

East Pacific Rise

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LA JOLLA, California--A small group of scientists working in half a dozen different fields here are fitting together bits of evidence to form a picture of a great physical feature of the earth's surface that was all but unknown ten years ago and still might be so had it not been for the International Geophysical Year.

In so doing, they have opened the door for future studies which may profoundly influence man's understanding of the history of his planet.

This new addition to the map of the globe is called the East Pacific Rise. A decade ago it was known only as a relatively shoal portion of the East Pacific Ocean. Today, as a result of a series of expeditions conducted by The University of California's Scripps Institution of Oceanography, its true dimensions can be seen:

It is one of the largest physical structures on earth. It runs in a sickle-shaped curve from near New Zealand 8,000 miles to the coast of Mexico. There its crest disappears from the maps, unless, as some scientists now think, it underlies the western part of the North American continent.

If so, then a previously described shoal area off the coast of Canada, reaching almost to Alaska, can be considered the northernmost end of the crest of the Rise. This would bring the total length to about 10,000 miles, almost half way around the world. If the Rise underlies western North America, then Salt Lake City, at 4357 feet above sea level, and volcanic Easter Island in the southeast Pacific sit on the same geological structure, and owe the altitude of the one, the very existence of the other, to the Rise.

Though the crest lifts itself two miles above the floor of the deep Pacific, it still lies one and a half miles below the ocean surface, except where volcanic islands, like Easter, thrust upward atop the great bulge of the Rise.

The Rise is part of a system of shoal areas found in all the oceans. The steep, jagged Mid-Atlantic Ridge is another arm of the system, as is the Mid-Indian Ridge in the Indian Ocean. The crests of these ridges are in the centers of the oceans, that of the East Pacific Rise lies at the eastern edge of the Pacific. In contrast to the Mid-Atlantic Ridge, the western approach to the crest is remarkably gentle: the sea floor rises at about ten feet a mile, rather than the thousand feet per mile often found on land. Hawaii lies west of the westernmost edge of the Rise. The sea floor thus slopes downward from the California coast all the way to Hawaii.

Four characteristics of the Rise especially intrigue scientists: 1) like other ocean ridges, it is the site of many shallow earthquakes; 2) beneath its crest the crust of the earth thins out, becoming two miles thick rather than the three miles of typical ocean basins, and perhaps twenty under the continents; 3) heat is flowing through the crest at a rate as much as eight times that in the deep ocean floor or on land, and to the flanks the rate of heat flow is much less than elsewhere; 4) the Rise is intersected by as many as eleven narrow mountainous belts called fracture zones that run almost due east-west. These fracture zones contain most of the volcanoes, extinct or active, found in the eastern Pacific. (One of these fracture zones lines up exactly with the great volcanoes of Mexico.)

To explain the Rise, scientists hypothesize that in geological terms it is a fairly recent feature of the earth's crust, akin to such ancient rises as that in the Central Pacific upon which the Hawaiian Islands have built

themselves. They say that perhaps the earth has been bowed up by a vertical current in the hot materials of the earth's mantle, materials that at weak points in the structure find their way to the surface as volcanoes. They postulate that this great convection cell below the Mohorovicic discontinuity explains the curious pattern of heat flow.

They are particularly interested in the fracture zones, for if they have existed elsewhere in the earth's history, time has erased all visible trace of them, except perhaps in China. These zones mark sharp changes in direction of the crest of the Rise and abrupt changes in elevation.

Just within the past few years, new studies have thrown startling light on these zones. Using maps of magnetic anomaly, scientists have discovered that the actual movement of the earth's surface can be clearly traced. The lines of magnetic anomaly run generally north-south and they form a pattern that looks rather like that made by the grain in wood. Maps prepared by the Scripps Institution show that across the fracture zones off California the pattern is interrupted. The grain patterns do not match, as if a piece of wood had been sawed in segments, and these pieces moved to the right or left.

Now they find that the original patterns can be reconstituted by shifting their maps back and forth. In one place, the pattern may have been moved to the right a hundred miles or so. In another, the movement may have been almost a thousand miles.

This means that in the sea floor off California, blocks of land as big as the state of Texas have moved bodily for several hundreds of miles. Earth movements on this scale are unknown on land.

The movement along these faults has been traced to the shoulders of the North American continent. What has happened there? Have vast sections of the sea floor simply slid beneath the continental mass? As yet, there is no way to answer the question.

Henry W. Menard, Associate Professor of Geology at Scripps, summarizes his own findings on the Rise and those of others in an article recently submitted to Science. Menard led a portion of Scripps' Expedition Downwind, which gained much of the information on the Rise. Downwind was an American contribution to the International Geophysical Year. "It is apparent that the study of oceanic rises and ridges which was accelerated by the IGY is one of the most fruitful fields available in geology and geophysics," Menard says, "By present planning, few, if any, months will pass during the next three years when oceanographers will not be at sea attempting to advance this study," Much of the work on the Rise has received support from the U. S. Office of Naval Research.