "Review of the National Ambient Air Quality Standards for Lead: Exposure Analysis Methodology and Validation."

The circuit court made the following findings regarding the variables used in Dr. O'Connor's formula:

> He recalculates, or reconstructs, how much air–arsenic is going to be in the air based on the dust samples. But he also took air samples and chose not to use those. Instead he's going to use a formula to reconstruct it. Now, that doesn't make much sense to the court, to start with. But when we look at the formula, which is D equals Co plus C1 times A, that's his formula. The C1 is the conversion factor. Well, he testified as an expert in a Gilmer, Texas case, and in that case the conversion factor was .35. In our case, he testifies the conversion factor is 8. And I haven't really heard a satisfactory explanation as to why there's such a huge difference between those conversion factor numbers other than he's testified that, well, he was wrong in the Gilmer, Texas case, that the .35 was an error so he was testifying erroneously in that case because he says, no, the 8 is the right number in this case. That causes this court some great concerns how he flip-flops around between those two numbers.

> He testifies the Co is 3.6, which came from this court after hearing arguments and testimony, actually of Dr. O'Connor, not to be plugged into some formula, just kind of a–you all were arguing about the background rate of arsenic. And that's a number that he didn't test for background, he didn't use–there's some figures out there from EPA or somebody as to what, maybe, the Fayetteville background is. I'm not sure if it's Northwest Arkansas background or Region 5 background. Anyway, he just kind of picks that number out of the air that came from this court.
>
> His number for the A is .45 nanograms per cubic meter, right. That's not a measured number. He's testified that he's never used it before, he's never seen another scientist that's ever used that number support, that he has no support in the literature, it's not been peer-reviewed, and I think he admits all those things in his deposition.

As pointed out by the circuit court, Dr. O'Connor admitted in his deposition that he used a conversion factor of 8 in the present case and a conversion factor of .35 in a case in Gilmer, Texas. *See Abron v. Dean Lumber Co.*, No. 2:99-CV-0197-TH (E.D. Tex. Feb. 7, 2003). When asked whether the difference in these conversion factors caused him any pause as to the reliability of his methodology, Dr. O'Connor stated, "Yes, I think maybe. If I were going back to the Gilmer case, I would want to reaccumulate those because I did that one on a straight proportional basis based on some Texas air data . . . I probably have an error by maybe a factor of 10 or more in the Gilmer data." He also testified, "I think I made an error in the methodology in Gilmer, Texas, because I didn't do it–I did not do it by calculating the slope."

[5] Dr. O'Connor further testified that variable "A," which he values at 0.45 ng/m^3, is the average air arsenic concentration on typical days that are unaffected by poultry litter spreading events. Dr. O'Connor used 0.45 ng/m^3 as a mathematical assumption, admitting in his deposition that this number could be incorrect:

> Q. What basis do you have, Dr. O'Connor, to assume that in good old rural Arkansas that the average air would be at a level of .45 nanograms per cubic meter and, therefore, below a 1 in a million risk level?
>
> A. One of the worst things we run across after I got doing expert witness testimony is the word "assumption" be-

> cause to the general population, that means I'm assuming this really happened up there and that doesn't–that's not what I mean. I mean I'm going to take this number and I'm going to state for you that I'm putting that number in as a mathematical assumption, which simply says that if the average air when there isn't any spreading event is it a 1 in a million cancer risk, that's the number out of a table. I'm not assuming that really happened any place in Arkansas or any place else. It's an assumption for purposes of arithmetic and it tells you where it came from and in reality maybe the air in that part of Arkansas gives you a 5 in a million cancer risk or 10 in a million. I don't have any way to know what that number is. I must say if the regular time just doesn't contribute anything significant to your risk and your risk is mostly coming from the poultry litter, then under that scenario, there's the number.
>
> . . . .
>
> Q. But how do you know, sir, that presumption is not wrong?
>
> A. I absolutely don't. It is a modeled event and whether it was something that Dr. Sharma could do, for example, in a sophisticated computer air dispersion model, there's still all kinds of assumptions that go into those things.

