directing the magma's flow. Rather, the broad east-west tension that is stretching the region's crust probably allowed the magma to force its way up a north-south fracture.

Magma may have forced its way to the surface where predicted, but at least beneath Obsidian Dome it did not do it in the expected manner. According to the conventional view, a lava enriched in silica (less mafic) would be extruded first, it having risen to the top of the underlying magma chamber as it separated from denser, more-mafic magma. But Obsidian Dome was unconventional. A 152-meter hole drilled straight through the dome near its outer edge, the first hole in the Inyo drilling series, showed less-mafic lava piled on top of more-mafic rock, the reverse of the expected order. The later hole slanted through the dome's conduit also showed that more-mafic magma rose first and coated the conduit before less-mafic material filled the center of the conduit. How that order of appearance came about remains unclear.

Another curiosity is the way the lava of Obsidian Dome ridded itself of excess water, one of the gases that can drive explosive eruptions. John Eichelberger of Sandia National Laboratories and the consortium and Henry Westrich of Sandia found that the lava dome's water content diminishes with increasing distance from the conduit. This trend suggests that the flow of lava on the surface contributes to degassing. But, once again running counter to conventional thinking, the abundance of bubbles also decreases with distance. It had been supposed that dense, nearly bubble-free obsidian rises from the conduit and then develops bubbles as the pressure holding the gases in solution decreases. In addition, rock deep within the dome has been degassed as if it had a direct connection with the atmosphere, according to the drilling results.

To explain these observations, Eichelberger proposed that obsidian is the product, not the starting material, of the degassing process. According to his model, magma rises from the conduit as a wet foam and ends up as dense, dry obsidian. The gases escape rapidly by passing from bubble to bubble as decompression and expansion of the magmatic foam connect the bubbles to form open pathways. After the gas escapes, the flowing of the magma smears out the bubbles and eventually destroys them entirely, according to this still controversial model.

The first penetration of a young magmatic intrusion also allowed the first measurements of the warmth lingering after magmatic intrusion. The narrow dike probably solidified in a matter of months and is now no warmer than the surrounding rock (15°C), but the dome conduit is still 82°C. That suggests conduction alone removed the heat without the aid of convection-driven ground water.

Because over 90 percent of the drilling returned core samples, the comparison of surface volcanic rock and pristine intruded rock will continue for some time. Geophysicists will also be able to calibrate their remote-sensing tools against a known intrusion. Consortium members hope to continue their drilling with a slant hole into the same dike but inside the Long Valley caldera, where the different geological setting may have modified the intrusion process.

The Inyo Domes drilling may not be as ambitious as the proposed 10-kilometer hole planned for the southern Appalachians (*Science*, 29 June 1984, p. 1418); that superdeep hole would cost several hundred times more than an Inyo hole. But, as Eichelberger has noted, "Science is not to be measured in terms of the depth of the hole. In thermal regimes, the frontier is just a few hundred meters deep."—**RICHARD A. KERR**


**Additional Reading**

1. J. C. Eichelberger *et al.*, *Eos* **65**, 723 (1984).
2. C. D. Miller, *Geology*, in press.


# Squarks at CERN?

As physicists sift through the data from their latest run on the proton-antiproton collider at the European Laboratory for Particle Physics (CERN), they are becoming more and more confident that the anomalous events first noticed in a previous run are (i) real and (ii) a sign that something new and unexpected is happening.

Specifically, the events might be the first evidence for supersymmetry, a much-discussed theoretical principle that relates every existing particle to a "superpartner" with different spin (*Science*, 29 April 1983, p. 491). Alternatively, the events might signal the long-sought Higgs boson, or some other kind of exotica. "The exciting thing," says theorist Lawrence J. Hall of Harvard University, "is that all the ideas people dream up involve new physics."

The events in question were found in the collider's UA1 detector, which is run by a large team of physicists headed by recent Nobel laureate Carlo Rubbia. What happens is that a proton and an antiproton meet head-on, annihilate, and produce one or more highly collomated "jets" of particles directed off to the side. Such jets are abundant in high-energy collisions, but they are ordinarily produced back to back in pairs. The anomalous jets are either not back to back or else consist of only one jet. In either case, an uncharged and therefore undetected particle appears to be carrying off some of the momentum.

The two types of anomalies are called "bi-jets" and "mono-jets," respectively, and only a handful were known before the CERN collider began its most recent run in October 1984. But that run produced three times as much data as before. And with only half of these data analyzed, the CERN researchers already have some 20 clear-cut events.

"The easiest thing is to say what these events aren't," says James Rohlf, head of the Harvard team at UA1. He and his colleagues have been able to rule out detector malfunction; the decay of a Z-boson into two new particles; the decay of a new heavy particle into a Z and a quark; the decay of a W-boson into a tau lepton; and a number of other possibilities.

One process that is still consistent with the data is the production of a "squark" and an "antisquark"—supersymmetric partners to ordinary quarks. Each squark then decays to an ordinary quark and a photino, the superpartner of the photon. Finally, the photinos leave the detector unseen, and the two quarks decay into two jets of hadrons. This explains the bi-jet events; the mono-jet events correspond to situations in which one of the quarks ends up going too slowly to make an observable jet.

Of course, a number of other processes are still in the running also. The CERN physicists are careful to point out that nothing has yet been proved. But the physics community is awaiting further word with interest.

—**M. MITCHELL WALDROP**