India gets under Eurasia's skin

The fate of most oceanic plates has been to plunge into the earth's mantle when they ram into other plates. But what happens when two continents collide? The Tibetan plateau is one result. This 700,000-square-kilometer chunk of land has been elevated 5 kilometers above sea level and its crust has been thickened to twice the typical amount. Scientists think it was created during the last 50 million years by the collision between India and Eurasia, but they have long debated the exact mechanism of its formation.

One theory, proposed 60 years ago, suggests that the Indian plate has slid under Eurasia and, because of its buoyancy, has been able to lift the plateau. However, after scientists completed a series of studies using seismic waves to probe the Tibetan crust, this idea lost ground to another theory, which holds that the ramming plates have squeezed together a warm and weak Tibetan crust, thickening it and pushing up the plateau.

Now, in the Sept. 10 JOURNAL OF GEOPHYSICAL RESEARCH, Kin-Yip Chun at the University of Toronto in Ontario and Thomas V. McEvilly at the University of California at Berkeley uplift the earlier idea. In scrutinizing past seismological studies, Chun and McEvilly found that investigators hadn't taken into account the differences in crustal structures between the Tibetan plateau and surrounding areas through which seismic waves had passed. Using an improved data set, the researchers developed a model in which seismic waves travel much faster through the lower crust than previously thought. According to Chun, the new velocity is comparable to that found under cold continental areas such as the Canadian shield. If the squeezing model were correct, he says, one would expect higher temperatures in the lower crust in order for it to be "squeezable." Chun thinks this cold layer is evidence of the underthrusting Indian continent.

The researchers also found that overlying this high-seismic-velocity layer is a low-velocity zone that is much more apparent in their work than in past studies. At first glance this low-velocity zone might appear to support the squeezing model, because similar zones are found in places with high crustal heat flow or recent volcanism. But the low-velocity zone is more pronounced under Tibet than in these other, high-temperature regions, and Chun argues that the slow seismic speeds in Tibet are due not to high temperatures but to water trapped in the cracks of the underthrusting Indian continent, which has increased the pore pressure of the crust.

Whole-world study embraced

When it met last month in Berne, Switzerland, the International Council of Scientific Unions formally launched an interdisciplinary research program aimed at studying the earth, and the life it supports, as a whole system. According to John A. Eddy of the National Center for Atmospheric Research in Boulder, Colo., who was a member of the U.S. delegation to the council, the attendees unanimously endorsed the International Geosphere-Biosphere Program (IGBP) (SN: 3/8/86, p.152).

Eddy thinks the enthusiasm for IGBP has been spurred by concerns about global changes, such as "greenhouse" warming, that may have been caused by human activity. In addition, he says, the tools for studying the planet have advanced, and earth and life sciences have "reached a point where we begin to see how they fit together like pieces in a jigsaw puzzle."

In the next few years, the council's committees will hash out the priorities of IGBP research, which is scheduled to begin in the 1990s and continue for at least a decade. The program will consist of existing research projects and about $1 billion worth of new studies. While council members are not yet sure how extensive the program will be, says Eddy, IGBP could well turn into the largest scientific program ever attempted.

Footnotes on alleged human footprints

The Taylor trackway near the Paluxy River in Texas has been an important toehold for creationists trying to prove that the earth — which they believe was inhabited all at once by humans, dinosaurs and all other creatures that have ever lived on the planet — was created only several thousand years ago. For decades they have argued that oblong depressions in the trackway were made by humans at about the same time a dinosaur left its characteristic three-toed prints in the mud.

Earlier this year, John D. Morris at the Institute for Creation Research in Santee, Calif., backed down on this interpretation after amateur paleontologist Glen Kuban of North Royalton, Ohio, noticed that blue-gray toeprints have emerged next to the oblong depressions in the otherwise tan rocks. Kuban and others suspect that the toeprints appeared because natural processes had long ago filled them in with sediments that differ chemically from the surrounding rocks, and that they are changing color now because the river level has fallen in the last several years, exposing them to air.

In his June 19 letter to NATURE, Morris says the appearance of the toe stains suggests that "an unprecedented geological phenomenon has taken place. . . ." But responding in the Oct. 2 NATURE, paleontologist James O. Farlow of Indiana University-Purdue University at Ft. Wayne notes that similar "color distinctions" in dinosaur tracks have been found at two Colorado sites. Moreover, Farlow reports that the step angle and the relationship between foot size and stride in the oblong tracks reflect those of hundreds of other dinosaur trails he and others have studied. So, he says, "the color distinction is just icing on the cake."

Kuban has explained the oblong shape of the Taylor tracks by suggesting that the dinosaurs, which normally walked on their toes, had been putting the entire soles of their feet down as they walked. Farlow thinks this is a reasonable idea and notes in his NATURE letter that "flat-footed" dinosaur prints, while not common, have been found elsewhere. The mystery, he says, is why some dinosaurs chose to walk that way.

Will creationists now turn on their heels? One problem with the trackway issue, says Farlow, is that most creationists haven't studied enough tracks to see that there is a whole spectrum to the quality and shapes of dinosaur prints. "None know anything about dinosaur foot anatomy or have done detailed studies of tracks," he says. "So it's not surprising that they have made these kinds of errors."

Sand ripple shape? The shadow knows

Trying to understand how trillions of grains are shaped into a sand dune is no easy task (SN: 5/3/86, p.282). One step toward that end is described in the September GEOLOGY by Bradley T. Werner at Caltech in Pasadena and his colleagues. They report on a simple but accurate method for measuring the cross-sectional shapes of sand ripples, which play an important role in theories of the formation of sand dunes.

According to Werner's group, other researchers have devised a variety of techniques for measuring ripple size and shape, including impregnating sand ripples with a hardening solution so that they can be taken back to the laboratory and using three-dimensional photography to study the formation of sand ripples in wind tunnels. " . . . [A]lthough all these techniques produce useful information, they place a strain on the patience of the investigator," write the researchers. So they invented a method that is easy to use in the field and is accurate to within one sand grain. Werner's group photographs the shadow falling from a straightedge suspended over the ripples. From the shadow outline, they obtain a profile of the ripples. The next step, they say, is to make shadow movies of the ripples as they form.