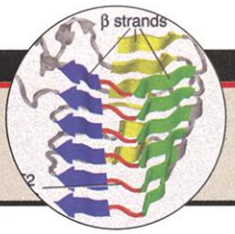
PAGE 806
Coaxing yeast to unite




809
Predicting a protein structure

SEISMOLOGY

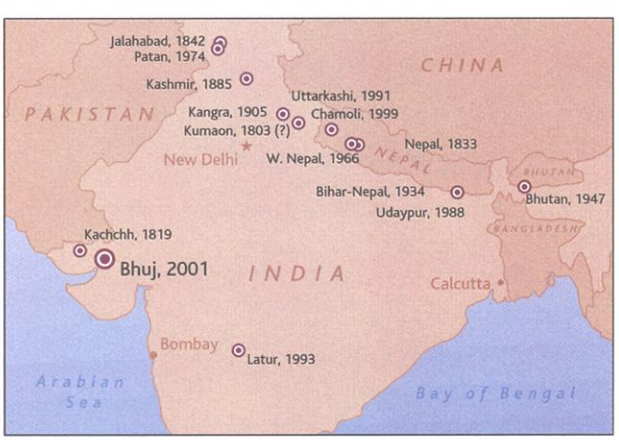
# Tectonics, Design Combine for Indian Disaster—More Coming

The major earthquake that shattered the western Indian state of Gujarat last week came as no surprise to seismologists. Neither did the devastation—leveling of villages at the epicenter, near-total destruction of the nearby city of Bhuj, crumpled schools 300 kilometers away in Ahmedabad. More than 10,000 people died in a few minutes. But worse is on the way: The same sort of quake that just struck the far western desert region of India—a relatively sparsely populated part of the country—will likely pop up without warning elsewhere on the subcontinent in the coming decades. And seismologists are as certain as they can be that larger quakes, upward of a dozen, will strike along the northern edge of the subcontinent. "This is a wake-up call," says tectonophysicist Peter Molnar of the University of Colorado, Boulder, who works extensively in India, "but it isn't as big as the quake that will come."

**Testing failure.** A five-story school in Ahmedabad 300 kilometers from the epicenter "pancaked," killing 45 of the 50 students inside. Himalayan quakes to the northeast of Bhuj presage more disasters.

The Bhuj earthquake, named after the desert city of 150,000 inhabitants located 20 kilometers from the epicenter, is typical in many ways of the quakes that strike what geologists call the "stable" interiors of continents. Most earthquakes rupture faults where two tectonic plates slide by each other, such as along the San Andreas fault between the North American and Pacific plates. Away from plate boundaries, the crust is relatively stable, but not absolutely so. The Indian subcontinent has been torn and stretched and strained over eons of plate tectonic jostling, creating weak spots in the crust. And this weakened crustal block is under strain today. India is still driving northward into Asia, pushing up the Himalayas and squeezing the whole subcontinent. Where that strain finds weak spots, earthquakes can strike.

Since 1956, India had suffered five such intraplate earthquakes that killed as few as 26 and as many as 9748, according to a compilation published last November in the "Seismology 2000" special section of *Current Science* by geodesist Roger Bilham of the University of Colorado, Boulder, and Vinod Gaur of the Center for Mathematical Modeling and Computer Simulation in Bangalore. The intraplate quakes struck with no apparent warning and with no obvious pattern, says Bilham. The Bhuj quake—the sixth and largest of late—seems to have ruptured a fault within a buried ancient rift where the crust was stretched, fractured, and weakened as India broke away from Antarctica and Africa 150 million years ago, he says. That makes magnitude 7.5 Bhuj the same type of quake as the trio of intraplate quakes that rippled along an ancient rift near New Madrid, Missouri, in the winter of 1811–12. Although ranging up to magnitude 8, these rift quakes inflicted little damage, because there was so little in the then-frontier area to shake down.




Bhuj is an atypical intraplate quake in that, unlike other quakes of the Indian interior, it didn't pop up out of nowhere. V. S. Ramamurthy, secretary of the Indian Department of Science and Technology, "was not surprised by the earthquake, since it falls in the highest zonation level" of the five levels on India's seismic zoning map, he says. The Bhuj area merited that ranking because a quake similar in size to last week's struck a nearby but separate fault segment in 1819, killing about 2000 people. And lesser seismic activity has continued in the general area, including a magnitude 6 quake at Anjar in 1956. In their November article, Bilham and Gaur assumed there would be "future events" in the area, but they looked westward toward Karachi for an extension of the active fault, not eastward as happened.

Although there was foreshadowing, seismology made little difference to the tragic outcome. "India is a large continent," notes Gaur. "The number of seismologists in the country is not large. There's appreciation [of the broad seismic hazard] but not an adequate amount of investment in seismic hazard response." The strain buildup that eventually produces an intraplate earthquake is so slow, he notes, that thousands of years pass before the same segment of fault fails again. With little or no inkling of past damaging quakes, standards for design and construction are not set very high, and what standards exist are often not met. Village homes near the epicenter of this earthquake as well as modern multistory buildings hundreds of kilometers away, including schools and hospitals, collapsed.

Most intraplate earthquakes may come as surprises, but India's biggest earthquake threat—from its plate edge—looms more clearly, according to Bilham. India's plate

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809 Booster shot for AIDS vaccines

812 Trench warfare over Gulf War illness

817 Battling harrassment in Japan's universities

edge falls in the northeast where the subcontinent plows under Asia to push up the Himalayas. Strain is building there far faster than within the subcontinent, so fast that great earthquakes should be rupturing one segment or another of the Himalayan plate boundary every few decades on average to relieve the strain, says Bilham. "You need 14 or 15 [large] earthquakes to let the entire arc rupture," he says. "We've had only three in the last 200 years; that leaves at least 11 to go. It looks as though they could happen at any time."

