Science & Society

What science is admissible in court?

On June 28, the Supreme Court ruled on what types of scientific evidence are admissible in a court of law. The decision rejected the view of two lower courts that research data and interpretations must be peer reviewed and published before they can be used to help decide legal claims.

The ruling grows out of a lawsuit against Merrell Dow Pharmaceuticals, Inc., brought by two boys born with severe birth defects and their parents. The families had alleged that Bendectin, an antinausea drug taken by the boys' mothers during pregnancy, led to the children's congenital abnormalities. But the case was dismissed in 1989 by a judge who ruled that the expert testimony upon which the families' case was based was inadmissible. Because of the recent Supreme Court decision, the case can now go to trial again.

In the opinion he authored for the court, Justice Harry A. Blackmun noted that the scientific community had been following the case closely. Allowing courts to exclude what judges deem "invalid" evidence, he said, might "sanction a stifling and repressive scientific orthodoxy." Other parties that had submitted "friends of the court" briefs in the case argued that letting experts determine what constitutes admissible data might allow conjectures and poor science to be presented as widely accepted facts or interpretations.

The court agreed that publication of information and ideas in a peer-reviewed journal should be considered in assessing the validity of material offered to a court. But publication should not be the sole criterion of admissibility, according to the justices. Sometimes, the court said, "well-grounded but innovative theories will not have been published." Other times, propositions may be "too particular, too new, or of too limited interest to be published." In the end, the court expressed confidence that "the traditional and appropriate means of attacking shaky but admissible evidence" – namely vigorous cross-examinations, presentation of contrary evidence, and careful instruction to juries – should ensure that justice will be served.

In a strongly worded, partial dissent, Chief Justice William H. Rehnquist and Justice John Paul Stevens asserted that several passages in the just-issued opinion are confusing. Moreover, they predicted, "countless more questions will surely arise when hundreds of district judges try to apply [this opinion's] teaching to particular offers of expert testimony." In part, the two justices said, the decision's general observations "suffer from the flaw . . . [that] they tend to be not only general, but vague and abstract." For instance, they said, the ruling fails to resolve the difference between scientific and technical knowledge – and whether the same rules of admissibility apply to each.

A bright investment

Worldwide sales of compact fluorescent lights increased 23 percent last year – to 134 million bulbs. Their substitution for standard, incandescent lights should annually save up to 6,000 megawatts of electricity, notes David M. Roodman in "Vital Signs 1993," a report released this month by the Worldwatch Institute in Washington, D.C. That's a savings equivalent to the annual energy output of 10 large, coal-fired power plants or about seven average nuclear plants.

Even at $15 to $20 each, these fluorescent bulbs should more than pay for themselves in energy savings, Roodman estimates. At the average cost of electricity in the United States of 8 cents per kilowatt hour, a compact fluorescent used three hours daily "will eventually save the buyer $35, even accounting for the lost income from not putting the money into long-term savings," he estimates. In Japan, where electricity costs 13 cents per kilowatt hour, Roodman estimates each bulb would eventually save consumers $55.

Technology

The logic to molecular computers

Every pocket calculator or personal computer needs at least one thing to do its job: a logic system. A basic component of such microelectronic systems is the information gate, which takes in some signals and sends others out. Some gates open or close to allow signals through; others select one of two pathways, A "or" B, for a signal to travel along; a third kind opens both routes, A "and" B.

"And" gates are critical. No computer can run without them.

Breaking new ground in this area, a team of chemists from Queen's University in Belfast, Northern Ireland, led by A. Prasanna de Silva, reports in the July 1 NATURE the fabrication of a single molecule that behaves as an "and" gate in a logic circuit. The molecule, an anthracene derivative called benzo-15-crown-ether-aldehyde, fluoresces, or emits light of one wavelength, when exposed to light of another.

The molecule can function as an "and" gate because it reacts differently to two inputs: hydrogen ions and sodium ions. The intensity of this molecule's fluorescence varies, depending on whether a signal comes from the hydrogen channel, the sodium channel, or both. When both channels provide input, the molecule radiates at a stronger intensity, clearly signaling that channel 1 and channel 2 are both on.

This technology offers the promise that single molecules could replace whole electronic components, such as transistors. Whereas microelectronic devices use electric currents and voltages to process information, a molecular system uses charges and light. In theory, a cluster of molecules could replace an entire computer chip, says Leonard F. Lindoy of James Cook University of North Queensland in Townsville, Australia. Since molecular devices are more compact and less linear than conventional integrated circuits, they could facilitate better parallel processors. The result may be smaller, faster, more efficient computers.

Listening for hidden fires

The snap and crackle of a moonlit campfire can gently set a scene for romance. But the subtle strains and creaks of a house catching fire certainly do not.

Either way, the distinct sounds of combustion have led scientists to a new way to detect hidden fires: Listen for them. Acoustic sensors can be tuned to catch the unique vibrations of materials about to burst into flames.

William Grosshandler and Margaret Jackson, at the Building and Fire Research Laboratory of the National Institute of Standards and Technology in Gaithersburg, Md., have tested sound sensors, called piezoelectric transducers, in experimental fires. The sensors are able to detect the specific acoustic signals of typical housing materials that are about to burst into flames. Using different types of wood, plastic, aluminum, and gypsum board, the researchers have found distinct acoustic signatures associated with the rapid heating of these materials.

Grosshandler calls this fire detection method "a viable but undeveloped concept."

A smoldering fire or overloaded electrical circuit creates heat, which causes surrounding materials to expand. That stress produces sound, at frequencies up to 500 kilohertz, which can signal a serious overheating event even before actual ignition, the researchers say.

The detection technique has many potential advantages, they add. It can scan a large area and is unaffected by the presence of people or machinery, both of which can sometimes give false clues of fire. The sounds of thermal expansion spread more quickly than combustion products or infrared radiation (heat). And an acoustic sensor may serve in an integrated, intelligent fire-detection system, which can locate and analyze hidden hot spots in a building.