THE UNIVERSITY OF KANSAS LAW REVIEW

February 2003 Volume 51, No. 2

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Now for something completely different than you've been hearing. I met Judge Robert Henry when we were at a program in Washington for appellate judges and we were sitting at dinner at the Supreme Court building after a glass of nice wine. He said, "You know, judges went into the law because they wanted to avoid science." Then we discussed examples and he said, "But it gets you anyway," especially after *Daubert*.[1] So in the law you have to know something about science and you need to be comfortable with science. I'll confess that I went into science because I wanted to avoid all those really mindless civics and government courses in high school. I never really studied the law, and it wasn't until I started working as science advisor for my congressman that I figured out how often people in the House get elected and what the districts are and that sort of basic government information. The point is that we all have a lot to learn from each other.

The Federal Judicial Center deserves a quick advertisement because their education programs are great. When they bring scientists and judges and lawyers together, as they try to do increasingly for rigorous continuing education programs, some of those programs are outstanding for all of us. Learning with each other has the effect of demystifying science for lawyers and judges and of demystifying law for the scientist and interpreter of science, like the historian and philosopher of science. We really have to have more of that going on so that we are educating each other and working together.

We hear a lot; and especially in this program for the Tenth Circuit courts, we've heard a lot about "gee whiz" technology, surveillance, computers, telecommunication, and the kinds of things that are going to make America safe or that put us at various kinds of risk. Those innovations are all very important. But biotechnology is another area where there is tremendous development that is less well understood by the larger public, including judges, and that's what we need to look at more closely. There's cloning, stem cell research, gene replacement, even science-fiction scenarios like DNA chips where we will all have our infor-

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1. Daubert v. Merrell Dow Pharmaceutical, 113 S. Ct. 2786 (1993) (requiring that a trial judge prescreen expert testimony to ensure that it rests on a reliable foundation and is relevant).

mation on our foreheads and get scanned so that "they" will know everything about us, maybe organ transplants from pigs or other farmyard friends, regenerative medicine—these sorts of things are out there in the press. They are being studied in research laboratories in various ways. So they are eventually likely to come into the courts, and will inevitably come into the law.

But how do we sort out what's real? What's hype? What's junk? What does the science really tell us; who is the expert on these things, and do we need special experts to sort out who counts as an expert on really specialized issues? Some of these innovations aren't just about any one area; they aren't only about genes, or just about development or even just about biology. They are about a lot of things and therefore we need a lot of different experts working together. This is complicated. At times maybe we need some level of meta-experts to sort out among the experts to decide what should count for which issues. I'm concerned with how science is important for the law, and with core questions including: who knows, who says, so what, who cares, and what difference it makes to you. Those are not modest questions that we will answer in the first five minutes, but rather they are obviously all big questions so it is valuable to focus in order to make progress in addressing them. I focus on embryo research in particular and ask questions like—what is life, what's the law and how did these two come together?

Let's remember back before September 11th, 2001—can we remember back that far?—to August 9th, 2001. For those of us who studied developmental biology, that was a very important day. That summer evening President George W. Bush spoke to us from his ranch in Texas about stem cell funding. Why? Why was the *President* telling us about scientific research and what would not be funded? There are already interesting legal questions there. What does Bush know about stem cells, or about science for that matter, and why did he tell us several times in his speech and many times since that he prayed for his answers about science, that he had consulted with all of the experts, including all of the major religious leaders about science? Bush said this week that he wouldn't appoint a judge who didn't understand that our rights come from God. Does science come from God too? Is God the expert on these issues? How do we decide?

Well, not really obviously, but clearly these aren't just issues about science but about how science plays out into society and how we value scientific knowledge. They are ethical issues, legal issues, and values issues, and we have to work together to figure out what the right laws should be and how to adjudicate among competing claims. How do we get a reasonable balance of science and social interests? What's going

on with cloning and stem cell research, with genomics, with zeno transplantations, things like that? I think everybody ought to be able to define somatic-cell nuclear transfer, for example, to talk about it at cocktail parties and know what you are talking about. This is the technique that gave us Dolly, the sheep, and we ought to understand this scientific innovation that shook us out of our biological complacency about what life is about. Somatic-cell nuclear transfer is actually a simple concept and every educated person should understand it and be able to explain it.

