

MAGNETOHYDRODYNAMICS

Magnetohydrodynamics

By T. G. Cowling. (Interscience Tracts on Physics and Astronomy, No. 4.) Pp. viii+115. (New York: Interscience Publishers, Inc.; London: Interscience Publishers, Ltd., 1957.) Paper, 1.75 dollars; hard cover, 3.50 dollars.

AFTER a protracted infancy, the field of magnetohydrodynamics has rather suddenly entered into what might be called its adolescence. This is largely due to the tremendous extension of observational material, both geophysical and astrophysical, that has become available during the past ten years or so. Apace with this has gone the development of certain theoretical ideas such as the notion that the terrestrial, solar, and stellar magnetic fields are due to some sort of self-amplifying dynamo mechanism.

This short tract represents the first coherent survey of the subject to appear in the literature. Prof. Cowling has been more intimately associated with all the phases of growth of magnetohydrodynamics than any other man, and we owe him a debt of gratitude for the present work. Such an effort is readily exposed to facile criticism by those who come after the pioneers and receive their material already pre-digested. The book shows the vestiges of pioneering; but the framework laid down here for the first time will no doubt remain and will stimulate others to fill in further details.

The treatment is essentially theoretical, observations being invoked only when they have a bearing on the theory presented. This greatly helps to make the presentation consistent in so brief a compass. The author wisely confines himself in the main to those aspects of the subject that can be described in terms of the field equations of classical physics. These are a combination of Maxwell's equations with the Euler equations of fluid motion, suitable coupling terms being inserted in both. The first chapter is devoted to establishing these equations and to a discussion of their general content. The presentation is very lucid; but one would wish it much longer, perhaps at the expense of some of the later, admittedly rather speculative, models of solar magnetic fields. The next three chapters deal with magnetohydrostatics, hydromagnetic wave motion, and the effect of a magnetic field on stability; that is, on the onset of turbulence as well as of thermal convection. There are a number of examples from solar physics. Some of the recent laboratory experiments and pertinent theories on the flow of liquid metals in a magnetic field are rather well covered.

The next chapter deals with dynamo theories of the Earth's field and gives a brief account of the effect of turbulence on magnetic diffusion. The last, brief chapter outlines the theory of some of the remarkable phenomena met with in rarefied ionized gases and gives applications to interstellar gas clouds. One of the outstanding features of the book is the gratifyingly close connexion which is drawn between the laboratory experiments with liquid metals and the analogous problems of stability in astrophysics.

The equations of magnetohydrodynamics are, in a manner of speaking, the most non-linear of all the known equations of mathematical physics. Hence such surprising phenomena as the presence of cosmic magnetic fields wherever there are conducting liquids.

This is something that could not have been predicted speculatively by any stretch of the imagination. Given our mathematical inadequacy in the face of non-linear equations, it will be a very long time before we can hope to possess rigorously deductive arguments for any essentially non-linear problem, for example, the dynamo problem. In the meantime we must be content with intuitively plausible but grossly oversimplified models. The situation is here similar to the physics of turbulence, which has not yet yielded to a deductive treatment in spite of long-continued efforts. The reader should keep this in mind when perusing Prof. Cowling's sometimes deceptively elegant discussion of the non-linear phenomena.

The book is, of course, essential for astrophysicists and geomagneticians. In addition, it should be valuable as a concise introduction to the subject for those now numerous physicists who are concerned with magnetohydrodynamics in the study of gas discharges.

WALTER M. ELSASSER

ZOOLOGICAL LITERATURE,
1954

The Zoological Record, Vol. 91

Being the Records of Zoological Literature relating chiefly to the year 1954. Edited by G. Burder Stratton. Pp. vi+2010. (London: Zoological Society of London, 1957.) £6.

THE issue of the present volume within little more than two years of the literature to which it refers is a remarkable achievement and reflects great credit on all those concerned in the compilation of this invaluable publication. Once again there is an increase on the previous volume in the number of zoological publications, an extra 260 pages, but from this must be deducted Vermes (1952), unavoidably omitted from Vol. 89. This indicates a rise of about 5 per cent in the period under consideration as compared with 10 per cent in the previous year.

The relative size of the various sections shows little variation from year to year, and although it bears some relation to the number of species in each group it is evident that some types of animals attract much more attention than others, especially those of economic interest. As would be expected, Insecta with 546 pages, involving 4,060 titles, is by far the largest section, followed by Vermes—another very large group. The space occupied by each of the other sections is arranged in descending order as follows: Mammalia, Protozoa, Arachnida, Mollusca, Aves, Pisces, Trilobita, Crustacea, Reptilia, Amphibia, Coelenterata, Brachiopoda, Comprehensive Zoology, Echinoderma, Bryozoa, Protochordata, and Porifera.

The number of pages, however, does not necessarily indicate the number of titles, and in the present volume the consecutive number which preceded each reference has been omitted in some of the sections. Judging from the number of titles, Aves, with a total of 1,972, is still the most popular group after Insecta, although its 1,972 titles and their analysis occupies fewer pages than Mammalia with 1,796 titles. It is curious that such a comparatively small group as the Amphibia, of little economic importance, should have more than three times as many references as such a large and comprehensive group as Echinoderma, but in zoology, like other subjects, fashion