

A federal judge in San Francisco held a meeting *in camera* with a group of lawyers; some represented policemen who had used radar guns and developed cancer, and others represented the companies that manufactured the radar guns. The judge told the plaintiffs' lawyers that he might not let the jury consider the causation issue involving the radar and the cancer because he had genuine doubts it could be proved, and he warned the companies that the jury was likely to be sympathetic to the plaintiffs because they had been struck down by cancer in the prime of their lives. The gist of the judge's advice was that the lawyers should settle the cases.

At the next meeting, the judge excluded the possibility that the plaintiffs could be awarded punitive damages, which took away their motivation to investigate whether the companies had conspired to hide scientific data, or whether they had known about potential risks of radar exposure but failed to evaluate them, which had been the avenues of attack that the big plaintiff-oriented law firms had used so successfully against the cigarette companies. He proposed a settlement based on each company's share of the market for radar guns, but the companies squabbled among themselves regarding who should be responsible for how much. There was also no unity of viewpoint on the plaintiffs' side; their lawyers bickered constantly about every case-management decision, large or small. In the end, the frustrated judge couldn't get a deal done. So he told the plaintiffs' lawyers to pick their most winnable case and take it to trial as a "representative plaintiff." "If you don't win that one," he said, "the whole ball game is over." At that point they contacted me, and we made arrangements to meet in Shreveport.

I met with the lawyers in Shreveport. I was given a copy of a memorandum that described the cases they had collected, and one of the lawyers summarized it for me. "One group involves melanoma or basal cell carcinoma in the head, neck, or upper back area. It occurred in situations where the transmitting antenna was mounted inside the patrol car, generally at about head level. The lymphoma and testicular cases appear to be directly related to hand-held use of radar guns. The officer usually placed the gun

in his lap or alongside his thigh when he wasn't aiming it at traffic. During this time the gun would continuously emit the radar signal."

"Why didn't they turn off the radar when they weren't aiming at a car?" I asked.

"A slight warm-up time was necessary for proper operation," he replied, "so the manufacturers advised that the radar beam be left on all the time."

Then another lawyer began reading the memorandum. "Terry Rosenbalm is a 39-year-old, married police officer. He works for the U.S. National Park Service. He has a 14-month-old daughter. He had a radar antenna mounted inside his police car. He developed a melanoma just below his shoulder. He is expected to die in 6–12 months.

"Michael Vesta is an Ohio state trooper, 51 years of age presently, married, with two sons ages 24 and 27. Vesta has a disastrous experience with cancer which started on the right side of his face about an inch below the ear. He had numerous operations thereafter until half of his face and forehead have been removed, including his entire right eye and part of his brain. He was unaware of any possible connection between his radar usage and his persistent cancer, so he just continued to use the radar gun until his retirement.

"Lawrence Sudduth died last month, at age 65, after a long bout with cancer, originally a melanoma in the area of the right eye. He was a police officer in Ohio. His radar was mounted in the vehicle behind his head. He leaves a wife and three adult children.

"Dave Scarafiotti, 55, is a St. Petersburg, Florida, police officer with a history of basal-cell carcinomas on the face and neck. Because of what happened to him, the Chief of the St. Petersburg Police Department discontinued use of traffic radar.

"Robert Quarles is 29 years old and suffers from a rare form of melanoma of the eye. He is also a member of the St. Petersburg Police Department whose cancer precipitated the discontinuance of traffic radar usage by the Department. Quarles is married and has no children. His prognosis is quite poor.

"Terrance Traveler is a member of the Maine State Police; he is 28 years old and has a malignant melanoma that originated on the left tricep and metastasized to the left lung, a portion of which was excised. Another lung spot was found and Mr. Traveler is undergoing special treatment at the National Institutes of Health in Bethesda, Maryland. He used the Zap-

per radar by holding it in his left hand outside the driver's window directly in line with his left tricep. He has two sons, age 2 years and 1 month. His prognosis is very poor.

"Greg Koechel is a 28-year-old Indiana State Highway Patrolman with testicular cancer. As is typical of virtually all of these police officers, he was in perfect physical condition with no family cancer history whatsoever. He faces radiation therapy and a long-term medical follow-up with uncertain prognosis. He has been advised that he and his wife may not be able to have children because of this illness.

"Edward Benecke is a 32-year-old police officer for the city of Petaluma, California, Police Department. He is married, no children. He has non-Hodgkin's lymphoma, originating in the groin, after years of resting the radar gun in his lap when not aimed at traffic. He and his wife are despondent over the reality of their not being able to have children, given his constant chemotherapy, radiation, and dire life expectancy. He is an intelligent, articulate spokesman, and would make an excellent courtroom witness.

"Anthony Hutson is a retired Petaluma, California, police officer, now age 51. He used a hand-held radar gun, and his lymphoma developed in his leg. He has undergone an enormous amount of chemotherapy and radiation treatment, with a very pessimistic prognosis. His wife is a great asset to the case, and would make a very compelling witness. They have one adult son.

"Dwain Power died approximately four weeks ago of non-Hodgkin's lymphoma. He was 35 years old, and died only nine months after he first noticed a lump in the lymph glands on the left side of his neck. He had a depressingly painful course of treatment, deterioration and, ultimately, death. He is survived by his wife and their two sons. He had no family history of cancer, and was a very vigorous athlete who neither smoked nor drank.

"James Zum is a 64-year-old retired policeman, and a major league baseball scout. He estimates over 4,000 hours of radar-gun usage in the last ten years. Zum was diagnosed with non-Hodgkin's lymphoma and learned about the possible connection to his radar usage through articles in the St. Petersburg Times. He has been married to his wife for 45 years, and has three children. His prognosis is very poor.

