loid at Stanford University Medical Center. Once there, he says, it's easy to see how they could block amyloid molecules from sticking together in plaques. "If the amyloid protein is bound to an antibody, there is no way it can form these aggregations," he says. What's more, Sisodia notes that recent studies in mice showed that when amyloid deposition is halted by killing neurons that secrete Aβ, existing deposits diminish over time. "The idea that you can ... get rid of [amyloid] is not inconceivable," he says. Researchers agree they'd like to see the immunization results repeated. They may not have long to wait, as at least one other group is rumored to have similar results.

But will the approach work in humans? Mice aren't a perfect mirror of human physiology, Steinman notes. In particular, he worries whether in humans "there is enough of a breach of the blood-brain barrier to allow this to happen." And St. George-Hyslop cautions that the protein precursor to Aβ is found in many cell types, so immunization might induce a harmful autoimmune response in nonbrain tissues.

Allaying concerns about autoimmune reactions may require further animal testing. But by the end of the year, Elan hopes to start clinical trials of the therapy on Alzheimer's patients. Those trials could yield a verdict not only on this therapeutic approach but also on the importance of plaque in Alzheimer's disease. "The bottom line of this all," says St. George-Hyslop, is that "we will know quite clearly what the true role of extracellular Aβ is in Alzheimer's disease. We will either get a brilliant treatment, or we will get some powerful insights that modify how we think about the disease." **–MARCIA BARINAGA**

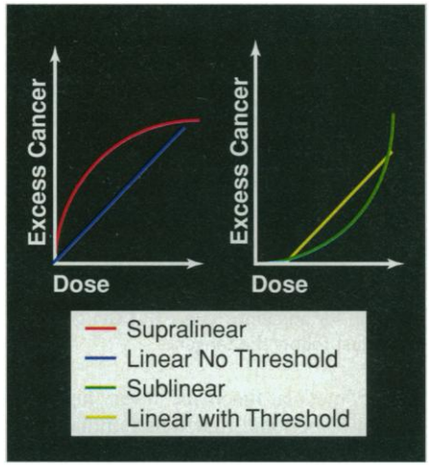
SCIENCE POLICY

NRC Pulled Into Radiation Risk Brawl

A festering feud over possible health risks of low radiation levels has blistered into public view. But instead of assailing each other, two bitter foes are unloading on the National Research Council (NRC) for assembling what they claim is a biased panel to weigh radiation risks. In response, the NRC last month canceled the panel's first meeting and agreed to review its composition. "We're just taking a breather," says radiation biologist Evan Douple, director of the NRC Board on Radiation Effects Research.

The nasty decades-long dispute centers on the risk posed by ionizing radiation from sources such as medical isotopes and spent nuclear fuel. A range of federal agencies have set exposure standards for the general public and for workers—standards based on accepted risk levels that the government tasks the NRC to review every several years. Billions of dollars are at stake: Stricter standards could increase the amount that agencies and industries must spend to clean up radioactive waste and protect workers.

Arriving at safe levels of radiation exposure is hard because little data exist on how low doses—less than 10 Roentgen equivalent man (rem) a year—affect health. (Annual U.S. exposure from all sources is 360 millirem). For years researchers have derived estimates mainly from cancer rates among 50,000 Japanese atom bomb survivors who received



Venomous debate. Groups disagree on which model best fits the data on low-dose radiation and cancer risk.

acute doses of more than 500 millirem. Current exposure regulations are based on the Linear No-Threshold (LNT) model, which uses a straight line to extrapolate the Japanese data to zero: It assumes no safe cutoff, and that doubling the dose doubles the risk.

The bone of contention is whether the LNT reflects reality. Some experts believe that population studies in regions with high background exposure—from radon or uranium deposits—suggest that radiation is harmless below a certain dose. Others point to data—including cellular studies—hinting that low doses may pose an even greater cancer risk, proportionally, than higher doses (see figure). At the request of several agencies, the NRC organized the latest panel on the Biological Effects of Ionizing Radiation to look at what model best fits the data.

