

to carp at unimportant idiosyncracies I should say that it is wholly recommended to such students because it largely fulfills them. The first hundred pages contain the author's exposition of the principle of equivalence, of Einstein's theory and of more recent developments. The rest of the book consists of eleven reprinted papers.

The author's account of the motivation for the theory is largely from the equivalence principle. Mach's principle is dealt with summarily; Einstein is said (page 12) to have hoped that his theory would incorporate it but the grounds for this hope are not made clear. Eddington's demonstration that relativity diminishes the number of constraints that "laws of nature" impose on the world is scarcely mentioned though for many students it is the most stimulating feature of the elementary part of the theory. Cosmology is dealt with quite briefly; the Robertson-Walker models are not derived and the book is not advanced enough for global properties or singularity theorems. Gravitational radiation is taken no further than the classic 1962 paper of Bondi, Burg and Metzner which is reprinted with explanation in the text; and the spinor calculus no further than Penrose's 1960 paper reprinted without.

The book is therefore not quite an introduction to current research, but an advanced textbook, and a very good one.

P. E. ROE

Teaching mathematics

Developments in Mathematical Education. Edited by A. G. Howson. Pp. ix+318. Proceedings of the Second International Congress on Mathematical Education, Exeter, UK, August 1972.) (Cambridge University: London, 1973.) £4.80; \$14.50.

THE conference reported by this book consisted of thirty-eight working groups which dealt with the subject, on a broad basis, from kindergarten to the university.

The report appears in three parts. The first consists of a survey of the congress and covers a wide range of topics, including the psychology of mathematics learning; mathematics and language; mathematics at primary and secondary level and its link with other subjects, applications, history and assessment of mathematics; professional training of teachers and the use of teaching aids; and mathematics in developing countries.

The second part of the report consists of invited papers whose authors include G. Pólya, J. Piaget and Sir James Lighthill. There is also a paper by S. L. Sobolev on "Some Questions

of Mathematical Education in the U.S.S.R.". The third part consists of a selection of congress papers. These cover problem solving; intuition, structure and heuristic methods; geometry as a gateway to mathematics; and the work of Piaget in the training of students to teach primary mathematics.

My impression of the present state mathematical education is that too much is going on at the same time on too many fronts. Confusion is evident in the clash of differing philosophies, and it will probably be a matter of decades before a settled place is found for mathematics as a field of human endeavour. There seems to be far too much experiment, much of which is badly planned, or, worse still, introduced on impulse. But mathematical concepts, as a way of thinking, are recognised as being of greater importance than in any past period of history. Mathematics is no longer a matter only of number and numeracy. Structure, including concepts and their relationships, is now consciously identified as a fundamental aspect of human thinking. One of the main problems of mathematical education in the coming years will be to determine the place of structure in the thinking and behaviour of the mass of mankind.

L. S. GODDARD

Air and ocean

The Physics of Air-Sea Interaction. By S. A. Kitaigorodskii. Translated from the Russian. Pp.v+237. (Israel Program for Scientific Translations: Jerusalem, 1973.) n.p.

THIS book will undoubtedly become an essential work for the ever increasing circle of physicists, meteorologists and oceanographers for whom the interaction of the air with sea has become an important problem. Although there are omissions it will provide an up-to-date text upon which to build some of the newest theories of air-sea interaction.

The book is written in three parts. The first part, "Dynamics of the Marine Surface Mixing Layer of the Atmosphere", is devoted to the physics of the layer of the atmosphere immediately adjacent to the water surface. From the starting point of the Monin-Obukhov form for the generalisation of a logarithmic boundary layer to a temperature-stratified medium, the author examines the usual turbulent fluxes of momentum, heat and water vapour before continuing with a study of the aerodynamic drag of the sea surface and its relation to the characteristics of the turbulent atmosphere and of wind-generated waves. Several chapters are devoted to the analysis of results from field measurements of atmospheric

turbulence over waves in the Mediterranean and show some of the procedures used for evaluating the results from this complex problem. The last chapter in part 1 is concerned with the possible influence of high humidity on the vertical density stratification over oceans and collates and analyses data from many sources on gradient measurements and standard seaborne observations.

Part 2, "Wind Waves in Deep Sea" is a description of some fairly general similarity hypotheses concerning wind waves, and of tests of these on experimental data. The author attempts to reduce the complexity of the problem by obtaining some universal dimensionless parameters to describe the relationship between the turbulent wind and the spectrum of the wind waves. The approach and content is very different to that found in Kinsman's *Wind Waves* and these two texts complement each other well. Again there is much use made of experimental data with prominence given to the Soviet Mediterranean expeditions in 1965. Particularly interesting are the results from a wide-band string wave recorder used to obtain extensive measurements of open-sea wave characteristics in the high frequency region (up to 7.5 Hz). No mention is made, other than a statement confirming its omission, of the non-linear interaction between components in the wave spectrum.

In the third part, "Dynamics of Vertical Mixing Processes in the Upper Ocean", the author turns from his extensive use of experimental data and considers some of the many physical hypotheses underlying the characteristics of sea turbulence and the ways in which they effect the vertical mixing processes. Several models are used to make predictions about the energy balance of dynamic small scale turbulence in the wind mixing layer. The final chapter considers the seasonal variations in the active layer of the ocean. It seems a little out of place in a book concerned mainly with the physics of small scale interactions. Perhaps the author is right at this point to expand the field of view and to introduce some long term variations.

The text is also valuable for the attention it pays to some of the less well known expedition results of the Institutes of Atmospheric Physics and Oceanology of the Academy of Sciences of the Soviet Union and for the comparisons made between these data and those of the more usually quoted sources. Overall, an excellent book; my only criticisms are the minute size of type used for the equations and the confusing choice of symbols on a few diagrams.

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