Bilham's particular concern is the massive riverside cities on the plain south of the mountains, where millions of people live on ground that could turn to mush when shaken by a big, distant earthquake. "It looks pretty grim to me," says Bilham.

As for the Bhuj quake, Ramamurthy promises a complete "scientific postmortem." The lessons, however, will be hard to apply. **–RICHARD A. KERR**

With reporting by Pallava Bagla in Ahmedabad.

BIOINFORMATICS

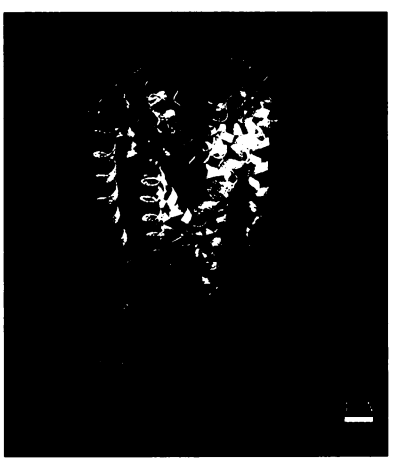
## Hughes to Build Own Tech Research Center

Best known as a virtual institute, the Howard Hughes Medical Institute (HHMI) of Chevy Chase, Maryland, will soon make a vast expansion in bricks and mortar. The heavyweight biomedical organization this week announced it will spend $500 million over 10 years on a suburban research center that will develop cutting-edge bioinformatics, imaging, and other tools. It will also serve as an incubator for visiting scientists—even those who aren't HHMI investigators.

The intramural research campus will be a major departure for the $12 billion HHMI, which since 1953 has focused on funding an elite corps of researchers at academic campuses around the country and nourishing a stable of education and training programs. But HHMI president Thomas Cech wants to develop expertise in new technologies, broaden the institute's reach, and continue Hughes's mission to support the best research. "This is something that will cut across all of biomedical science," says Cech.

The few researchers who have heard about HHMI's closely guarded plans are enthusiastic: "It sounds like they're going to create a great playground" that will encourage the kind of mixing among disciplines needed to develop these technologies, says Harvard Medical School neuroscientist Carla Shatz, a former HHMI investigator who now serves on its medical advisory board. "I think it's an amazing opportunity."

The institute will break ground in 2003 on a 112-hectare site in Virginia, about a 45-minute drive from its present headquarters. Plans call for spending $200 million to $300 million on a cluster of buildings with 46,000 square meters of space on the site, bordering the Potomac River in Loudoun County and not far from Dulles International Airport. The campus, which will eventually house up to 300 scientists and has room to double in size, should open by 2005 with an annual operating budget of roughly $50 million. But it won't be another Whitehead or Salk Institute, says HHMI vice president for biomedical research Gerry Rubin: "They don't leave two floors vacant for visitors [like we will]."



**Technological leap.** Hughes's planned "collaborative" center may develop tools such as the new electron microscope technique used to make this first-ever 3D image (in gray) of a voltage-gated ion channel.

Cech, Rubin, and David Clayton, vice president for science development, came up with the idea for a "collaborative research campus" as Cech was preparing to take the institute's helm in January 2000. They wanted to cap the number of HHMI investigators—which soared in the 1990s as the institute's endowment grew—at around 350 to keep the program manageable. With money to spare, institute officials decided to feed investigators' insatiable appetite for high-tech tools such as bioinformatics software and low-temperature electron microscopy. The trio wanted to ensure that all HHMI investigators—not just those at wealthy campuses—could get access to these tools and the expertise needed to run them. But being just a service center "sounded dull to us," Cech says.

The 24 resident investigators, who won't have tenure, are likely to include physicists, computational scientists, engineers, and other discipline-crossing experts who "don't fare very well in the traditional academic system," as well as top talent from industry, Rubin says. Although the research topics have yet to be defined, HHMI's leaders are talking about hot fields such as proteomics and bioinformatics; they're also discussing new tools for imaging cells and tissues in live animals. "A lot of the things we'll be doing are more typical of the best biotech companies," Rubin says. But although HHMI will seek patents on discoveries, fostering business start-ups "is not a major goal," Rubin says. Nor is making money. "We're not doing this as a way to increase our endowment," he notes.

The center will spend half its budget on a second mission: incubating new ideas by funding the most interesting proposals to be carried out at the plush new facilities. Some researchers might bring along a few grad students or postdocs to learn new software, analyze samples, or develop new instruments. Others may be scientists from far-flung institutions who want to work on a compelling idea—one that won't necessarily involve technology. The visitors may stay just a few weeks or take a sabbatical year. HHMI will pay all the bills, putting up as many as 100 scientists on campus and giving them lab space. "There's no place in the world that does that," Rubin says. The center will also host courses similar to those at New York's Cold Spring Harbor Laboratory, which Cech says is "just saturated."

This plan won't end the shortage of qualified people in bioinformatics, note experts such as Sean Eddy, an HHMI investigator at Washington University in St. Louis, Missouri. But "in the short run, centralized facilities ... do seem like they'll be a good way to maximize the utility of a small number of skilled bioinformaticians," Eddy says. While observers at the National Institutes of Health are awaiting details, they say the new center should complement NIH's own recent efforts to bolster bioinformatics and imaging through a new institute. "Computational biology is likely to be the driving force in biology for the foreseeable future," says Marvin Cassman, director of the National Institute of General Medical Sciences. **–JOCELYN KAISER**

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