Based on these admissions by Dr. O'Connor, we agree with the circuit court's finding that Dr. O'Connor's theory of using these variables in the lead formula to calculate arsenic levels has never been tested, and therefore does not meet a key consideration for admissibility as set out in *Daubert*.

Another pertinent consideration in determining whether a theory or technique is scientific knowledge that will assist the trier of fact is whether the theory or technique has been subjected to peer review and publication. *See Daubert*, 509 U.S. at 592. The *Daubert* court stated:

> Publication (which is but one element of peer review) is not a sine qua non of admissibility; it does not necessarily correlate with reliability, see S. Jasanoff, The Fifth Branch: Science Advisors as Policymakers 61-76 (1990), and in some instances well-grounded but innovative theories will not have been published, see Horrobin,

> the Philosophical Basis of Peer Review and the Suppression of Innovation, 263 JAMA 1438 (1990). Some propositions, moreover, are too particular, too new, or of too limited interest to be published. But submission to the scrutiny of the scientific community is a component of "good science," in part because it increases the likelihood that substantive flaws in methodology will be detected. See J. Ziman, Reliable Knowledge: An Exploration of the Grounds for Belief in Science 130-133 (1978); Relman & Angell, How Good Is Peer Review?, 321 New Eng. J. Med. 827 (1989). The fact of publication (or lack thereof) in a peer reviewed journal thus will be a relevant, though not dispositive, consideration in assessing the scientific validity of a particular technique or methodology on which an opinion is premised.

Id. at 593-94.

[6] In the present case, the circuit court found that the test used by Dr. O'Connor had not been subjected to peer review. During his deposition, Dr. O'Connor testified that the first time he applied the formula to arsenic was in the Gilmer, Texas case. He admitted in his deposition testimony that he had not submitted his use of the formula for arsenic for publication and therefore it had not been subject to peer review. However, in his March 25, 2006 affidavit, Dr. O'Connor stated that his "methods in this particular case have been peer reviewed and published," citing to his own 2005 article "Transformation, Air Transport, and Human Impact of Arsenic from Poultry Litter" in *Environmental Forensics*. In the article, Dr. O'Connor explains the results of his study reporting "on the transport of both roxarsone and some of its degradation products through the air to impact homes near poultry litter-applied fields, resulting in house dust arsenic levels in 29 tested homes ranging from 10.7–130 mg/kg." The study does not, however, discuss the "inhalation exposure reconstruction" of Table 9.

[7] Another factor to consider when reviewing a particular scientific technique is the known or potential rate of error. *See Daubert, supra.* Here, the circuit court found that the potential error rate of Dr. O'Connor's formula had not been shown. We have found nothing on appeal to refute this finding.

With regard to the existence and maintenance of standards factor, the circuit court noted in its ruling that Dr. O'Connor's method in computing the average dust concentration for arsenic in

Prairie Grove homes had been "severely criticized." Dr. O'Connor analyzed twenty-three dust samples taken from homes in Prairie Grove for arsenic content, including samples taken from air conditioner filters and interior surface dust samples. In eight of the samples, the level of arsenic was "below detection limit" ("BDL"). Dr. O'Connor testified in his deposition that he excluded these BDL values from his calculations of average dust concentrations:

> Q: Well, for the purpose of trying to handle data as you've tried to handle, in your Table 9 in your expert report, you've got average dust levels in parts per million reported in that table, right?
>
> A. Yes.
>
> Q. When you calculate average dust levels, which is really another way of saying the mean for the dust levels taken in a particular residence, if you have below detection limit as one in the entries for dust sample, you need to consider that in calculating the mean, don't you?
>
> A. Well, there are four things that you can do with a non-detect: A, you can consider it to be a zero and average it in with all the rest and then divide by number of samples; B, you can plug it in the detection limit and use that and calculate the average; C, you can plug in one half the detection limit and calculate it. And D, you consider it an outlier because you don't know why it was below detection limit and it might have been a bad sample in which case you leave it out entirely and average the rest. That's what I usually do.
>
> Q. Is that what you did here? You left it out entirely?
>
> A. That's what I usually do. If I've got a below detection limit and I don't know whether that means we didn't have enough sample and I don't go back and look it up, I will typically look at the ones where we have the numbers and average all of those.

