

upward heat transfer because he argues for a quite narrow zone of conditions between the regimes on either side.

The evidence on these matters is skilfully assembled and discussed by the author. He also presents a theory of buoyant motion which is cogent and well supported by the experimental record so that mechanism begins to appear. The bridge has yet, however, to be built to the more fundamental approach adopted in recent years by W. V. R. Malkus in which disposable constants do not appear—this work is not referred to by Priestley. Not the least valuable part of the author's work is to relate the surface fluxes to the larger-scale motions of the atmosphere and to the problem of air-mass modification.

This is an excellent monograph for those with some familiarity with the subject of turbulent transfer, not necessarily in the atmosphere. It is thus to be recommended not only to meteorologists but also to practically all fluid dynamicists concerned with boundary layer problems. They will find writing which is primarily physical in approach and only so much mathematics as is needed to make the physics effective. The writer is a notably good apologist for his own cause, and the reader's enjoyment and stimulus should come in part from reacting to the writer's essence. No serious misprints have been noted and the book is nicely produced.

P. A. SHEPPARD

## THE WORLD AROUND US

### The World around Us

Edited by Sir Graham Sutton. (Six Essays based upon the Christmas Lectures delivered at the Royal Institution, 1958.) Pp. vi+122. (London: The English Universities Press, Ltd., 1960.) 16s. net.

THE 1958-59 Christmas Lectures at the Royal Institution were planned to mark the close of the International Geophysical Year, and this collection of essays based on the Lectures tells of the kind of work that geophysicists do, and describes some of the projects undertaken during the Year. I have never been able to understand the difference between a 'juvenile auditory' and 'teen-agers', or why it is that the former flock eagerly to hear lectures of the highest excellence by outstanding scientists, and the latter are cynically fobbed off with commercialized intellectual fare which could be described as abysmal if it were not certain that there are lower depths yet for future dredging. The answer is, I suppose, that chance is a fine thing. The regular publication of the Lectures brings them annually before a wider and equally eager audience; and as a most attractive book at about half the price of a long-playing record, this present volume should become the best-seller it deserves to be. It gives young people what they really want when they get the chance to choose it.

The first essay, by J. A. Ratcliffe, describes the exploration of the electron density in the ionosphere by radar echo-sounding, satellite transmissions, and observations of whistling atmospherics. J. M. Stagg describes the general features of the Earth's magnetic field, the complex interplay of surges in the Earth's liquid core and effects from outside, particularly the emissions from solar flares. R. L. F. Boyd writes on the information obtained about the upper atmosphere from rocket experiments and instruments carried in

rockets and satellites. Sir Graham Sutton, who has edited the book, deals himself with the lower atmosphere and its weather. G. E. R. Deacon's account of oceanography presents a general picture of the scope of a science that ranges from the detailed recording of variations in mean sea-level to harbour design, tidal waves, and the tracking of deep sea currents. G. de Q. Robin describes the problems of establishing and maintaining an antarctic base, and the work done at Scott Base as part of the programme of the International Geophysical Year.

The authors and editor are to be congratulated on transmuting the Lectures into essays that reach the highest level of popular interpretation. They contain so much information that is really new to the ordinary scientist who has not followed the march of events closely, and should be widely appreciated on this account as well. The publishers also must be congratulated on the production. G. R. NOAKES

## EXPLORING VECTOR SPACE

### Vector Space and Its Application in Crystal-Structure Investigation

By Prof. Martin J. Buerger. Pp. xiv+347. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1959.) 96s. net.

PROF. D. KOSAMBI, the Bernal of India, has written a collection of articles entitled "Exasperating Essays". It would make a very suitable second title for Prof. Buerger's "Vector Space and Its Application in Crystal-Structure Investigation". The book is exasperating because the subject is of vital concern to X-ray crystallographers, endeavouring to piece together the jig-saw puzzle of their experimental data, and yet one cannot help feeling that the really significant aspects could be presented in a smaller compass and made easier to assimilate.

The crystallographers' jig-saw puzzle, when the pieces are finally fitted together correctly, gives a picture of the electron-density distribution in the crystal, the peaks corresponding to atomic positions. Unfortunately the pieces will fit together in many different ways, and the key, the phase angle of the diffracted X-ray beam or the number on the back of the piece, which would enable the picture to be built up directly and systematically, has been obliterated. There is no means yet known by which the relative phases of diffracted X-ray beams can be determined directly, and it is this 'phase problem' of the structural crystallographer which is responsible for the study of 'vector space'. The concept originated in 1934 when Patterson showed that a modified jig-saw puzzle could be constructed directly from the experimental data, but that the picture so constructed was the 'vector set' derived from the actual atomic arrangement. That is, all the possible vectors between atoms are constructed and one end of each is then transferred to the origin. In general, there are  $n^2$  peaks in the vector diagram derived from  $n$  atomic positions, and the problem resolves itself into the 'unsquaring' of this distribution of vector peaks.

Prof. Buerger has played a prominent part in the gradual development of systematic methods of tackling this problem, and the present book presents a survey of these methods, many of which the author has himself originated. It may be said that the book is too complete and insufficiently critical, but another