"Edward Certain is a 35-year-old former Walnut Creek, California, police officer with Hodgkin's disease, presently in remission. He has had a dramatic struggle with the disease for more than six years, but has been

symptom-free for more than a year. However, the disease is characterized by remissions and exacerbations, and the prognosis is always poor. His radar unit was mounted in the interior rear passenger-side window, and his first tumor was in the neck on the right side.

“Christopher Lindow is a police officer with the Oxford, Ohio, Police Department, age 31. He has testicular cancer. Following surgery and radiation therapy, he has had no further symptoms. Lindow is engaged to be married, and his prognosis is relatively good.

“Edward Cottom is 46 years old, and a Concord, California, police officer. He and his wife have three children. Cottom was afflicted with testicular cancer which apparently has not metastasized. The afflicted testicle was removed after which he had radiation therapy. He is only one year post-surgery, and so is still significantly at risk. He used a hand-held radar gun and rested it in his lap constantly.

“Linn Jonson is a sergeant with the Concord Police Department and was diagnosed with cervical cancer about three years ago, after five years of traffic radar usage; she rested the gun in her lap when not in use. At this point, there is no apparent metastasis. She is now 34 years old.”

I agreed to become involved in the lawsuits, so the lawyers reviewed the medical records of all fifteen policemen to select the most winnable case. The prospective plaintiff needed to be tough-minded. He would be examined by medical experts, subjected to hostile depositions and physical examinations by batteries of defendants' physicians, and would undergo brutal cross-examination in court. In addition to all that, the ever-present media would dramatize the case, including intimate details of his medical condition. The lawyers eliminated the policemen who had died because the judge said that a suit by the survivors of a dead policeman would be unfair to the defendants because there would be no plaintiff to be examined by the defendants' experts or cross-examined by their lawyers. The lawyers also dropped from consideration all the policemen who had been smokers, because the defendants' lawyers were certain to blame the cancer on the cigarettes. Then the lawyers conducted mock cross-examinations of their remaining clients to assess how well they would hold up. In the end, they selected Edward Benecke as their representative client.

The policemen had used radar guns made by different manufacturers, but Benecke had used only the Zapper radar gun, so the case was brought against that company.

Initially the plaintiff's lawyers were happy with the judge because he was known as an activist, and he had a brother who was a police officer. As the case had progressed, however, his pretrial rulings didn't consistently favor one side or the other, so both sides became more uncertain of which way he leaned. One of his last rulings before the trial dealt with Zapper's motion to dismiss the case for the reason that the scientific testimony would be too complex for a lay jury, and therefore that any verdict in which the company were held liable would be arbitrary and capricious. The judge replied, "That's not the way our legal system works. The jury will decide all factual issues, regardless of the level of education of each juror. The people must be heard on this issue."

In a pre-trial memorandum Zapper claimed the freedom to do anything that wasn't illegal, which manufacturing radar guns wasn't. On the contrary, Zapper said, "most radar guns are manufactured under contract to state or federal governments. If there were something harmful about radar, the government had a responsibility to say so and to promulgate laws and rules accordingly. The government has not done so, from which it follows that radar guns are safe."

After Benecke had been chosen as the plaintiff, I had no difficulty in linking his cancer to exposure to microwave EMFs from a Zapper gun, and I agreed to describe to the jury my method of analysis and the data on which I had relied in reaching that conclusion. My plan was to explain that animal studies showed that EMFs could be carcinogens. Benecke had not been exposed to other known carcinogens, and the level of EMFs that he had experienced from the Zapper gun was far greater than the EMF levels experienced by people who didn't develop cancer. For these reasons it was probably true that he got cancer from the radar. I wrote out questions for Benecke's lawyers that would elicit the responses which would sum to this rationale.

Immediately after I took the witness stand but before I said a word to the jury, a lawyer for Zapper asked for and received permission to approach the bar. A discussion ensued between the judge and the lawyers for both sides, and when they returned to their seats the judge ordered the jury removed from the courtroom. Zapper's lawyer then read from a summary of my testimony, which the rules of evidence had required that I provide. The part he read was, "On the basis of animal studies I will testify that electromagnetic fields are probably capable of causing cancer in people."

“Your honor,” he said, “the defendant has several serious problems with this proposed testimony. First, it is not generally accepted that electromagnetic fields can cause cancer. Second, even if they could, there is no evidence to indicate that microwaves such as those used in police radars could cause cancer. Third, it is not generally accepted that the ability to cause cancer in animals necessarily means that the responsible agent would also cause cancer in human beings. Finally, there are no generally accepted studies that prove that EMFs from police radar guns can cause the particular type of cancer that the plaintiff has. Dr. Marino’s proposed testimony is therefore purely theoretical and speculative, and does not constitute accepted scientific knowledge. For these reasons his testimony should not be admitted into evidence.”

The judge turned to me and asked, “Do other scientists accept the principle that EMFs can cause cancer?”

“Well, that’s hard to say because...”

“Either they do, or they don’t. Which is it?”

“The only thing I can say, your honor, is that I know some people who do, and some people who don’t.”

“In other words your theories aren’t generally accepted by other scientists. Right?”

“Yes ... I guess so ... but.”

“List for me the names of other scientists who agree with you.”

“Well, your honor,” I said, “I can’t really speak for anybody else.”

“Are you a one-man band?” he said.