In his March 25, 2006 affidavit, Dr. O'Connor addresses the argument that he should have included substitute values for results that were below detection limits. "Specifically, they state that I

should have included in my averages the method detection limit ("MDL"), one-half the MDL, or zero. Although such procedures are sometimes employed, they are not appropriate in this case, as I was prepared to explain in my March 3, 2006, deposition, had the question been asked." Dr. O'Connor goes on to say that he omitted the two BDLs from the dust samples taken from the Greens' home because "[i]f I had substituted zero for those BDLs, that dust arsenic average would have been 17.4 ppm, rather than 26.1 ppm–still at a 'contaminated' level and within about 66% of the value I used. That is well within an acceptable error range for the type of data available." Paul N. Boothe, Ph.D., agreed with Dr. O'Connor's exclusion of the BDLs, stating in his affidavit, "after careful review of the dust arsenic data in question, Dr. O'Connor's exclusion of the eight (8) BDL samples was the most valid decision for the data in question. The resulting average dust arsenic concentration is scientifically valid, conservative, and fair."

[8] However, Dr. William Sawyer testified in his deposition that generally, the EPA's methodology requires that non-detects be considered when calculating averages. He further testified that non-detects should be considered in arriving at an average of arsenic concentration in dust in the present case. Moreover, Dr. Elizabeth L. Anderson's report states that "EPA risk assessment guidance (1989) clearly states that sample results below the limit of detection, should not be censored but rather assumed to be present in the sample at a value equal to or less than the limit of detection." According to Dr. Anderson, Dr. O'Connor's decision to ignore the non-detects in the average concentrations biases the averages high. The testimony of these experts shows, as pointed out by the circuit court, that Dr. O'Connor's method in computing the average dust concentration for arsenic has been criticized.

Finally, general acceptance within the scientific community can also have a bearing on the inquiry of the admissibility of expert testimony:

> A "reliability assessment does not require, although it does permit, explicit identification of a relevant scientific community and an express determination of a particular degree of acceptance within that community." *United States v. Downing*, 753 F.2d at 1238. See also 3 Weinstein & Berger ¶ 702[03], pp. 702-41 to 702-42. Widespread acceptance can be an important factor in ruling particular evidence admissible, and "a known technique which has

> been able to attract only minimal support within the community," *Downing*, 753 F.2d, at 1238, may properly be viewed with skepticism.

Daubert, 509 U.S. at 594.

[9] In the present case, the circuit court found that the scientific community had not generally accepted Dr. O'Connor's formula, stating:

> This formula, or one very similar to it, in fact, he got it from lead, from analyzing lead data. And, in fact, I read in the literature that accompanied it said don't use for other metals. Well, what does Dr. O'Connor do? He uses it for arsenic, when its got a warning on there, don't use it for any other metals. But, the bottom line is that he cannot pass–the plaintiffs have not shown to this court that this table from Dr. O'Connor has any validity. It's not shown to this court to be reliable.

We have found no evidence that Dr. O'Connor's use of the EPA formula to calculate arsenic levels has been generally accepted by the scientific community. In "A Detailed Explanation of Previously Reported Results from the Mathematics of Air Composition Reconstruction based on the Composition of Settled Dust," Dr. O'Connor states that, while his formula had been used by EPA scientists to relate changes in dust lead levels to changes in air lead levels, "the equation is an absolutely true mathematical statement applicable to any dust composition of settleable, nonvolatile material." However, because the EPA has only used the formula to determine lead levels, we cannot say that Dr. O'Connor's use of the formula to determine arsenic levels has been generally accepted by the scientific community.

