SCIENCE IN THE COURTROOM

Should Engineer Witnesses Meet Same Standards as Scientists?

Five years ago the U.S. Supreme Court gave trial judges more authority to throw out testimony from scientists that doesn't meet strict tests of scientific validity. Now the court may be ready to rule on whether judges should apply the same rules to testimony from other kinds of technical experts.

The high court has agreed to rule on a case, *Kumho* v. *Carmichael*, involving the testimony of an engineer who claimed that a defective tire led to an accident. At issue is whether his testimony should have to meet scientific standards. Late last month the National Academy of Engineering (NAE) filed a brief in support of the tire company, urging the court to set the same rules for engineers in this case that it does for scientists. But the case is likely to extend far beyond the engineering community to everyone from accountants to forensics experts. "The extension to engineering is an important clarification, but in the background is the whole question of how medical testimony is going to be treated," says Joe Cecil, a researcher at the Federal Judicial Center in Washington, D.C., who found in a 1991 study that 40% of expert witnesses in federal civil cases are from medical and mental health fields and only 10% are scientists.

Although pro-business groups have lined up in support of the principle that technical testimony must be grounded in rigorous science, organizations that represent people who bring product liability suits argue that crucial evidence from many kinds of experts who do not publish their findings could be shut out. "It could really undermine the ability of experts to testify based on their experience and knowledge," says Sarah Posner of Trial Lawyers for Public Justice, a group in Washington, D.C.

The backdrop for Kumho is a 1993 decision, *Daubert* v. *Merrel Dow Pharmaceuticals*, in which the Supreme Court called for trial judges to act as "gatekeepers" and screen out unreliable scientific testimony (*Science*, 2 July 1993, p. 22). Until then, the prevailing standard was whether testimony was generally accepted by the scientific community. The court said judges should instead use four criteria: empirical testability, peer review and publication, rate of error of a technique, and its degree of acceptance. In some cases this has helped to get novel technologies into courtrooms, including DNA evidence, notes Cecil. But more often it has allowed judges to exclude testimony, especially in product liability cases, deemed to lack scientific validity.

ANN ELLIOTT CUTTING

The Supreme Court left open whether *Daubert* could be used to assess other kinds of expert testimony, and circuit courts have been split on the issue. In *Kumho*, a minivan owned by the Carmichael family of Alabama blew a tire in 1993, leading to an accident that killed one of their children. The family sued Samyang Tire Inc. (now Kumho Tire Co.), the tire's manufacturer, offering testimony from a mechanical engineer who claimed a defect had caused it to fail. A trial court rejected the testimony, saying it didn't meet the four *Daubert* factors, and dismissed the case. But the 11th Circuit Court found that it was wrong to apply the *Daubert* principles, ruling that the engineer's testimony was "more like a beekeeper['s]" than a scientist's because it relied on observations and experience.

Kumho's lawyers argue that expert engineers should meet the *Daubert* standard and that this would "drive the quality of such expert evidence in the right direction by ensuring the reliability of their analyses and methods before admitting their testimony." Washington, D.C., attorney Richard Meserve, who filed the NAE's amicus brief, agrees: "Should engineering [be subject to the same] reliability call? The brief says yes ... especially where something failed."

The families have yet to file their brief, but they argued in a response to Kumho's petition that the tire expert's testimony shouldn't be judged by the *Daubert* criteria because it was "based upon technical and specialized knowledge as opposed to his application of scientific principles and theories." Their attorney, Robert Hedge of Mobile, Alabama, says that although *Daubert* may apply to some types of nonscientific testimony, there are "literally thousands of areas of expertise," from tire analysis to a surgeon's assessment of a herniated disk, where an expert's opinion is based on experience and "there's no error rate, no peer review, and it can't be tested."

Some legal observers say that requiring judges to apply *Daubert* to all technical experts could cause confusion. "Peer review and publication in some careers just doesn't make any sense," says Margaret Berger of Brooklyn Law School. The reliability of the testimony is more important than whether it meets *Daubert* criteria, she says.

Berger adds that "I think a lot of this is, 'My discipline is as good as your discipline.' " In a sense, NAE agrees. It asserts in its brief that engineering "is founded on scientific understanding" and can be judged by the same principles. —JOCELYN KAISER

MICROBIOLOGY

Cattle Diet Linked to Bacterial Growth

Food safety experts have been losing ground against bacterial contamination. The most threatening strains, like *Escherichia coli* O157:H7, continue to pop up in spite of increasingly stringent food safety standards, be it in beef from a Nebraska-based company, Japanese radishes, or Wyoming tap water. On page 1666, a research team from the U.S. Department of Agriculture (USDA)

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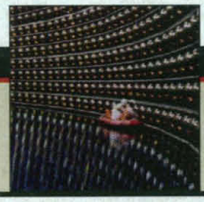
Young investigators: "Feelings of disappointment, frustration, and even despair are palpable."

LEAD STORY 1588
How the cerebellum fine-tunes movement



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Neutrinos weigh heavy in physics theory

and Cornell University offers findings that support a novel explanation for the increased numbers and virulence of *E. coli* outbreaks over the past decades. The problem, they say, may stem in part from diet changes among beef cattle.

