One of the products Knittle detected, for example, is iron (II) oxide. Under high pressure, this compound acts like a metallic alloy with an electrical conductivity a billion times greater than plain rock. Some of the irregularities that seismologists see in the lowermost mantle could be 100-kilometer blobs of iron oxide, Jeanloz suggests. If so, then the blobs would play havoc with the core-generated magnetic field—and therefore with geophysicists' ability to see into the core. Field lines would snag on the blobs near the core-mantle boundary, producing the swirling variations in the field at the surface that researchers have always assumed reflected the swirling of the fluid core itself.

Researchers in the magnetics of Earth routinely take exception to this whole idea. But, Jeanloz explains, "I'm promoting this to encourage the magnetics people to coordinate with the seismologists on the discrimination of what they see at the core-mantle boundary. Not that it's the only reasonable answer. We're just asking how much of the variation can be attributed to these reactions. Either the idea will survive or not. I find it difficult to get emotional about science; it's always changing." This laid-back attitude may be in tune with Jeanloz's equally laid-back, 70s look, but it tends to belie the self-assurance sometimes seen in his papers and talks.

But that does not mean Jeanloz relentlessly promotes himself. In fact, he frequently promotes his students. "All I do really is collaborate with my students," he says. "I've been very lucky in having students willing to work hard and take the initiative and tell me if I'm dead wrong. I'm not a smart person, so I have to work pretty hard to catch up. If I'm putting in a lot of work, I expect everyone else to as well."

True to his collaborative philosophy, Jeanloz was second author on the paper describing the core-mantle boundary experiment, which was the 110th or so of his career. And he is second author on almost all of his papers involving his students. "I've viewed the first author as having a primary responsibility. It's not only credit, it's also who's going to take responsibility."

Who is going to take lead responsibility on a paper also depends, however, on how much flak it is liable to draw. If it is a matter of describing an experimental result, then the student takes the lead. A bit of interpretation and extrapolation is fine, too, as long as the student is comfortable with it. But Jeanloz saves his boldest speculations—the blurring of the view of the core, for example—for talks and review papers on which he is the first author.

Direct tests of some of Jeanloz's bolder speculations must await further technological developments. Among them will probably be the analysis of samples in diamond-anvil cells with synchrotron x-ray radiation.

At a cost of several million dollars to buy into just a part of a synchrotron x-ray source, this evolving field is big science indeed. But it is one innovation Jeanloz has yet to capitalize on to any great extent. "If a synchrotron were critical in an experiment, we would do it, but my style is more oriented to the small scale of the diamond-anvil cell and the small group. I've always had just two to four students at a time because I couldn't handle more than that."

Some choices between style and the greater use of synchrotron sources are probably not that far off, but Jeanloz is in no hurry. He is still having fun. "I find it intellectually challenging becoming familiar with what's going on over broad areas of science, identifying a significant problem, and ultimately solving it. I think a lot of the slowness of our science is a psychological barrier, people convincing themselves that it can't be done." The expensive, multi-investigator work required by a synchrotron source would surely put a crimp in that style.

But there are other options, Jeanloz says. "It's something of a fluke that I'm in the sciences," he notes. Perhaps there are other endeavors that could absorb his energies just as well. In his youth, he was quite serious about playing the violin and had no interest in science until a stint at an isolated California junior college brought him face to face with geology. "Now I have some ideas about what would be useful to do. In 10 years, I may not." As he is fond of saying about the controversy he provokes, "it will work itself out." ■ RICHARD A. KERR

Faith in Fifth Force Fades

The case for the "fifth force" seems to be falling apart fast. Not only has a new experiment failed to find any evidence for it, but two earlier confirmations have now been withdrawn. "We're now saying that the evidence does not support the fifth force," declares Donald H. Eckhardt, who is a physicist at the Air Force Geophysics Laboratory in Bedford, Massachusetts, and a principal investigator on one of the experiments being retracted. "The case has not been established," agree the principal investigators on the other experiment, geophysicists Robert L. Parker and Mark A. Zumberge of the Scripps Institute of Oceanography in La Jolla.

The fifth force is supposed to be a new type of fundamental interaction beyond the four forces—strong, weak, electromagnetic, and gravitational—now known. Empirically, it is expected to show up as a tiny deviation from the inverse-square law of Newtonian gravity. If real, it would require major revisions in current theories.

The fifth force hit the headlines in January 1986, when Purdue University physicist Ephraim Fischbach and his colleagues found apparent anomalies in a 1922 measurement of the gravitational constant by the late Hungarian physicist Roland Eötvös. More direct evidence came from experiments such as Eckhardt's, which was conducted last year on a 600-meter television tower near Raleigh, North Carolina, and Parker's and Zumberge's, performed in 1987 in a 2-kilometer-deep borehole in Greenland. In each case, the scientists took gravity measurements at several different levels and found fifth-force type deviations from predicted Newtonian values.

Only one problem: the deviations disagreed in both magnitude and sign, raising suspicions about their significance. And, as Parker and Zumberge point out in the 2 November issue of *Nature*, those suspicions are well founded. The researchers show that the results of any such experiment are extremely sensitive to the corrections made for the gravitational effects of local geology. Indeed, they claim that equally plausible corrections can account for all the results *without* a fifth force.

Eckhardt, although skeptical of Parker and Zumberge's analysis, says he now concedes that his original conclusions are wrong for another reason. Subtracting out geological effects requires having ground-level gravity measurements for miles in every direction. But in eastern North Carolina, the survey teams tend to take their measurements by the roadsides instead of out in the swamps. "So you find that the gravity measurements are biased to high ground," he says.

And finally, there is a third nail in the coffin. In the 30 October issue of *Physical Review Letters*, James Thomas and his colleagues at the Lawrence Livermore Laboratory report on an experiment performed on a 465-meter tower at the Nevada Test Site, where the geological data are extremely complete. Their conclusion: no fifth force with an accuracy of better than one part in 10 million.

■ M. MITCHELL WALDROP