of the U.S. Geological Survey (USGS) in Pasadena, California, "but we clearly do not understand that relation. There are going to be a lot of hypotheses."

Geologists have speculated that faults can reach out and touch one another because earthquakes redistribute stress. When a fault ruptures, it reduces stress in broad zones to either side; their extent can be calculated from the way the fault broke. Great earthquakes like the 1906 San Francisco quake and the 1857 "Big One" in southern California reduced the stress over great swaths along hundreds of kilometers of the San Andreas fault, damping seismic activity in those areas for decades (*Science*, 16 February 1996, p. 910).

But stress can actually increase beyond either end of a ruptured fault. The Landers rupture produced prominent lobes of heightened stress across the Mojave Desert to the north and south across the San Andreas near Palm Springs and Riverside. One southward lobe, as calculated by geophysicist Ross Stein of the USGS in Menlo Park, California, and his colleagues, seemed to trigger the magnitude 6.2 Big Bear quake 3 hours after Landers struck 35 kilometers away.

Seven years later, the other shoe seems to have fallen. Early last Saturday morning, 40 kilometers of a previously unnamed fault, now dubbed the Lavic Lake fault, broke across the Twenty-Nine Palms Marine Base. The quake's epicenter and much of the rupture lie in what Stein and his colleagues calculate was one of the two northern lobes where the Landers quake intensified the stress. The match between the quake and the area of heightened stress buttresses the argument that "if you jack up the stress on a fault, you get a higher rate of earthquakes, big ones and smaller ones," says Stein.

Most of Stein's colleagues agree that faults do keep in touch with each other, speaking the language of stress. "There's clearly some relationship between the two earthquakes," says David Wald of the USGS in Pasadena. "There's no doubt stress triggering is happening."

But Wald adds that "the physics behind it is not clear." For one thing, he wonders why the small nudge from Landers would set off such a long-quiescent fault. For another, stress changes depend to some extent on characteristics of the fault. Some faults, like the San Andreas, are thought to slip with essentially no friction, perhaps because of a claylike lubricating layer where the rock faces meet. Robert Simpson of the USGS calculated that if the Lavic Lake fault is also frictionless, the Landers rupture would not have heightened stress across the Hector Mine rupture. Stein argues that the Lavic Lake fault should have higher friction because it slips only infrequently and therefore hasn't developed a lubricating layer.

Whatever the physics, the Hector Mine quake, as well as the Turkey quake of last August, which might also have been triggered by an earlier quake (*Science*, 27 August, p. 1334), are persuading seismologists that an earthquake may heighten seismic threats elsewhere. For example, Stein and USGS colleague Tom Parsons estimate that the Hector Mine temblor has increased the chance of a big one on the San Andreas in the next 30 years from 41% to 44%. To understand seismic hazards of a fault, he thinks, all the chatter among its neighbors must be understood. **–RICHARD A. KERR**

ARCHAEOLOGY

New Questions About Ancient American Site

Brad Pitt and his paramilitary protégés in the celluloid tale *Fight Club* aren't the only ones putting up their dukes and taking a swing this week. With a belligerence rarely seen in scientific spats, American researcher Stuart Fiedel has landed the first punch in a new battle over the authenticity of what may be the oldest archaeological site in the Americas: southern Chile's Monte Verde.

Tracking the past. Pre-Clovis people may have left these footprints at Chile's Monte Verde site.

CREDIT: T. DILLEHAY/UNIV. OF KENTUCKY

In the November/December issue of the popular magazine *Scientific American Discovering Archaeology* (discoveringarchaeology.com), Fiedel contends that the final report on Monte Verde is riddled with errors and omissions that make evaluation of the evidence all but impossible. The original authors counter that the errors are simply ones of bookkeeping, but it seems clear that clouds have gathered over Monte Verde once again. "The site is in limbo," says archaeologist Daniel Sandweiss of the University of Maine in Orono.

For decades, archaeologists have believed that the first inhabitants of the Americas were the spear-wielding, big game–stalking Clovis hunters, who migrated from northern Asia to Alaska along the Beringian landbridge and then trekked south between retreating ice sheets 13,500 years ago. But after 8 years of excavations in a peat bog 560 kilometers southeast of Santiago, a team led by archaeologist Tom Dillehay of the University of Kentucky in Lexington concluded that early humans had lived at Monte Verde 1000 years before the first Clovis site, building pole-frame houses and dining on mastodon, wild potatoes, and medicinal herbs.