I had thought of myself as part of a growing band, but its size was not part of my rationale because my inferences were new, and so couldn’t be “generally accepted.” The really important point, I thought, was that I had arrived at my conclusions by a *method* that was generally accepted. By my lights, it would be crazy to say that something wasn’t a fact, or wasn’t reliable, simply because everybody didn’t already believe it. If something can’t be accepted until it’s a fact, and it can’t be a fact until it’s accepted, then the situation is hopelessly circular. I tried to tell all this to the judge, but he said, “You’re a lawyer, Dr. Marino, you should know the law is that scientific evidence can’t be accepted by a court unless it’s first generally accepted by the scientific community. *That* is what makes it a fact,” he said. The lawyers argued for a while, and in the end the judge ruled that all testimony regarding the effects of EMFs in animals was inadmissible as evi-

dence, and that all scientific testimony would be restricted to questionnaire studies, and the opinions of physicians.

In the evening one of Benecke's lawyers told me the story of how "general acceptance" became a federal rule of evidence. "In 1922, a man named James Frye was arrested in Washington, D.C., for murder. At that time there were many amazing scientific machines on the market, one of which was a lie detector. When a subject was asked a question, either a green or a red light would flash depending on whether he told the truth or lied. Frye was asked if he had committed the murder. He replied 'No,' and the green light lit. His lawyer tried to have that result admitted into evidence to prove Frye's innocence but the judge was skeptical because of an earlier case he'd had that involved a different machine."

"What machine?" I asked.

"An oscilloclast," he said.

"I've seen an oscilloclast," I said. "It's a box with many knobs and dials. Adjusting them was supposed to transmit the precise rate of energy to a patient to counteract his disease. But the machine was a hoax."

"Yes," he said, "and it was the judge in the *Frye* case who had presided over the trial where the truth about the oscilloclast first came out."

"What happened in that trial?" I said.

"One of the parties," he said, "presented an expert who testified he had opened the machine and examined how it was wired. He said that there were no connections between what was inside the machine, and the knobs and dials on its front face, so the oscilloclast couldn't transmit anything to the patient."

"The settings of the knobs and dials didn't matter," I said.

"Exactly," he said, "and because the judge was already skeptical about the reliability of black boxes, he told Frye's lawyer to produce an expert who had examined the lie detector and could testify about how it worked."

"Did he?"

"No. The expert told the judge that the machine was hermetically sealed and that his operator's rental agreement prevented him from opening the machine. The same kind of arrangement had existed with the oscilloclast, but that expert had broken the lease, opened the machine, and the truth came out. So when Frye's expert refused to actually examine the lie detector the judge ruled that the expert's testimony was inadmissible as evidence, and the jury ultimately found Frye guilty of murder."

"Frye appealed, I suppose," I said.

"Yes. He claimed that he would not have been convicted if the results of the lie-detector test had been admitted. Judge Josiah van Orsdel was assigned to decide the appeal. He was a rancher in Wyoming who apprenticed in the law and was eventually appointed to the Court of Appeals by Teddy Roosevelt. Van Orsdel's daughter had developed cancer and a doctor treated her using an oscilloclast, but she died. Shortly afterwards the oscilloclast hoax became public."

"This story is like a Greek tragedy," I said.

"Judge van Orsdel upheld the trial judge's decision to exclude the test results."

"On what did he base that decision?" I asked.

"He invented the rule that scientific testimony can't be admitted into evidence until it's generally accepted by scientists," he said. "Since the principle of detecting liars using a machine wasn't generally accepted, he denied Frye's appeal."

"He invented the rule?"

"Yes. And for seventy years it's been respected by the courts as if it were one of the Commandments, especially so within the last few years."

"So that's the story behind the *Frye* rule?"

"Yes," he said, "according to what I've been told."

"How ironic," I replied, "that the method for identifying what constitutes reliable scientific evidence, turns out to be the *ipse dixit* of a Wyoming cowboy."

The next morning I took the witness stand to testify about the EMF questionnaire studies, which were the only kind of studies that the judge would allow me to talk about. I told the jury that it was never possible to know anything confidently on the basis of questionnaire studies, but that it was possible to use them to reach reasonably reliable conclusions when there were many positive studies, which there were in the case of EMFs. Some federal agencies reasoned exactly as I did, and I gave examples. The Environmental Protection Agency relied partly on questionnaire studies when it decided that various agents were probable carcinogens. The Food and Drug Administration routinely made its decisions on the basis of questionnaire studies when it reached decisions that a particular drug was probably safe or unsafe, or probably effective or not effective.

I ignored the federal agencies that took a different approach because I



considered their policies ignorant and short-sighted. The Federal Communications Commission required absolute and certain knowledge that EMFs from TV and radio antennas caused cancer before they would take remedial steps. The Federal Trade Commission had the same attitude.

Under cross-examination, Zapper's lawyers established the following facts:

I was not a physician;

I had never treated anybody who had cancer;

I had never attended medical school;

I had never taken a course in cancer or oncology;

I had never examined the plaintiff or studied his medical records;

The EMFs in the questionnaire studies that I had described in my testimony had not come from police radar guns;

I did not know of any study that showed police radar guns caused cancer;

There were some questionnaire studies that were negative, though I did not discuss them.

After I left the witness stand, Benecke's lawyers presented two medical experts, each of whom testified that they routinely diagnosed and treated patients who had non-Hodgkin's lymphoma, that they both had examined him, and that they both believed that his cancer was caused by the micro-waves emitted by the radar gun that he had used.

Then Zapper presented a medical expert named Dr. Edward Boutbad who had examined Benecke and reached the opposite conclusion. Boutbad had written a textbook on the diagnosis and treatment of non-Hodgkin's lymphoma, and was generally regarded as the world's foremost authority on the subject.

During cross-examination Benecke's lawyer asked, "Dr. Boutbad, what causes non-Hodgkin's lymphoma?"