I think everybody should understand fundamental biological issues. Why is it that Senator Ted Kennedy and Senator Orrin Hatch, who were usually not political buddies, you know, why did they both say that a thirteen-year-old named Katie was a terrific lobbyist, one of the most persuasive on Capitol Hill. Young Katie said, in response to a question after a hearing where she read her statement, "Mr. Senator" (I don't think that's the right form of address but it works if you are thirteen), "Mr. Senator, do you really believe that a bunch of cells in a dish are as important as I am?" She has juvenile diabetes. "Do you really think they have the same dreams and the same suffering that I have? Can you really pass laws that will protect that bunch of cells and not allow research that might help me?" What we need to do is talk about the science, to understand the basic scientific concepts and advances that matter to all of us. Then we can talk intelligently about the implications of the science and the legal and social aspects. We can understand that with something like stem cell research it is not a matter of moral good guys on one side and overly-enthusiastic or wild-eyed researchers on the other side. It isn't that simple, of course.

Let's start thinking about science: What is it? What is it not? Many of you, like most people, confess that you are afraid of science or you say things like, "Well, science wasn't my subject." But you are judges and lawyers. You have to address important questions and to be social leaders. Science has to be your subject. It has to be all of our subjects. That holds for congressmen, teachers, some doctors (some of whom say that science wasn't their subject and that's really scary) and even scientists, who will often say about other specialized areas of science than their own that, "That's not my subject." A chemist may know a little about biology, a geologist a little bit about astronomy, and certainly none of them knows everything about all of science.

What we need to do is get comfortable with and demystify the process of doing science so we can figure out who knows what. Who are the experts, and with respect to what issues? What is junk science? What is sound science? We need to understand things like that science changes over time and that's just fine. It can be a problem for the law if we don't

understand that scientific knowledge changes. We need to think about how that works. In law, what we know is supposed to stay known. It's not supposed to change. Science is supposed to give us something reliable, something like truth, and truth is supposed to be true forever, right? It never changes. But even though scientific processes remain consistent, scientific knowledge does not remain stable, nor is it even supposed to. Science should change over time because we learn more and we revise what we thought we knew. That's fine, and it's normal, and indeed that's a fundamental part of science. Let's learn to deal with that fact.

In addition, at any given time, some science is uncertain. It's probabilistic, statistical and that's the best we are going to get. We are going to have to figure out how to work with this too, even though that's not easy for you as judges and lawyers when you want an answer and statistical answers are too messy. Finally, science is imperfect and incomplete. There are some things scientists don't know and can't know, and we have to figure out how to work with those limitations. We have to understand that at any given time there may be competing claims for what counts as good science. So which experts will we listen to? How will we know?

When I was doing an all-day in-court seminar in New Orleans for the Federal Judicial Center we were lingering over one of those wonderful New Orleans's breakfasts. One judge from nearby said somewhat timidly, "You know I'm probably going to fall asleep. My daughter teases me because I never understand science. It wasn't my subject. I'm afraid of science. I'm only here because Chief Judge Helen Berrigan told me I had to come. I'm really sorry if I get sleepy. It's nothing about you if I don't understand what's going on." So my challenge all day was to get her jazzed and to have her go away knowing what somatic-cell nuclear transfer was. She did get excited and at the end of the day she said, "I get it! I get it! That wasn't science. I understood that. That was fun." Okay. That's the point. Science should be fun. It should be interesting. It should be something for all of us and certainly not some expertise that only some eggheads out there in the universities and research labs have. I'm an unrecovered academic. I love teaching; I love being an academic; and I love learning. Many of you are also teachers; teaching from the bench or before the bench is an important part of your job. And we are all learneds. We can all learn from each other, and it's important that we do our best to do so. Thanks!

[*Applause.*]