But the 16-person committee that the NRC unveiled on 10 June, chaired by Harvard epidemiologist Richard Monson, drew an angry response. The panel "is completely skewed" toward people who favor relaxed standards, claims Dan Hirsch of the Committee to Bridge the Gap, a nuclear watchdog group in Santa Cruz, California. His organization and 73 other groups and individuals claim in a 22 June letter that most panelists have published studies or opinions

ScienceScope

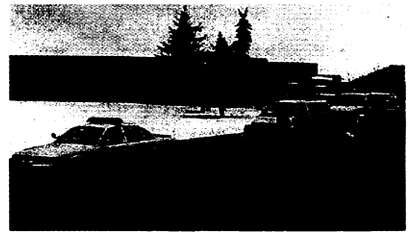
Dying Flame? The Department of Energy's (DOE's) fusion program is dangerously close to flickering out, says an advisory panel.

In March, Energy Secretary Bill Richardson appointed a task force led by physicist Richard Meserve, a Washington, D.C., attorney, to examine DOE's $230 million fusion portfolio. Battered by budget cuts, DOE's "vibrant and valuable" fusion work "is now subcritical," the panel states in a draft report scheduled for release today. All it would take to get the effort back on track, the panel suggests, is a gentle management shake-up and a budget increase of less than $20 million a year to fund a handful of promising research projects.

The report is "mostly a pat on the back" for DOE, says Stephen Dean of Fusion Power Associates in Virginia. More-critical reviews could come later this year, when a National Academy of Sciences committee and another DOE advisory panel offer their advice on fusion's future.

Blood Money Scientists could get an extra $25 million over the next 5 years to study youth violence. In the wake of the Columbine High School shootings, House and Senate lawmakers have passed anti-crime bills calling on the National Institutes of Health to spend the funds—which would come on top of more than $50 million the agency already pumps into related work each year.

The American Psychological Society had pushed for a $100 million boost for studies on violence prevention, peer



Columbine High School.

pressure, and other issues. But the lower figure is fine with executive director Alan Kraut, who calls it "a big first step."

There are still some hurdles to clear before the cash arrives. Later this year, House and Senate negotiators must agree on a final version of the crime bill—but talks could bog down over controversial provisions, including several on gun control. And even if the bill passes, Congress must still come up with the money in the 2000 budget, now under discussion.

CREDIT: (BOTTOM) JEFF HAYNES/AP

suggesting the need for looser standards.

Other groups say the panel contains the opposite bias and ignores researchers who believe the LNT model is too restrictive. A nonprofit called Radiation, Science, and Health Inc., which insists low doses are harmless, claims that panelist Geoffery Howe, a Columbia University epidemiologist, has "obfuscat[ed] data so as to support the LNT." Bridge the Gap, meanwhile, finds fault for a different reason, claiming Howe advocates "the premise that low doses of radiation are substantially less harmful than officially presumed." Howe told *Science* he considers the LNT model "a reasonable assumption not proven."

NRC hopes to announce any revisions to the panel within a few weeks, Douple says. But that may not quell the fire: If the NRC makes "minor cosmetic changes that do not alter the imbalance of the panel," Hirsch says, his group may file a lawsuit under the Federal Advisory Committee Act. Revisions to the act in 1997 opened panel memberships to public debate in the first place.

–JOCELYN KAISER

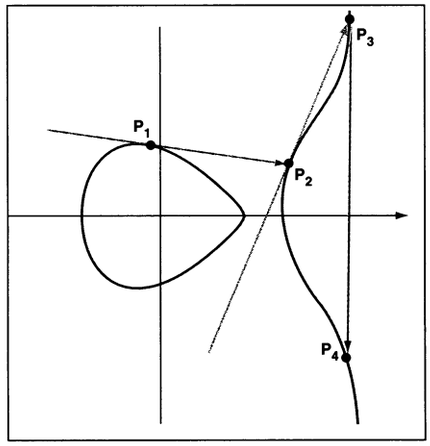
MATHEMATICS

Fermat's Last Theorem Extended

Five years ago, the proof of Fermat's Last Theorem by Andrew Wiles of Princeton University hit the mathematical world like an earthquake, rearranging the landscape and leaving previously unassailable peaks on the verge of collapse. This month, an aftershock has finally leveled the most prominent of these, a 40-year-old unsolved problem called the Taniyama-Shimura conjecture. While it lacks the colorful history of Fermat's 350-year-old unsolved puzzle, this conjecture applies to a vastly broader class of problems.