"Bad genes, I suppose," he said. "There are some theories, but no one knows for sure."

"Well, if you don't know what causes any particular cancer, how do you know that EMFs don't cause all of them?"

"The very idea is preposterous."

"Why do you say that? On what basis?"

"On the basis of my experience. I have been treating cancer patients for almost forty years. If EMFs were carcinogens, I would know about it."

"Then your testimony is that since you don't know about it, it can't

be true?”

“Objection, your honor,” said one of Zapper’s lawyers. “He’s leading the witness.”

“Sustained. Move on, counselor,” the judge said.

“Are you aware of a report by the Environmental Protection Agency that labeled EMFs ‘probable carcinogens?’”

“I heard about it. But it was only a draft, not an official report, and the Environmental Protection Agency backed off that claim.”

“Do you know why it was not adopted?”

“No.”

“Would it surprise you to learn that it was a result of political pressure?”

Before he could answer Zapper’s lawyer jumped up and yelled, “Objection, your honor! He is badgering the witness.”

“Sustained,” the judge said to the lawyer. “Move on,” which he did.

“Dr. Boutbad, you have heard the two medical experts for the plaintiff testify that microwaves caused the plaintiff’s cancer.”

“Yes I did, and I’m afraid it’s my fault.”

“Why is it your fault?”

“Because they are both former students of mine. They did their residency at my medical oncology program. The ignorance that they displayed in claiming that EMFs cause non-Hodgkin’s lymphoma points to a weakness in my program, which I will correct.”

The jury deliberated for two hours and then brought back a verdict in favor of Zapper, acquitting the company of all liability for causing Benecke’s cancer. In an interview for television the jury foreman said, “The top man in the field said that radar didn’t cause the cancer. We didn’t feel that we could go against him.” Another juror told a reporter outside the courtroom, “I would actually like to see these guns tested for safety.”

The attorney for Zapper told the press, “There has been a lot of hysteria about microwaves, but the radar guns emit only low-level energy. It’s comparable to the amount put out by a child’s walkie-talkie or a nursery-room monitor. Now,” he said, “police officers can breathe a little easier.” He then sued Benecke to recover attorney’s costs for defending against what he claimed was a frivolous lawsuit.

Soon after the Benecke trial ended, just before Christmas, someone called and said, “Dr. Marino, I’m a lawyer, my name is Jack Cordaro. I’m writing an amicus brief in a case pending before the U.S. Supreme Court,

and I think you can help me.”

“Powerlines or microwaves?” I asked.

“It’s a dispute over a drug prescribed to pregnant women. The plaintiffs took the drug and then gave birth to malformed children. My clients, however, are scientists. They became involved as friends of the court because they’re concerned with the underlying issue.”

“Which is what?” I asked.

“How courts should handle scientific evidence,” he said. “I know you’ve been involved with that question in the context of electrical energy, and even before that.”

“Before EMFs?”

“The safety of BHT,” he said.

“How did you know about that?” I asked.

“My father worked for the FDA. When I was growing up he would never let me or my sisters eat cereal that had BHT. Years later he told me that he had deemed it unsafe after some conversations with a scientist in Syracuse named Marino. I supposed that the BHT Marino from Syracuse and the EMF Marino from Shreveport are the same Marino. Correct?”

“Yes.”

“I’ll be in New Orleans on Thursday. May I drive up and see you late that afternoon?” he asked, and I agreed.

When we met he began by telling me that he had graduated from Tulane law school, after which he had clerked for a judge on the Federal Eleventh Circuit and for Justice Harry Blackmun at the U.S. Supreme Court before entering private practice. Then I said, “Tell me about the case.”

“The appellants took a drug for morning sickness called Bendectin, and their children had birth defects. They sued the manufacturer, Merrill Dow, under a variety of legal theories including negligence. Merrill Dow claimed that the proposition that Bendectin could cause birth defects was not generally accepted, and therefore that scientific testimony to that effect shouldn’t be allowed into evidence.”

“The *Frye* rule,” I said.

“Yes,” he said. “The judge followed the rule and excluded all the evidence that tended to show a link between the drug and birth defects, so Merrill Dow won. But judges in other federal circuits have rejected *Frye*. The split is eight in favor and three against, and the Supreme Court finally granted cert to decide what the legal standard should be to admit scien-

tific testimony into evidence. Many state courts use the federal rules of evidence, so whatever decision the Court makes will profoundly affect the legal system.”

“Who are your clients, what’s their interest?” I asked.

“They’re principal investigators supported by the National Institutes of Health who are afraid that science may become marginalized in society,” he said. “They think that ‘general acceptance’ is unrealistic because there is no community of scientists that can generally accept anything except the broadest scientific facts, like gravity, or DNA. So the effect of *Frye* is to keep science isolated in an ivory tower. That makes it seem to the public as if very little of what NIH scientists do leads somewhere or sums to something. If the public gets that idea, there will not be any grant money, at least not enough to go around.”

“And your clients think that whether Bendectin can cause birth defects is not such a broad fact.”

“Exactly,” he said. “There probably aren’t a hundred scientists in the world who care, one way or the other, and many fewer who are experts in the area.”

“If the courts move beyond ‘general acceptance’ as a method for deciding what scientific ideas are reliable and start looking into how we actually do science,” I said, “your clients may not be happy with where that leads.”

He looked at me quizzically and, after a pause, said, “Tell me what you think the rule should be for admitting scientific testimony into evidence.”

I said, “Anyone who claims that he knows something that can only be known by means of the scientific method should be required to explain how the method produced the knowledge.”

“And if he can’t?” he asked.