There are other hints of early, non-Clovis cultures, but Monte Verde's direct challenge to the Clovis-first theory fuelled intense debate. Then in 1997 a blue-ribbon panel of archaeologists visited the site and agreed in a public announcement that it was truly pre-Clovis (*Science,* 28 February 1997, p. 1256). But there were always a few skeptics, and now they are mounting a new assault.

Fiedel, a consulting archaeologist from Alexandria, Virginia, and the author of a primer on New World prehistory, wanted to know exactly where three hafted stone scrapers were found, as well as what the precise association is between these scrapers and the radiocarbon-dated materials that support a pre-Clovis date. But when he pored over the Monte Verde final report, he found dispersed and inconsistent descriptions that left him uncertain even about how many such scrapers were found. He says he was "peeved," and he began looking for similar data on the site's projectile points, cores, and other bifaces (stone tools flaked on two sides). He couldn't find it. In his article—which he says he published in a non–peer-reviewed journal so that it would be available quickly—he details 19 pages of errors, ranging from minor slips, such as individual artifacts bearing three different catalogue numbers, to more worrisome problems such as maps drawn to the wrong scales. "When I finally got an opportunity to look at the whole thing," says Fiedel, "I discovered that the report's just full of holes."

Dillehay readily concedes that errors crept into his team's massive 1300-page report, which won a 1998 Society for American Archaeology award "for the extreme care given to the site's excavation, analysis, and publication." But he says that some 85% of the glitches result from changes made in cataloguing when his team expanded test pits into large block excavations and later entered data in new computer programs. Those are common problems in large, multiyear excavations, agrees Jon Driver, an archaeologist at Simon Fraser University in Vancouver, British Columbia.

Dillehay suggests that the report is being subjected to impossibly high standards because Fiedel and other critics simply don't want to accept evidence contrary to the Clovis-first paradigm. "A colleague told me a couple of years ago that some card-toting member of the Clovis police would be stepping forward again with another blast," says Dillehay. "Well, here it is."

Part of this fight is a clash of outlooks. Fiedel zeroes in on stone-cutting tools and projectile points, which he and others consider of prime importance because they are undoubtedly made by humans. "Dillehay should make sure that everybody knows where those bifaces come from," says Driver. "That's what's going to convince many North American archaeologists."

But Dillehay's team built its case mainly on simpler stone flakes. The researchers used wear patterns and the preferential use of certain stone types to argue that the flakes were human handiwork, and they determined their age from nearby radiocarbon-dated materials. Ruth Gruhn, a University of Alberta archaeologist who has worked extensively in early South American sites, thinks that's a reasonable approach. "North American archaeologists have a very strong bias towards bifacially flaked projectile points because North America is just saturated with projectile points," she says. But in South America, Paleo-Indian peoples preferred simple unifacial tools, she says. She thinks that there's "no question" that the Monte Verde flakes were created by pre-Clovis humans.

All the same, other researchers are dismayed both by the substance and the sheer quantity of errors in the report. "To find that many mistakes and confusions in the final report for such a significant site is certainly very disappointing," says Sandweiss. But the question remains: Are those errors fatal? Dillehay's team now needs to clear up the inconsistencies, says David Meltzer, an archaeologist at Southern Methodist University in Dallas and a member of the panel that visited Monte Verde. "Then once all [the minor glitches are] eliminated," he says, "it will be worth taking a look and saying, 'Are there legitimate issues here?' " —HEATHER PRINGLE

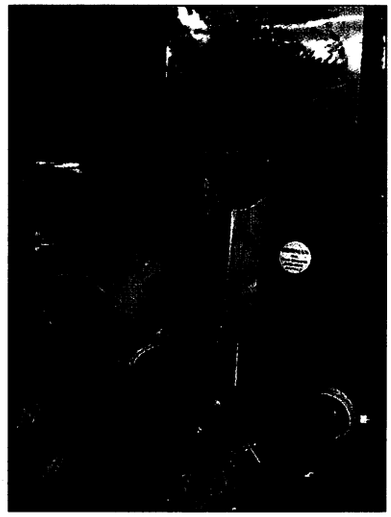
Heather Pringle writes from Vancouver.

