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

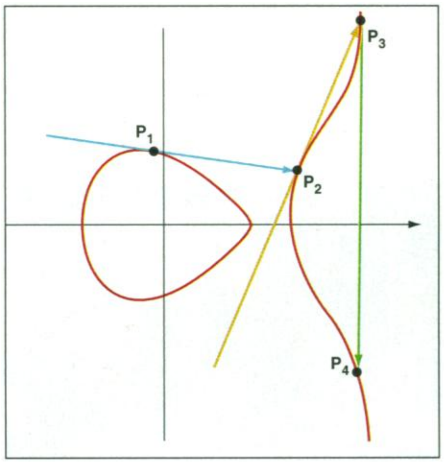
MATHEMATICS

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

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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