“Then,” I said, “he has no way of knowing and therefore has no knowledge, only opinion, which is not evidence of anything except what the witness has persuaded himself is good to believe in.”

“Shouldn’t an expert be able to tell a judge that something in an authoritative text is reliable?”

“Only if the expert can explain how he knows it’s reliable,” I said, “because scientific knowledge is a product of method, not authority.”

Cordaro agreed that my view was reasonable, and I continued along that same line because I thought the point was important and wanted to

drive it home. "Would you accept something as factual just because someone who was rich said it was a fact?"

"No," he replied.

"What if the claim were made by a governmental official, or a preacher?"

"I would trust those claims even less than I would that of a rich man."

"The same skepticism should greet those who claim scientific knowledge. Possession of an M.D. or Ph.D. isn't necessarily a surrogate for reliable knowledge."

"That makes sense," he said, and I went further down the road. "Do you know why knowledge claims based solely on authority should always be legally insufficient?"

"Tell me."

"Because the practice of according respect to authority sprang from a conception of scientists as being free of ignorance or bias, and always motivated by the desire to do good."

"Are there such scientists?" Cordaro asked.

"No," I said, "That's precisely why the law became an ass when it conjured them up."

I could tell that Cordaro was not ready to appreciate this perspective, so I simplified my explanation by appealing to the pragmatic justification I felt he had probably already settled on.

"The problem with 'general acceptance' is that it's unworkable because no one knows what it means or how to prove it," I said.

"That's plain from all the cases that followed *Frye*," he said. "No two courts have ever agreed on a definition."

"Isn't recognition of the practical shortcomings of 'general acceptance' sufficient for you to write a brief on behalf of your clients?" I asked.

"No, unfortunately," he replied.

"Why not?"

"When I clerked for Justice Blackmun, he always told me, 'Don't look at the legal issues. Go for the jugular. Tell me what the case is really about.' When I do that in this case I see a big problem."

"Which is?"

"The Court is increasingly conservative. One way this comes out is in its attitude toward rules that facilitate transfer of wealth from business to individuals, or that increase the cost of doing business. Toxic-tort and

product liability cases do just that, so it's to be expected that the Court will be hostile to those kinds of cases. I also know it's concerned about trial lawyers bringing specious cases based on scientific evidence that bamboozles the jury."

"So you're worried that what replaces *Frye* may be even more restrictive."

"Yes," he replied, and continued, "Despite its shortcomings, the *Frye* rule is empowering for judges. It enables them to keep control of their courtroom, and they have relied on it increasingly to exclude testimony from venal experts."

"That's good," I said.

"But the price is great. Testimony can be truthful and reliable even if it's not generally accepted," he replied.

"You seem to think that the Court is poised to throw out *Frye*."

"I'm almost certain of it."

"Why?"

"Well, just look at the facts in the case. The six experts who testified for the plaintiffs were well trained in various aspects of science relating to birth defects. Their full-time jobs involved performing laboratory and animal studies on drugs, including Bendectin, and they all worked in government or university laboratories. The single expert for Merrill Dow, on the other hand, simply read the literature and concluded in an affidavit that there were problems and uncertainties and that not everyone agreed Bendectin could cause birth defects. He was the president of a consulting company that specialized in providing company-friendly advice for drug companies. So, if you intend to reject the authority of the 'general acceptance' rule, this is the perfect case for granting cert."

"Do you have a hunch about what rule the Court will put in place after it dumps *Frye*?"

"My contacts with the clerk network aren't what they used to be. When I was there the Chief was in favor of asking Congress to create a science court, with judges who were scientists."

"The Chief?"

"Chief Justice Rehnquist. One Friday, after the justices had finished discussing that week's cases, Justice Blackmun returned to our office angrier than I had ever seen him. I asked him why he was upset and he said that the justices had been discussing a particular scientific point in con-

nection with one of the cases and the Chief had remarked, "How are we supposed to decide, nobody here knows the difference between an atom and an asshole."

"Why did the remark anger Blackmun?" I asked.

"Because he thinks of himself as a scientist," Cordaro replied.

"Blackmun, a scientist?"

"Well, sort of. He has a degree in mathematics from Harvard, and he's spent a lot of time in medical school libraries, something nobody else on the Court ever did."

"What did the other justices think about the idea of a science court?"

"They never said. They always deferred to the Chief whenever the question of the *Frye* rule was raised in a cert petition because they knew he wanted to wait for Congress to create a system of judge-scientists, so they always went along with him and denied cert. Now, that's changed. There will be a new rule."

"And it's hard for you to see what rule the Court is predisposed to adopt?"

"Whatever it is, it will be shaped by what the Court thinks is important. And what is most important to the Court is not science, it's judicial power. They want to keep control of their own courtrooms in the age of science. Also, it's a clean issue."

"What do you mean, a clean issue?" I said.

"The Supremes are political animals," he said. "They're very conscious of how they are perceived by the public. Their political standing and that of the entire judicial branch is determined by the hot-button issues that cause widespread emotional reaction and interest."

"Like Blackmun's abortion case?"

"Yes. He can't go anywhere without someone following him, waving a picket sign. At the other extreme there are cases that generate almost no emotional or political interest. Those involving scientific issues are examples, as are those involving rules of evidence. This case involves both, so there are two solid, independent reasons why the public isn't much interested in it. When the pressure is off, the Supremes always do what's best for the judiciary."

"So you need an argument that doesn't simply repeat those of other parties and that serves your client's interests, but that doesn't frighten the Supremes into thinking they will lose some power, and you think they're likely

to buy such an argument because there won't be any political fallout."

"Exactly," he said.