[10] The circuit court also considered Dr. O'Connor's reconstruction of Prairie Grove school exposure in reaching its finding that Table 9 was unreliable. The circuit court limited Dr. O'Connor's testimony by prohibiting him from testifying that dust samples taken from various Prairie Grove homes were samples taken from Prairie Grove schools because "it grossly misleads the jury." During his deposition, Dr. O'Connor testified that the school numbers he used actually came from twenty-three houses in the vicinity of the Prairie Grove schools because the school testing had been invalidated. Dr. O'Connor claimed that either the

principal or the superintendent "came in the night before our people were there along with all of his janitorial crews, cleaned everything and pulled all the air-conditioning filters so when our crew arrived the next day there weren't any air-conditioning filters that had anything on them." Dr. O'Connor testified that he considered the samples of dust to be unreliable because someone had tampered with the sampling points. Because he considered them unreliable, he tested nearby homes and used these homes to compute the arsenic levels in the schools. We agree with the circuit court's ruling that allowing Dr. O'Connor to take samples from homes and present them as school samples would grossly mislead the jury, and we therefore hold that the circuit court did not abuse its discretion in limiting this testimony.

After a thorough analysis of the *Daubert* factors, we cannot say that the circuit court abused its discretion. The Greens have failed to carry their burden of proof on the issue of reliability. *See Foote, supra.* Because we give the circuit court considerable leeway in deciding how to determine whether particular expert testimony is reliable, *see Kumho Tire, supra,* we hold that the circuit court did not abuse its discretion in excluding Table 9 and limiting Dr. O'Connor's testimony. Accordingly, we affirm the circuit court's ruling on this point.

C. Dr. Sawyer

For their final point on appeal, the Greens argue that the circuit court abused its discretion in refusing to allow Dr. Sawyer to testify about a dose calculation. Specifically, they assert that Dr. Sawyer was prepared to apply his own formula, experience, and conclusions to the data that appeared in the first column of Dr. O'Connor's Table 9, and render his own independent dose calculation on the amount of airborne arsenic that was ingested by Blu Green. Alpharma responds, asserting that the Greens' argument is unfounded because the circuit court ruled that Dr. Sawyer and the Greens' other experts could rely on Dr. O'Connor's raw data, and that Dr. Sawyer did give a dose calculation opinion.

In his decision limiting the testimony of Dr. Sawyer, the circuit court stated:

> Dr. Sawyer is not going to be allowed to use any of Dr. O'Connor's Table 9 figures except the measured dust amounts of arsenic in the homes. He's not going to be allowed to use the

> ingestion dose rate–well, I guess that's his ingestion dose rate that he calculated using the inhalation exposure reconstruction that was done by Dr. O'Connor. And since it was based on this Table 9, this court has no confidence in that ingestion dose rate either, since it was based on Dr. O'Connor's inhalation exposure reconstruction.

In the August 2-3, 2006, hearings, the circuit court again addressed his decision regarding the limitation of Dr. Sawyer's testimony stating, "I did say your raw data, you know, whatever they measured, people can use, but not these averages that are on Table 9." Therefore, the circuit court's ruling only precluded Dr. Sawyer from relying on Table 9, and did not preclude him from using Dr. O'Connor's raw data.

[11] In fact, Dr. Sawyer did testify at trial that the arsenic dust levels found in the filters of the Greens' home constituted a dose. At the close of the Greens' case at trial, the circuit court acknowledged that there was testimony by Dr. Sawyer that the arsenic dust levels were sufficient to cause leukemia and partly relied on this testimony in denying Alpharma's motion for directed verdict. Accordingly, because we hold that the circuit court did not abuse its discretion in excluding Table 9, and because Dr. Sawyer was not precluded from offering a dose opinion, we affirm the circuit court's ruling on this issue.

Affirmed in part; reversed and remanded in part.