BOOK REVIEWS

Electromagnetism and The Earth's Interior. 308 pp. By T. Rikitake, Elsevier Publishing Company, Amsterdam. 1966.

This book, the second in a series of books on developments in solid earth geophysics, is concerned with how the study of the earth's magnetic field has extended our knowledge of the physics of the earth's interior. These developments have been twofold. Attempts to explain the existence of the earth's field have led to a dynamic model of the earth rather than the static model implied by seismology: convection—thermally driven—in the fluid core provides the energy for the maintenance of the geomagnetic field. Secondly, the study of the time variations of the geomagnetic field has determined the variation of the electrical conductivity with depth—the explanation of which in terms of semiconduction has helped to draw attention to the relevance of the ideas of solid state physics to the earth's interior. Professor Rikitake's book is concerned with a systematic mathematical account of these topics. As the basis of these methods is the proof by spherical harmonic analysis that the main geomagnetic field is wholly of internal origin and that the external part of the transient variations can be separated from the internal, induced, part, it is a serious defect of the account that this fundamental topic is not fully set out. In fact, the book often loses sight of the physics in a perhaps too detailed exposition of the algebra of the various induction problems. This is not, of course, entirely the author's fault: most of the problems with which he deals—the self-exciting dynamo in a spherical, conducting core, induction in spheres and cylinders are intricate exercises in applied mathematics. But even the professional mathematician would not have the patience to read carefully through much of these accounts unless he wished to make a personal contribution to the subject. Bearing in mind that those working in geophysics come from a wide variety of disciplines, the reviewer feels that the book ought to have paid more attention to the needs of those comparatively poorly equipped, mathematically.

However the book is a very important bringing together of work now widely scattered in the literature and should be of great use to geomagneticians. Of especial interest is Dr. Rikitake's account in chapter 19 of the conductivity anomalies in the crust and upper mantle, which were discovered as a result of the attenuated vertical component of short term variations. This has given rise to an exciting new method of probing the upper mantle.

S. K. Runcorn

The Earth's Crust and Mantle. By Vening Meinesz. Elsevier Publishing Company, Amsterdam. 1965.

This book is appropriately published during the period of the Ipper Mantle Project of the International Union of Geodesy and Geophysics in which geologists and geophysicists from many countries are co-operating in new studies. Professor Vening Meinesz in this book sums up his work on the figure of the Earth, his pioneer studies on deformations of the Earth's curst, and the hypothesis of convection currents in the mantle, which he has done much to develop. There is no doubt in my mind that this book is a classic of the Earth Sciences. It has not an exact mathematical treatment which one finds in many textbooks of geophysics, but in a remarkable way it welds together the approach of the geologist and the physicist. Vening Meinesz's arguments in favour of convection in the Earth's mantle are remarkable in being so different. His first need to infer the existence of these currents came from the necessity of explaining the negative anomalies associated with the deep ocean trenches, a result of his pioneer work in measurement of gravity at sea. The modern results of studies of the ocean floor and in particular the world-wide rift system, indicate tension in certain parts of the world and fit nicely with the hypothesis of convection currents. These more recent developments are very well explained by Vening Meinesz.

The second line of evidence which drew Vening Meinesz to the hypothesis on convection currents is by contrast remarkable for its subtlety. By the use of spherical harmonic analysis Vening Meinesz drew attention to certain regularities in the distribution of continent and ocean which pointed to a cell-like structure of the mantle. The strength of the third, fourth and fifth harmonics in the harmonic expressions for the topography were shown by him to fit well with the theory of convection. Again, in this book, Vening Meinesz sets out this argument in a way likely to be appreciated even by the unmathematical.

There are of course now other arguments in favour of convection in the mantle: it clearly has to be assumed if continental drift is to be explained and Professor Vening Meinesz does not do more than point out the connection. The relationship of convection with the distribution of heat flow and with the supposed discontinuities in the mantle are not clear, and this book does little to resolve what many think are obstacles to the convection hypothesis. The book however stands, it seems to me, with Urey's 1951 book on *The Planets* as a milestone in the development of satisfactory ideas about the evolution of the Earth.

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