"What are the other arguments that have been advanced thus far in the case?"

"The appellants will attack the authority of *Frye*, the respondent will claim that overruling 'general acceptance' will undermine the integrity of science, and the other amici will support one side or the other while making arguments that are flavored by their perspective regarding what is important."

"What arguments do you anticipate that the amici will make?"

"The American Association for the Advancement of Science and the National Academy of Sciences are in favor of the *Frye* rule," he said. "They claim it results in legally reliable science. I think they're worried that if there are too many controversies Congress might start poking its nose into how scientists spend money, like in the days of Proxmire's Golden Fleece Award. Evidence fuels controversy. *Frye* keeps out evidence. So, for them, it's a no-brainer."

"They won't say that in their brief, will they?"

"No, only that *Frye* is necessary to avoid outcomes in court that are what they call 'at odds with reality.'"

"Who else is in favor of *Frye*?"

"The American College of Legal Medicine," he said.

"Who are they?"

"People who think that doctors are sued too often. They want *Frye* upheld, and then extended to malpractice cases."

"Are there more amici?" I asked.

"Oh yes," he replied. "The American Insurance Association is strongly pro-*Frye*. They say it would add uncertainty to their business if the *Frye* standard were to be relaxed. Of course, uncertainty is not something they like."

I said to Cordaro, "They all argue that a particular result would be just, but in reality it's what they desire."

"Or what they realistically think they can achieve," he said. "The public position of the Chamber of Commerce is that *Frye* should not be changed. They actually favor a more pro-business rule, but their lobbyists haven't been able to generate any support for it on the hill. So I expect them to make the political decision to throw their weight behind *Frye*."

"What rule do they favor?"



"That experts shouldn't be permitted to present any scientific evidence in court unless they first present the results of a survey of all experts in the relevant field showing that at least 75% of them agree that the proffered testimony is a scientific fact."

"What other friends of the court have jumped in?"

"The Pharmaceuticals Manufacturers Association and the American Medical Association. They both say that *Frye* is far too liberal. Undoubtedly they will advise the Court to adopt a stronger test."

"What's their interest?"

"The ready availability of drugs. For them, Bendectin is the poster boy for what can happen to a drug when the legal standard for admissibility of scientific evidence is too low. Bendectin was approved by the Food and Drug Administration as safe and effective. Following the initial lawsuits that claimed it caused birth defects, the FDA reevaluated Bendectin and again concluded that it was safe. Nevertheless, the number of lawsuits continued to increase, and Merrill Dow took Bendectin off the market. Now there is what the AMA calls a "significant therapeutic gap" in the treatment of morning sickness. They're afraid that the pharmaceutical companies are going to stop pursuing all research in contraception and fertility."

"Who else supported *Frye*?"

"The American Tort Reform Association."

"Who are they?"

"An amalgam of trade associations of industries that tend to be defendants in lawsuits in which what they consider to be junk science is used against them. They would very much like to see that problem go away."

"So they want to toughen the *Frye* rule?"

"Of course," he said, "and there is more than a little basis for their concern. There have been some suits in which people claimed that exposure to an infinitesimal quantity of a substance was responsible for their illness. It's not hard to find an expert who will testify to virtually any theory of causation up to and including the fantastic."

After we agreed that every profession has its counterfeiters, Cordaro mentioned one more group that wanted to put in its two cents.

"The *New England Journal of Medicine* filed an amicus brief in support of Merrill Dow. That surprised me," he said.

"Not me," I said.

"Why?" he asked.

"It's the most famous medical journal in the world. Its editor decides what constitutes scientific knowledge, because publication there entails general acceptance. Weakening *Frye* would knock it off of its perch."

After Cordaro had brought me up to speed regarding what he thought the other amici would say, he asked, "What do you think I should urge the Court to put in place of *Frye*?"

"During a trial," I said, "suppose a lawyer proffered a witness who would testify that the traffic light was red when the plaintiff entered the intersection. Would the judge allow the witness to testify?"

"If the testimony were relevant to the case, yes."

"On what basis would the judge make that decision?"

"According to your hypothetical, the witness has knowledge about relevant events in the case."

"This personal knowledge that the witness has, how did he get it?"

"By perception. He saw what happened."

"So if the witness is asked, 'How do you know the light was red?' he can respond, 'I saw it.'"

He agreed.

"Then not only does he have knowledge, he can explain how he got it."

He agreed.

"It must be the same for an expert. He must have knowledge, and he must explain how he got it. Since his claim is that he possesses scientific knowledge, he is restricted regarding the basis upon which he can establish that he actually has such knowledge. He must have obtained it by means of the scientific method."

"That's not something judges know a lot about," he said.

"I understand," I replied, "atoms and assholes."

When he stopped laughing I said, "Judges don't have to be scientists. They only need to let the adversary system work, and if the lawyers aren't assholes it will be more or less obvious to the jury which experts are ignorant, or worse."

"I think you've got something there," he said.

As Cordaro was preparing to depart I asked him, "What's your guess regarding who will be assigned to write the opinion?"

"It will probably be my old boss," he replied.

"Blackmun?"

"Yes. The other justices usually defer to him in scientific matters,

though that deferential respect irritates some of the others, particularly Justice White.”

That night I found it difficult to sleep. The Supreme Court was going to decide a case that would have a profound impact on science. Their decision could push science even farther to the edges of society, making it the exclusive province of enormously specialized technocrats. Or the Court could move in the opposite direction and require scientists to explain themselves, which would bring science itself, not just technology, into the stream of ordinary life where it belonged. After all, the public owned science, the way a man owns his hand. A hand doesn't think for itself and justify itself by saying, “Leave me alone and I'll continue to do what you want if it's also what I want.”

