# Book Reviews

## Plate Tectonics: The Evidence

**Geomagnetism in Marine Geology.** VICTOR VACQUIER. Elsevier, New York, 1972. viii, 186 pp., illus. $14.75. Elsevier Oceanography Series, 6.

Despite its modest title, this book is essentially an introduction to plate tectonics. The main elements of the new paradigm of the earth sciences are by now well known: The earth's crust is divided by a network of boundary faults into a dozen rigid "plates." Along the plate boundaries earthquakes, volcanoes, geothermal areas, mountain belts, and zones of mineralization are generated as the plates move relative to each other. Like Darwin's paradigm of evolution a century earlier, the new paradigm of plate tectonics has produced a remarkable synthesis among previously diverging scientific disciplines. It would be difficult to exaggerate the impetus given by plate tectonics to both theoretical and applied earth science.

As is generally true in scientific revolutions, the new paradigm did not appear de novo. Half a century earlier, for example, Alfred Wegener had put forward his hypothesis of continental drift. Subsequently Arthur Holmes proposed that convection currents in the earth's mantle are responsible for the movement of the continents and for the formation of ocean basins. As early as 1939, David Griggs suggested that the ocean basins are young because they are swept clean by mantle convection currents which rise beneath the basins and descend beneath island arcs and mountain chains like the Andes, generating deep earthquakes in the process. These ideas have a surprisingly modern ring to them, so much so, in fact, that the question naturally arises, Is there anything new in plate tectonics other than the name?

The answer is yes, there is. The new paradigm of plate tectonics is different from earlier hypotheses in the same way contemporary atomic theory is different from the atomic theory of Democritus. The earlier theories were rather vague and speculative in the sense that they did not point to a critical experiment capable of testing their validity. In the case of continental drift, the result was that most geologists remained tectonic agnostics.

The critical experiment was provided by paleomagnetism, the study of the fossil magnetic record contained in rocks. The first step was to apply this technique to continental rocks to determine whether the continents had been displaced. Movement of North America relative to Europe was demonstrated in this way by Irving and Runcorn in 1956. The next important step was to extend paleomagnetism to the study of the sea floor. Experimentally it was difficult to obtain oriented samples from the sea floor for paleomagnetic analysis because they are covered by 5 kilometers of water. So it was necessary to turn to remote sensing.

In this volume Victor Vacquier presents the basic physics involved in these experiments and the scientific results obtained during a decade of research. Vacquier is in a good position to do this. He developed the fluxgate magnetometer that was used in the first marine magnetic surveys; he was among the first to recognize that magnetic lineations are displaced across transform faults; and he was among the first to use the magnetic anomalies over old seamounts in the Pacific to demonstrate that the Pacific sea floor has moved northward thousands of kilometers relative to the earth's rotation axis. In the present book Vacquier describes all of the mathematical techniques used in analyzing marine magnetic anomalies up to (but not including) the recent use of Fourier transform analysis by Schouten and Blakely. This is done with enough detail to enable a neophyte in the field to get started. The book also gives a fairly complete review of the scientific results obtained from marine paleomagnetism up to (but not including) the recent analysis by Larson, Chase, and Pitman of the older Mesozoic anomaly sequence. It concludes by showing how marine geomagnetism fits into the broad framework of plate tectonics.

In short, this small volume presents a very useful introduction to one of the most exciting episodes in earth science. The story is told by a scientist whose own work was central to the development of marine geomagnetism. And it is told with great modesty: I cannot recall another major review in which the author cites his own work only twice!

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## Physiological Ecology

**Environmental Physiology of Marine Animals.** WINONA B. VERNBERG and F. JOHN VERNBERG. Springer-Verlag, New York, 1972. x, 346 pp., illus. $19.80.

Marine physiologists, like their terrestrial counterparts, measure reactions and tolerances to various parameters such as temperature, salinity, and oxygen. From such data they try to project the organism of interest into the natural setting and see how it "fits." It is now fashionable to call this physiological ecology. Interest, though, centers on the individual rather than the grouping of species in a given place. This latter "community" is treated more by ecologists, frequently even when they don't have data on individuals.

A lot of physiologists have taken a lot of such data. We are currently being inundated by a multiauthor, multivolume work, edited by Kinne, that attempts to treat all this. The Vernbergs have produced a more tractable, small book which should prove worthwhile to students, and as a prelude to Kinne. It is heavily slanted toward the temperate latitude shore, as is their own work. But that is where marine stations and universities are most frequent, and so whence there is the most literature. They have made a commendable effort to cover the literature up to the time of publication.

I confess that I find it hard to make biological sense out of countless curves of oxygen consumption against temperature. Poikilotherms surely use more