"Before Wiles came along, nobody even knew how to begin proving the conjecture. Afterwards, there was a widespread belief that it was just a matter of time," says Brian Conrad of Harvard University, who collaborated on completing the solution with Christophe Breuil of the Universite de Paris-Sud, Fred Diamond of Rutgers University, and Richard Taylor of Harvard. "The Taniyama-Shimura conjecture is a wonderful, major conjecture," comments number theorist Kenneth Ribet of the University of California, Berkeley.

The conjecture, which Wiles partially proved en route to Fermat, states that all elliptic curves are modular. A couple of definitions make the statement a trifle less gnomic. An elliptic curve is not an ellipse: It is the set of solutions to a cubic polynomial in two variables, usually written in the form $y^2 = x^3 + Ax^2 + Bx + C$. If x ranges over all real numbers, such equations indeed define curves—mildly wiggly ones that come in one or two pieces. However, number theorists are generally interested only in rational solutions—values of x and y that can be written as fractions. And an elliptic curve is modular if every rational solution can be found with the help of "modular functions," a very high-tech version of periodic functions familiar from geometry, like sine and cosine.



Algebra from Geometry. One solution to an equation for an elliptic curve (P_1) can generate many: Just follow the tangents.

In 1955, a young Japanese mathematician named Yutaka Taniyama first suggested using such modular functions to describe all rational points on an elliptic curve. Taniyama, who committed suicide at age 31, never got a chance to work seriously on his problem. However, his contemporary Goro Shimura, now at Princeton University, took this geometric approach to the problem further, strengthening the conjecture into its present form in the early 1960s.

To explain how geometry can be used to solve algebraic problems, Conrad cites the oldest problem in number theory: finding Pythagorean triples. These are sets of three integers such that the square of one is the sum of the squares of the other two: for example, $3^2 + 4^2 = 5^2$. This equation can be rewritten as $(3/5)^2 + (4/5)^2 = 1$. In this way, Pythagorean triples correspond to rational points, such as (3/5, 4/5), on the circle whose equation is $x^2 + y^2 = 1$. And Conrad notes that there's a simple geometric technique for finding all the solutions. First pick one solution—say (1, 0)—and draw any line through that point whose slope is a rational number. That line intersects the circle in a second point, the coordinates of which will be another rational solution.

A similar idea works for elliptic curves. Given one rational solution, called a "generator," you can get another by drawing a tangent to the curve at that point and looking for its other intersection with the curve. By repeating this procedure (and a variation of it) over and over, you can get lots of solutions—but only if you have one to start with. Sometimes, no such "generator" exists. In other cases, no single generator can produce all the rational solutions. The current record-holder is a curve that requires at least 23 of them. At present, modular functions offer the only hope for predicting the number of generators.

Indeed, number theorists have proven quite a few results about modular elliptic curves, including how to tell if they have only one generator. But until now, they didn't know which elliptic curves would turn out to be modular. Wiles, in effect, found modular traces for many elliptic curves. Now, Breuil, Conrad, Diamond, and Taylor have proved that such modular functions exist for all the rest.

"It is very aesthetically pleasing that now the full conjecture has been proved, rather than just 'most' of it," says Berkeley mathematician Hendrik Lenstra. "It is just as with stamp collecting ... having a complete collection is infinitely more pleasing than having all but one." Lenstra and other mathematicians note, however, that they have not yet been able to judge the correctness of the proof, which so far has been presented only in public lectures. "I hope a complete draft will be ready by the end of the summer," Conrad says.

–DANA MACKENZIE

Dana Mackenzie is a writer in Santa Cruz, CA.

GENETIC TESTING

Beryllium Screening Raises Ethical Issues

Analytical chemist Reed Durham finds himself at the cutting edge of an ethical debate over research on genetic risks in the workplace—but not as an investigator. Instead, Durham has become a significant data point in an effort to understand why a small percentage of people exposed to the metal beryllium—element number four on the periodic table—develop an incurable and sometimes fatal lung disease. And he's not happy about being removed from his job after testing positive for a sensitivity to the metal that is believed to be caused by a genetic variation. "I have been excluded from anything that has to do with beryllium," says Durham, who does not have the disease. "All the expertise that I've gained over the past 30 years working with these materials, I can't use any more."

Durham spoke about his plight at a 24 June meeting outside Washington, D.C., on the ethical problems of conducting workplace health studies. His case illustrates the "troublesome aspects" of using a test without clear benefits to those taking it, one that not only produces lots of "wrong" answers but that also monitors a condition that cannot be