Despite the importance of the looming decision, no one seemed to care about it. A clean case, as Cordaro had said. If you had just landed from Mars and scoured the media for information, you would find almost nothing that signaled that the Court was on the verge of making such an important decision. I don't know how long I lay awake, staring at the ceiling, but eventually I fell asleep.

• • •

I saw Justice Blackmun. He was seated at his desk reading some scientific journals. He seemed very old. When he noticed me he greeted me warmly and said, “We talk to lawyers all the time, but we don't often talk to scientists.”

“I would like to ask you something,” I said. “Every place you go you are picketed by people who try to make your life miserable. It looks to me as if the road you've taken is not easy, and now that you are near the end I'd like to know how it looks to you. What's it like to be hated by so many people? Is it a hard time of life?”

“I'll tell you how it is, Andrew. From time to time I talk with the other justices, and most of them complain about the abuse they receive. They say it's an inevitable consequence of a life as a judge, and they look back fondly to the time in their lives when they were popular with everyone. At first I too suffered, but age has brought me peace. It is the character of a person that matters most. If someone is balanced and rational, then frenzied attacks in public are only moderately troublesome. If not, then it is hard to deal with any form of criticism. My notoriety is not a cause of pain because my decision was just.”

"Why so?" I asked.

"Because it was based on scientific knowledge in journals," he replied.

I was amazed by what he said and I wanted to hear more, so I said, "Perhaps the hoi-polloi don't accept that your decision was based on scientific knowledge because they think it sprang from power. They say that justice is anything the Court says it is, like a baseball umpire calling a pitch a strike or a ball."

"There's something to that," he said, "but not so much as is generally supposed. My decision wouldn't have become law had I not been a judge, but it's not the law that makes it just, rather it is the science on which the decision was based. The man without power cannot make law, nor can the man who does not adhere to science even if he has power."

"Then your decision will be that judges should read the journals to decide questions like whether Bendectin causes birth defects, because that's where scientific knowledge is stored?"

"Yes. If that scandalizes some, then so be it." As he spoke he gently stroked a journal on his desk as one might do to the head of a small child.

"So you think that science is naturally honest, and that the information in journals is reliable?"

"That's right," he said.

"Didn't you ever hear the expression, 'He who has the gold makes the rules?'"

"Yes."

"Couldn't that sentiment account for some of the facts that appear in journals?"

"What do you mean?"

"I could tell you about published facts that are actually counterfeit. For example, if you don't want to find stress effects in rats due to electrical energy, make them live in tiny cages so that they're already stressed from being crowded. Then you can write in the journal that electrical energy doesn't cause stress. Even better, keep doing an experiment over and over until you get the results you want, and then publish that as if it were the whole truth."

"That's very sad," he said, "but I think that the truth eventually works its way out."

"All in God's time, like a ripe apple that falls from a tree," I said, but my attempt at irony failed and the old judge replied, "Well put."

“What if no one plants the tree,” I said, “or fails to provide what it needs to grow, or hides the apples?”

“What has that to do with scientific knowledge?” he asked.

“I’ve just told you how I have often seen it obfuscated,” I replied.

“The world is governed by mathematical laws,” he said. “No conspiracy can stop those truths from emerging.”

“A biologist has no equations. His knowledge consists only of rules derived from observations that depend on experimental conditions, and on the perspective of the observer.”

“Then biological knowledge cannot be certain or absolute?” he asked.

“When I was young I thought so. Even after I had confronted the issue of health risks from electrical energy, where I saw strong differences of opinion that seemed impossible to resolve, I still believed in the existence of a canonical scientific method. After a long time, however, I understood that there was something deeper than method – there was desire, the reason why anyone makes any effort in the first place. Desire is the only absolute.”

“Well, it’s hard to know what to make of that,” he said. “Ever since my days at Harvard I’ve admired the scientific method. It is the greatest machine for discovering knowledge ever invented. It’s so much purer than the adversarial process.”

“So you think that the scientific method and the adversarial process are different?”

“Of course,” he replied. “You don’t?”

“I think that they are more or less identical, as evidenced by the many things they have in common,” I said.

“Such as?”

“They both seek truth.”

“Yes. What else do they have in common?”

“Both activities are carried out by specialists for the benefit of others.”

“That’s true,” he said.

“They have two other similarities. One is a process for purging error. Scientists have peer review, lawyers have cross-examination.”

“What is the other similarity?”

“They both seek victory in battle.”

“What do you mean?”

“What does a lawyer do when faced with evidence against his client?” I asked.

"Oppose it," he replied.

"Suppose a scientist was employed to champion nuclear power, a strong military, or the healing power of pharmaceuticals," I said, "what would he do when faced with evidence opposing his client's interests?"

"The same as the lawyer, I suppose."

He paused for a few moments during which time he resumed patting the journal, and then he commented, "But the facts in science are complex. Juries can sometimes be confused."

"So you think that judges are better than juries at determining what constitutes scientific knowledge?"

"For the most part," he said.

"I can't imagine why," I said, "because every pertinent study has concluded that juries are at least as good as judges in deciding whether scientific evidence is reliable. It's harder to razzle-dazzle twelve men than it is only one."

"Then do you think that questions like whether Bendectin can cause birth defects are exclusively within the jury's province?" he asked.

"The judge should decide whether there is any evidence produced by means of the scientific method that Bendectin can cause birth defects, like requiring someone to examine a machine to determine that it operates as advertised. Then the adversarial system should be permitted to play its role. It is for the jury to decide whether Bendectin probably can cause birth defects and whether, in the particular cases, it probably did so."