The digestive tracts of cattle nurture some of the most virulent strains of *E. coli*, which can later find their way into beef and also into other foods that come in contact with infected manure. Since the Second World War, cattle diets have shifted from hay to starchy grain feed. And the Cornell team, including USDA microbiologist James Russell, postdoc Francisco Diez-Gonzalez, graduate student Todd Callaway, and undergraduate Menas Kizoulis, now shows that the digestive systems of cows fed hay generate less than 1% of the *E. coli* found in the feces of grain-fed animals. What's more, bacteria from the grain-fed animals were much more resistant to acid, making them more likely to survive in the human stomach and cause infection.

BILL BEATTY/VISUALS UNLIMITED

Healthy diet? Feeding cows hay may help prevent the spread of *E. coli* in beef.

"This [research] is in a class by itself," raves Gary Schoolnik, chief of the infectious disease division at Stanford University Medical School. "[It] opens the door to a whole field of research that needs to be done." Schoolnik suggests deliberately infecting cows with the O157 strain, so that researchers can directly compare its incidence in animals fed hay and grain diets rather than focusing broadly on the bacteria as Russell's team did. More work will also be needed to test a practical implication of the new finding: that switching cattle to hay a few days before they are slaughtered could limit the frequency of dangerous *E. coli* outbreaks.

The researchers began by surveying 61 Cornell-owned cows that were consuming different types of feed. One group was eating hay or grass, which is naturally rich in fiber, while the other two received either 60% or 80% corn diets. After at least 3 weeks on the diets, the three students tackled the not-so-pleasant task of removing fecal samples from the cows' rectums and determining their *E. coli* counts.

They found that *E. coli* flooded the digesta of the high- and midlevel grain groups, with more than 6 million cells in every gram. But among animals fed hay, researchers logged a mere 20,000 cells per gram. When the samples sat for an hour in acid similar to that in the human stomach, virtually all *E. coli* in the hay-group digesta were destroyed; in the 80% grain division, 250,000 per gram survived—more than enough to sicken an individual if the O157 strain is present. "We were absolutely shocked by the difference," says Russell. "We never found an animal that didn't agree with the trend."

Russell attributes this dramatic variance to the digestive tract of cattle, which has a hard time breaking down starch. Consequently, large amounts of grain can pass into a cow's intestines undigested. This triggers a fermentation process that provides more nutrients for the bacteria to grow on, as well as releasing acid, thus exposing the *E. coli* to an environment that selects in favor of acid-resistant strains. This theory got a boost when Russell's team found that the colonic contents of grain-fed cattle were up to 100 times more acidic than those of animals given hay.

Not all microbiologists were convinced by the data in the paper, however. Michael Doyle, who directs the Center for Food Safety and Quality Enhancement at the University of Georgia, Griffin, argues that lauryl sulfate broth, used to determine the numbers of *E. coli* by dilution, is no more selective for *E. coli* than other bacteria and would not reveal an accurate count. "The methods as they're written" don't make sense, he says. Russell counters that although lauryl sulfate isn't a foolproof selection method for *E. coli*, "the results were confirmed by other tests." For example, the researchers showed that, as expected for *E. coli*, the bacteria could grow in a medium containing lactose, releasing carbon dioxide gas as an end product.

If further work confirms the connection between diet and bacterial growth, the cattle industry might help keep *E. coli* O157:H7 out of the food supply by switching cattle off grain before slaughter. Russell says their work showed that "in 5 days on hay, you can eliminate all acid-resistant *E. coli*."

It may not be easy to persuade the cattle industry, however. "I think people in feed lots are going to be hesitant to institute a change" in cattle diet, says Fred Owens, a ruminant researcher at Optimum Quality Grains in Des Moines, Iowa. Owens cites logistical problems, such as having to transport and store large quantities of hay, as well as a potential drop in market value should the cows' weight fall while on hay.

But many microbiologists believe the costs might be worth it. "I think whatever steps we think make sense we ought to consider doing," says John La Montagne, deputy director of the National Institute of Allergy and Infectious Diseases. He adds, "*E. coli* O157 is a big problem, potentially a very big problem." —JENNIFER COUZIN

BIOMEDICAL RESEARCH

Senate Committee Votes Boost for NIH

Biomedical researchers can chalk up another big advance on Capitol Hill: The Senate Appropriations Committee last week approved a bill that would raise the National Institutes of Health (NIH) budget by almost $2 billion, to $15.6 billion, a massive increase of 14.7%. This is much more than Congress has offered other research agencies, and $800 million more than the NIH increase proposed by the White House. If the bill is approved as written, it would put NIH on track for doubling its budget within 5 years, an ambitious goal set by health research advocates and congressional leaders early this year (*Science*, 10 April, p. 196). The bill would also establish a new earmark: At the behest of Appropriations Committee Chair Ted Stevens (R–AK), it includes a $175 million set-aside in NIH's budget for prostate cancer research. This year, NIH is spending about $114 million.

But before any of these plans come to fruition, congressional aides say, a few road-