When the Earth moved

Kurt Lambeck

The Ocean of Truth: A Personal History of Global Tectonics. By H.W. Menard. *Princeton University Press: 1986. Pp.353. $29.50, £19.70.*

IT IS said that in the twentieth century the Earth sciences experienced a revolution; that a series of bold steps provided geology with a physical and philosophical framework into which many previously disparate observations and questions could be slotted. But when did this revolution occur? Was it in 1912, when Wegener put forward his ideas about continental drift? Or did it occur a half-century later with the formulation of the global plate-tectonics model? Despite strong advocates such as DuToit and Holmes, the early ideas on continental drift had little influence on scientific opinion and by the late 1930s the controversy had ended more by exhaustion of the arguments than with firm conclusions — hardly the hallmark of revolution. The formulation of the plate-tectonics hypothesis in the latter half of the 1960s led, however, to an almost overnight conversion to a new set of beliefs about the mobility of the Earth's surface. Staunch anti-drifters became equally strong supporters of the new theory. This, surely, was the revolution.

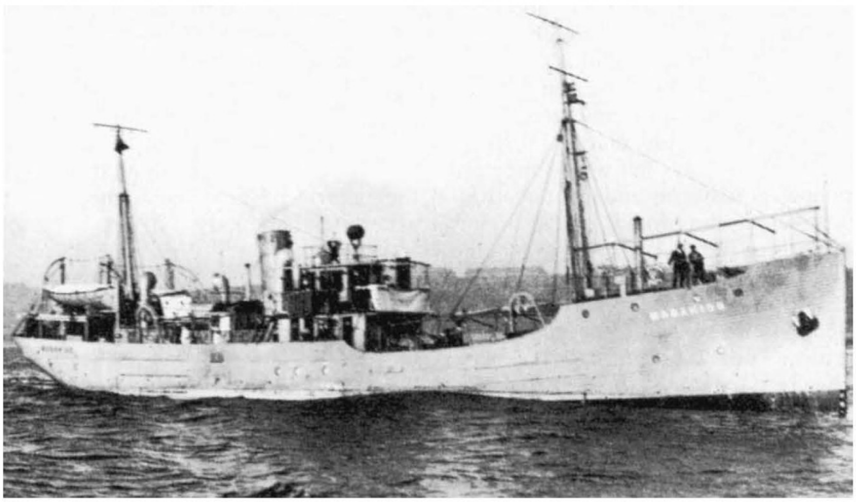
In writing *The Ocean of Truth*, H. W. Menard — who sadly died not long after completing the book — set out to trace the history of the developments that led from continental drift to plate tectonics, and to summarize the general principles underlying progress in the Earth sciences. Many histories of this time of changing geological thought have been produced by scientists who were not directly involved, and from them one is often left with the belief that progress resulted from flashes of insight from a few brilliant people. The evolutionary nature of the progress is lost sight of and the owners of the toes upon which those remembered stood are forgotten. Menard, in contrast, was ideally placed at San Diego to observe and contribute to the developments in marine geology that were central to the definition of the plate-tectonics hypothesis.

The period after the Second World War was one in which geologists moved from the continents to the deep oceans, the work of the new marine groups at Scripps, Columbia and Cambridge leading to the rapid spread of ship tracks across previously uncharted seafloor. Menard participated in these programmes and made many contributions to the understanding of the morphology of the seafloor and of submarine volcanoes, ocean ridges and fracture zones. He knew and corresponded with most of the players throughout this period. Above all, he had a memory for detail and a passion for the history of science.

The growth in marine geology in the 1940s and 1950s led to increasingly sophisticated tools to probe the seafloor: improved echosounders, gravimeters and magnetometers, piston corers, explosion seismometers and dredges. It was a time of keeping one's ships at sea and of the collection of much new data. Each new expedition came up with discoveries. It was found that the ocean crust was younger and distinctly different from its continental counterpart; that the sediment cover was generally thin; and that the basement rock was consistently basaltic. Ocean ridges and trenches were charted in detail, and the main fracture zones were discovered and mapped. Most important was the detection of the magnetic patterns of the seafloor. With each passing year, some fragment of geological dogma had to be discarded.

Menard discusses these discoveries almost in passing. His emphasis is upon the scientists involved, and on the rivalry and cooperation between and within institutions, and he looks at the responses of some of the leading geologists and geophysicists of the time to the early models of seafloor spreading. Which one of the founders of the plate-tectonics model still did not see the significance of the hypothesis of seafloor spreading as late as the end of 1966? As well as giving possible cause for embarrassment to those concerned, Menard traces the development of concepts and interpretations as new surveys were completed. The remarkable magnetic anomaly patterns of the seafloor, for example, had already been recognized by the mid-1950s and the reversals in the magnetic field had been detected. Mason, one of the discoverers of the anomalies and one of the first to attempt to correlate the reversals from core to core, apparently received little support for his ideas from his colleagues. It was to be nearly a decade later, when the groups in Canberra and Menlo Park began to publish their geomagnetic reversal timescales, that first Morely, and then Vine and Matthews, independently proposed that the magnetic anomalies were clear evidence of seafloor spreading. This was despite the fact that the ideas and papers of Hess and Dietz on seafloor spreading had been in circulation for some years. Cautious acceptance of the seafloor-spreading model then crept into the marine geology community, but its global nature was not yet acknowledged. Seafloor spreading without subduction implies expansion of the Earth, and Menard also discusses the debates that centred on this topic.

The fracture zones were discovered and



Voyage of discovery — the Egyptian ship Mabahiss, *the research vessel of the John Murray Expedition of the 1930s, which undertook a major survey of the Indian Ocean and surrounding seas. The picture appears in* Deep-Sea Challenge: The John Murray/Mabahiss expedition to the Indian Ocean, 1933–34, *edited by A.L. Rice and recently published by UNESCO (British distributor is HMSO). The book is published to commemorate the fiftieth anniversary of the voyages and most of the text is taken up by a narrative by the leader of the expedition Lt-Col. R.B. Seymour Sewell. The upsurge of interest in the* Mabahiss *because of the anniversary has fostered hopes that the ship may be converted into a floating oceanographic museum of Egyptian marine science.*