"So you would say that the question for the judge is *how* does the expert know, and the question for the jury is *what* does he know?"

"I would," I said.

"Andrew, I must leave now to sign my retirement papers and turn in my keys," he said, and he hurried away.

The *Frye* rule died on June 28, 1993, the day Justice Blackmun issued his decision. Writing for a unanimous court, he rejected "general acceptance" as the applicable rule of evidence in federal courts for admitting scientific testimony, and held that it could be admitted only if it actually was "scientific knowledge."

For a long time, Judge van Orsdel's rule, that the condition for the law to regard a scientific proposition as reliable enough to be considered by a jury was that the proposition be generally accepted by scientists, had lain dormant, like an ungerminated seed in dry soil. During that time science

and law rarely encroached on each other's domain. When the law began to progressively take cognizance of scientific knowledge, it was almost always in the form of the personal opinion of an expert, the pivotal courtroom question for whom was, "What do you know?" He was never asked, "How do you know?" because the answer to that question was presumed to stem in some mysterious way from the expert's training and experience that laymen could not understand. The prototypical expert was the physician who testified in a kind of legal case that developed in the latter half of the twentieth century, medical malpractice. One expert sympathized with the patient and identified what he thought was a substandard aspect of the care provided by the defendant. Then, according to the law's formula for that cause of action, the expert would make the extraordinary statement that the defendant's substandard performance caused the plaintiff's injuries. How exactly did the expert know this? Why couldn't the cause have been the part of the care that was standard, or even the disease process itself? Don't ask! Let the experts for both sides testify, and the jury will decide. How will the jury decide? Don't ask!

When there arose the matter of whether cigarettes caused cancer, the law headed farther out into the wilderness. The physician expert testified on the basis of training and experience, his examination of the patient and, remarkably, on the basis of questionnaire studies that showed an increased probability for cancer among smokers. Statistical evidence was admitted by the courts for the first time to help establish the proposition that the plaintiff's cancer was caused by smoking. But it's one thing to say that, in general, smoking causes cancer, and it's quite another to say it did so in the plaintiff. So how does the expert know that smoking caused cancer in the plaintiff? Don't ask!

The pattern was repeated many times. Cases were brought by workers who had been exposed to asbestos which, they claimed, had caused their cancers. The proof they offered consisted of opinions of physicians and the results of questionnaire studies, and they prevailed. The Richman law firm made millions of dollars from these cases. It was less than the billions they got from winning a string of cigarette cases, but a good payday nonetheless. After that came Agent Orange, and breast implants.

While all this was going on I had arrived on the scene, full of wonder about what EMFs could do and concerns about the harm that could arise from their indiscriminate use. From the beginning I worried about how I

knew what I thought I knew, and about how the experts who testified for the companies knew what they claimed to know. I became convinced that they didn't know, and that they were only telling a story in specialized language, like poets. I waited for those experts to be put to the test, but that never happened.

I didn't take seriously the proposition that a physician could look at a patient and say what caused or did not cause his disease, and I didn't think questionnaire studies were probative – and even if they were, I thought it was evil to rely on them for knowledge of what causes cancer. So I paid little attention to law cases that were founded on the opinions of physicians and the results of questionnaire studies. That kind of evidence was not relevant to what I was attempting to do. I suppose that I hoped the law would develop to the point where an expert would have to explain and defend what he claimed was scientific knowledge. I believed that evidence relevant to what had caused disease, any disease, must come from experiments involving animals, and that there was no other ethical or logical method to know such a thing. That was the course I was on, and I'd had no other choice but to ignore the misguided law of scientific evidence known as the *Frye* rule, which is what I did. During this period, *Frye* claimed even more victims. The most pathetic were Vietnam veterans who had developed cancer and birth defects after they had been sprayed with Agent Orange. The judge in those cases said that it was not generally accepted that animal studies could be used to prove whether something could cause cancer in human beings, and he declared all such testimony inadmissible as evidence. He required each veteran who was trying to prove that his cancer came from Agent Orange to submit an affidavit from a physician expressing that opinion. How absurd! How ridiculous! But how inevitable!

Then the *Daubert* decision was announced and everything changed, at least in theory. The decision did more than drive a stake through the heart of *Frye*. Every justice on the United States Supreme Court agreed that scientific knowledge was not a matter of authority or popularity, but rather the product of a method. If Supreme Court decisions were measured by a quotient consisting of the impact they eventually have on the world divided by the quantum of society's perception of the importance of the decision at the time it was issued, then the *Daubert* decision might be the Court's most important decision.

In the wake of *Daubert* a crucially important problem remained unre-



solved, as I saw vividly when I participated in a post-*Daubert* trial where the allegation was that powerline EMFs caused the plaintiff's leukemia. My old friend Patty Ryan ran the show for the defendant and, because of *Daubert*, he was unable to prevent me from testifying on the basis of animal studies that the plaintiff's cancer had been caused by the company's powerline. But I saw that it took more than *Frye's* death to get at the truth of the matter, it took lawyers who not only liked what I was saying because it helped their clients, but understood what I was saying and, consequently, understood why the experts who testified for the power company were advocating a vastly inferior position. Understanding requires effort, and making the jury understand requires even further effort. I saw that a prerequisite for success under the *Daubert* regime was a plaintiff's lawyer who understood scientific language and who therefore could cut through it to expose the weakness of the defendant's experts with the requisite clarity that could lead to understanding on the part of the jury. But, in my whole life, the only lawyer I ever met who knew the difference between an atom and an asshole was Patty Ryan. So from my point of view, until I found the right lawyer, further cases were a waste of time, and I turned my attention elsewhere.