tossed aside, say Chang Tsuei and John Kirtley, physicists at IBM's T. J. Watson Research Center in Yorktown Heights, New York. The two lead a team that's produced some of the most convincing evidence that d-wave symmetry is present in YBCO and a thallium-based compound (*Science*, 19 January, p. 288). Although symmetry experiments can't rule out pairing mechanisms, they may be able to do the opposite and rule in some possible mechanisms. Tsuei and Kirtley say they are currently extending their experiment to other HTS materials to see if they also show a d-wave. If not, it would suggest that different HTS materials use different mechanisms to hold electrons together as they travel, says Kirtley.

Turning up the heat

The pairing issue isn't entirely an academic question. Researchers hope that insights into the superconducting mechanism may help experimentalists devise new recipes that could break the 134 K barrier. Of course, experimentalists have pushed up temperatures in the past without theoretical guidance. And many experimentalists at the meeting were optimistic that they will do so again. "There's no fundamental reason why we shouldn't be able to get the Tc even higher," says Chu.

In fact, there are good reasons to expect that they should. For one, when crunched in a diamond anvil, a copper-oxide compound made with mercury superconducts at 164 K, 30 degrees higher than it does at ambient pressure. So researchers are trying to alter the chemical composition of the materials to simulate the effect of pressure on the crystal lattice—but without the anvil. For instance, by replacing mercury atoms with smaller gold and silver atoms, researchers might shrink the spacing between atoms, simulating the pressure effect and driving up the superconducting temperature.

Not everyone is optimistic, at least as far as the copper-oxide-based superconductors are concerned. Oregon State University physicist Arthur Sleight says that "people have been trying these strategies for years" with these compounds, to little avail. That sentiment has convinced other researchers, such as physicist Robert Cava of Bell Laboratories, to continue their search in noncopper-oxide materials, such as boron-carbides.

The next breakthrough could come from just about anywhere, says Grant. If this field has demonstrated anything, he says, it's that "there are no signposts" for superconductivity: "If you find a new metal, you better cool it down and find out what happens. You may be surprised."

–Robert F. Service

EXTINCTIONS

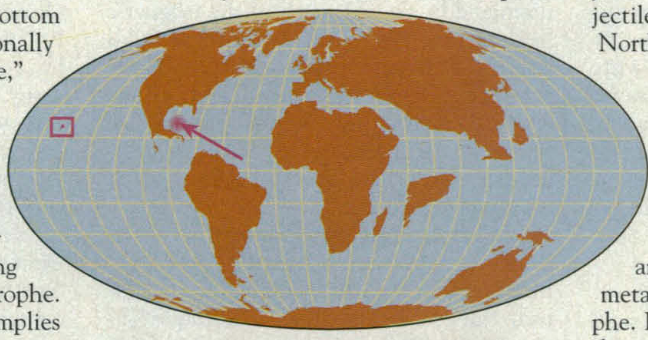
A Piece of the Dinosaur Killer Found?

In their search for the cause of the mass extinction at the end of the dinosaur age, geologists already had a smoking gun: a 180-kilometer impact crater on the Yucatán Peninsula. Now they may have a piece of the bullet. At last week's Lunar and Planetary Science meeting in Houston, geochemist Frank Kyte of the University of California, Los Angeles (UCLA), flashed slides of a chip of rock that he thinks may be a tiny fragment of the 10-kilometer object that blasted Earth 65 million years ago.

From the age and makeup of the 3-millimeter chip, found in the ooze at the bottom of the North Pacific, Kyte is "personally convinced that it is a piece of the bolide," a conclusion other researchers say is at least plausible. "What all the implications are, I'm still trying to figure out," he adds. "The unfortunate thing is that it's mainly mud and rust" after sitting in Pacific sea-floor sediments for 65 million years. But it is already offering some clues to the nature of the catastrophe. A first look at the rock chip's makeup implies the fatal object was an asteroid, not a comet, as some researchers have speculated, and its survival supports an earlier suggestion that the parent body struck Earth at a shallow angle—which may have been the cruelest possible blow.

Kyte hadn't been looking specifically for bits of the bolide. He was methodically sampling a sediment core drilled years ago from the floor of the northwest North Pacific in search of the far-flung debris of the impact. As he sampled he noticed a bit of rock embedded in the mud, an odd find indeed considering nothing bigger than a microscopic piece of clay could wash that far out to sea. He guessed that it had fallen out of the sky as a meteorite—a suspicion that grew when the nugget turned out to be rich in elements like iridium that are abundant in meteorites but rare in Earth's crust. Equally telling, the rock held micrometer-size metallic grains that are up to 87% nickel.

"It probably is meteoritic," says Alan Rubin of UCLA, a meteoriticist who has been consulting with Kyte but was not a co-author on his paper. "The nickel-rich metal is what persuades me. You wouldn't expect [free] metal of any kind in Earth's crust except in



Long shot. Asteroid that struck the Yucatán may have flung a piece into the Pacific.

SOURCE: C. R. SCOTESE/PALEOMAP PROJECT

bizarre places." But is it really a chip off the dinosaur killer? Chemical and mineralogical signs in the sediments surrounding it, says Kyte, put the rock fragment at the base of a 10-centimeter-thick layer rich in debris particles thrown from the impact crater. This would be only the second time a recognizable meteorite had been found in ocean sediment, so the odds against its being an unrelated small meteorite that happened to fall into the debris at exactly the right moment are just too great, Kyte feels. "Where else do you expect it to be from except the projectile?" he asks.

If so, it had to have escaped obliteration in the fireball at the crater and fallen back to Earth thousands of kilometers away, something cratering specialist Peter Schultz of Brown University says is "physically reasonable," especially if the impacter "comes in at a modestly low angle—probably around 30 degrees or so." Schultz had already concluded from his study of asymmetries in the shape of the buried crater that the impacter did indeed come in at an angle of about 30 degrees from the southeast. Given that trajectory, "I wouldn't be surprised to see [projectile debris] in the Pacific, especially the North Pacific," says Schultz.

Kyte is studying the rock chip in search of evidence that would clinch its identity as a meteorite and strengthen the case that it is a piece of the impacter. If it is, "my guess is [the original body] wouldn't be a comet," says Rubin, because comets are not thought to be sources of free metal. That could point to a milder catastrophe. Because asteroids are richer in iridium than comets are, a killer asteroid could have had a smaller mass and still account for the total mass of iridium deposited worldwide at the time of the impact. Asteroids also have slower impact velocities than those of comets, on average.

But if Schultz is right about the angle of impact, things get ugly again. By splashing material thousands of kilometers downrange, a shallow approach would have created a far larger fireball than a more vertical one would, visiting particularly severe devastation on the interior of North America. In that case, Kyte's rock may not be mitigating evidence.

–Richard A. Kerr