SCIENCE EDUCATION

Scientists Strike Back Against Creationism

New Mexico's school system took an evolutionary leap earlier this month when the State Board of Education voted to ban a creationist credo that had influenced the curriculum for 3 years. The counterpunch was largely the result of a grassroots campaign engineered by a group of scientists who are now moving to raise the scientific sophistication of teachers and students throughout the state. "Without scientists, the trend to reverse [the teaching of creationism] would never have started," says Kim Johnson, a physicist at Quasar International Inc. in Albuquerque and president of New Mexico's Coalition for Excellence in Science Education (CESE).*

New Mexico's success is encouraging researchers in Kansas who are rallying opposition to new statewide education standards that eliminate the teaching of evolution and anything suggesting our planet has been around for billions of years (*Science*, 20 August, p. 1186). Because creationists believe that God created the universe, the Earth, and life in 6 days 10,000 years ago, any science that contradicts that view—including the big bang theory, the geologic timescale, and the validity of radioactive decay as a measure of great age—is vulnerable, says Marshall Berman of Sandia National Laboratories in New Mexico. "We have to realize that this is an assault on all science," he says.



Leading the charge. Berman's group helped purge creationism from New Mexico's public schools.

The assault took most New Mexicans by surprise in 1996, when with just 2 hours of public notice, the New Mexico board voted to purge many aspects of biology, geology, and physics from the state's education standards, which guide the development of teacher lesson plans and test materials. In a matter of days, Johnson and Berman began rallying colleagues to action. "We zeroed in on the solution—to get somebody knowledgeable on the board," Johnson says. Berman won a seat on the Board of Education last year, replacing a creationist, then helped orchestrate a public education campaign. "We had all these Ph.D. scientists walking around neighborhoods, pounding on doors," recalls Berman, a nuclear physicist. "It was a miracle—pardon the expression—to watch these personal transformations take place." Two other staunch pro-science candidates ousted a creationist and a supporter of creationist policy in local elections last November, setting the stage for change.

Stealing a page from the creationist play book, the grassroots campaign built a broad base of support that includes teachers, parents, and many religious leaders anxious to defend the separation of church and state in public education. Supporters also formed CESE last year to raise the state's level of science teaching. One program they initiated is "Hotspots," which pays for teachers to spend 2 weeks in the summer out in the field with geologists. Meanwhile, a state-appointed panel drafted science performance standards —what students need to know at each grade—that reincorporate evolution and other science fundamentals. "Just about every Methodist minister in New Mexico signed a letter supporting these changes," Berman says. The two-pronged effort paid big dividends: On 8 October, the Board of Education voted 14 to 1 to adopt the new standards and ban creationism from the curriculum. In a ringing endorsement, Catholic Archbishop Michael J. Sheehan published a letter in two New Mexico newspapers on 15 October strongly supporting the revisions.

Kansans opposed to their school board's new anti-evolution guidelines are hoping for a similar victory. They have put together a coalition, Kansas Citizens for Science†—initiated largely by scientists drawn from state universities and colleges—that is planning an education campaign to reverse the decision. Other groups are considering a legal challenge to the standards based on the separation of church and state.

In the meantime, Kansans are getting supporting fire from a surprising weapon: copyright law. The National Research Council, the American Association for the Advancement of Science (publisher of *Science*), and the National Science Teachers Association have all denied the Kansas board permission to use portions of their respective science standards publications in the state's new guidelines. That means the guidelines cannot be implemented until after they are revised to remove the copyrighted materials—a costly and timely endeavor—which should leave last year's sound standards in place for the rest of the fall term, predicts biologist Steve Case, a member of the new coalition. He and others welcome the delay. "It's tough to weed something out once its been implemented—very much like cancer," Case says.

Creationists forces are not resting on their gains, however. The Web site of the Christian Coalition of New Mexico warns its constituents that Berman will continue to "take a strong pro-evolution stand" and urges them to try to unseat him in the 2002 elections. But Berman and his colleagues have their sights set on the road ahead. "The board will be regularly reviewing and improving its standards, because science is a growing, changing field," he says. —BERNICE WUETHRICH

Bernice Wuethrich is a science writer in Washington, D.C.

* www.cesame-nm.org † www.kcfs.org