SCIENCE NEWS OF THE WEEK

California Tectonics: Bits and Pieces

No wonder California attracts the restless — the land itself is constantly on the move. Like passing trains stuck in the same tunnel, the east and west halves of the state lurch and shudder past each other along the giant seam of the San Andreas fault.

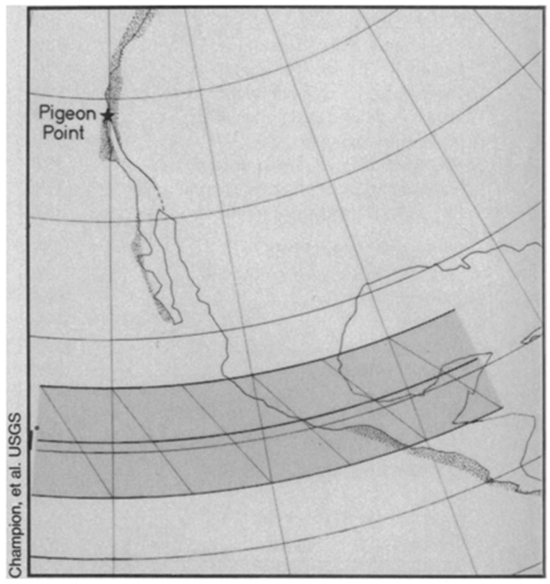
Until now, the north-bound "train" — that sliver of land west of the San Andreas that runs from Baja California in the south to Eureka, Calif., in the north — was thought to have journeyed only about 650 kilometers in the past 100 million years or so. But a collection of papers presented at the recent meeting in San Francisco of the American Geophysical Union suggest that that piece — or pieces — of real estate may have been more like a rush-hour express, moving farther and faster than anyone imagined.

The emerging picture of California's assembly from fast-moving and far-flung pieces is startling. Drawn by Duane Champion, David G. Howell and others at the U.S. Geological Survey in Menlo Park, Calif., and Bradley Erskine and Monte Marshall of San Diego State University, it shows some segments cruising northward as much as 2,500 km in 70 million years, shoving aside earlier arrivals, and other pieces twirling and zooming — compared to present rates of motion — into place in only 15 million years. Considering its radical departure from present notions, the image is a hard one for some researchers to digest.

This portrait is the product of a relatively new field called paleomagnetism. This technique depends on the fact that certain rocks — particularly volcanic rocks — contain bits of magnetic material that line up parallel to the earth's magnetic field when the rocks are still molten and that "freeze" in that position when the rocks cool. Because the direction of the field is slightly different everywhere on the globe, a rock that has moved from its original position will have a different magnetism than would be expected from its current location. From this deviation, and taking into account the position of the pole at the time the rock formed, the amount of north or south movement and the degree of rotation of the rock can be determined. The original longitude cannot, however, be discerned, because the direction of the field is constant across a given longitude.

Using this method, Champion, Howell and Sherman Gromme examined 70 million-year-old rocks from Pigeon Point, Calif., about 40 miles south of San Francisco, and found that the region appears to have moved at least 2,500 km from the south. Earlier work by Howell and others, which matched the geology of the region with that of other areas to the south, estimated a northward trek of, "at the wildest," 1,000 km. Moreover, Champion says that Pigeon Point and the geologically coherent Salinian block on which it sits appear to have made most of their expedition before 50 million years ago and to have moved only about 250 km in the last 20 million years.

With Hugh McLean and J. G. Vedder, Howell takes this idea even further, suggesting that regions of southern California, based on their similarity to the Salinian block, hitched a ride on that fantastic voyage. Matching this welded block to a geologic "hole" near Acapulco, Mexico, Howell suggests that these chunks broke off the Mexican coast, swept northward with the Pacific plate, beached in southern California, scooted over the existing terrain and created mountains. This scenario requires that this sutured block moved about 7 to 8 centimeters per year, a speed with which most geologists are comfortable.



Rocks from Pigeon Point, Calif., suggest that part of the state moved 2,500 km, twice as far as previously thought. Shaded portion is possible zone of origin.

Many are not so comfortable with the speed envisioned for another chunk of California by Bradley Erskine, now at the University of California at Berkeley, and Monte Marshall. Erskine and Marshall examined rock samples from a block that extends from Riverside, Calif., to Baja California. Their results indicate that this segment traveled a total distance of possibly 1,300 km, putting San Diego 100 million years ago where Mazatlan, Mexico, is now. The voyage had two very different legs, Erskine notes: Between 90 and 15 million years ago, the parcel of land rotated about 42° clockwise but moved north only 120 to 500 km. Beginning about 15 million years ago, however, the rocks tell of a 700- to 1,200-km-long journey, suggesting that the block moved at tectonically breakneck speeds. Some geologists voice doubt about that amount of movement in only 15 million years, but Erskine maintains that similar results "keep popping up" from rocks in other regions. "I can't believe we'd keep seeing these same numbers if there weren't something there," he says. "It's a lot of movement, but it may work out."

All the researchers agree there is much left to be done before California's piecemeal portrait is completed. Champion and Howell plan to take paleomagnetic samples from the San Gabriel mountains, for example, to see if that region was indeed a fellow traveler of the Salinian block. Whatever the outcome, California tectonics will never be the same. As Champion says, "It's part of a new picture. Everything is moving, everything is mobile. Our scale of perception is changing quickly." □

A plasma laser, not a laser plasma

It seems as if almost anything can be made into a laser. Such is one of the impressions recorded by Theodore H. Maiman as he reviewed the 20 years since the invention of the laser in a keynote speech at the International Conference on Lasers '80 held last week in New Orleans. Maiman's first laser used a ruby rod. When his success became public knowledge, as he says, nearly everybody with a crystal in his laboratory tried putting mirrors on the ends of it to see if it would lase. The surprising thing is that many did.

A large number of substances and different states of matter have been used as the active element in lasers. Now it is the turn of what is sometimes called the fourth state of matter — plasma — in the form of ionized metal vapors. W. T. Silfvast of Bell Telephone Laboratories describes "a new laser we've [E.O.R. Wood II and others] been working on." It makes use of the radiation generated as an ionized gas recombines — that is, as the ions recapture the electrons they have lost and neutralize themselves.

Silfvast describes this as "the simplest laser anyone could make." He says it gives gas lasers some of the desirable properties of solid state lasers. It also shows promise of providing laser radiation in the vacuum ultraviolet part of the spectrum.