

concessions have been made to the mathematically under-privileged, the importance and significance of the underlying physical principles have not been neglected so that the honours degree student, irrespective of his mathematical attainment, will find much to stimulate his interest in, and to clarify his ideas on, this the most fundamental branch of physics.

The initial chapters are devoted to the establishment of general principles by first laying the statistical foundations, then deriving the principal thermodynamic quantities and relations associated with the macroscopic state and finally obtaining the standard distribution functions, both classical and quantum. Then follow admirable comprehensive treatments of particular applications to closed systems in thermodynamic equilibrium, some examples of which are perfect and real gases, condensed bodies, solutions, chemical reactions, fluctuations and surface phenomena. A chapter on the symmetry of macroscopic bodies could well be omitted as the treatment is too condensed for all but professional crystallographers, and for them it is unnecessary.

There are some weaknesses in the general presentation. The style is occasionally laboured and an improvement in the continuity could be effected by including in the text the material added in numerous footnotes. Further, it is surely unnecessary to derive first a dimensionless expression for entropy into which later must be inserted Boltzmann's constant. Again, after the excellent exposition of the basic statistical principles it is surprising that reference should be made to both the specific heat and the Gibbs free energy per molecule. Finally, the authors depart in several instances from the conventional in their use of thermodynamic terms; in particular, by "adiabatic" they always mean "reversible adiabatic".

H. STEEPLE

## THE GREAT LAKES

Geology of the Great Lakes

By Prof. Jack L. Hough. Pp. xviii + 313. (Urbana, Ill.: University of Illinois Press, 1958.) 8.50 dollars.

**F**ORTY-FOUR years have passed since Leverett and Taylor published their classic work on the history of the Great Lakes. During much of the last twenty-seven of these Prof. Hough has been engaged on studies of the various aspects of this great group of inland waters. There has been a growing need for a summary of the large amount of work that has been accomplished in the interval.

The book is divided into two parts. The first deals with the topography and hydrology of the present lakes and the deposits on their floors, as well as the pre-glacial and glacial history of the region in general terms. The latter is inevitably a simple outline which forms the basis for the more important second part of the book.

Part 2, comprising rather more than half the book, deals with the history of the stages of evolution of the lakes as bodies of open water fluctuating in extent, with changes in the position of the oscillating front of the ice sheet to the north. The series of outlets of the lakes to the Mississippi, to the Mohawk and Hudson valley, to Lake Erie and the St. Lawrence, and to the St. Lawrence via the north-east corner of Lake Huron and the Ottawa River came into action repeatedly. The story now unfolded is substantially more complicated than the account of Leverett and

Taylor, and the work is very much better documented, in consequence of the research by many workers, including substantial contributions from the author himself. This applies particularly to revised and more detailed correlation of events over the vast area involved.

Particularly noteworthy parts of the book are the detailed but concise critical assessments of the evidence on which correlation is based, a valuable correlation chart based with an absolute dating scale on carbon-14 measurements, and among the many text figures 23 diagrams, summaries of the successive stages in the fluctuation of the extent and outlets of the lakes throughout late and post-glacial time. The large-scale southerly tilt of the area consequent on the isostatic rise as a result of the progressive de-glaciation of the area introduces complications in the history in the correlation of shore lines, and this is accentuated by the erosion of considerable lengths of the old beaches during later stages of the history of the lakes.

The author is to be congratulated on a major contribution to late-glacial geology of the region. The text figures are clearly produced and there is an excellent bibliography.

S. E. HOLLINGWORTH

## ANTING

Phoenix Re-born

By Dr. Maurice Burton. Pp. 224 + 16 plates. (London: Hutchinson and Co. (Publishers), Ltd., 1959.) 25s. net.

**F**OR many years anting in birds has held considerable fascination for students of bird behaviour. So, too, has the myth of the Phoenix, and when Maurice Burton saw a tame rook disporting himself on a heap of burning straw it led to an association of ideas which was ultimately responsible for the production of this book. After thorough exploration of the Phoenix legend, Burton carried out experiments with his tame rooks and a pet jay to determine their reactions to certain substances and to heat. He also examined the literature to see whether records of bird and other animal behaviour might reveal anting incidents which had been unidentified. Eventually Burton reached certain conclusions which show a clear connexion between Herodotus's account of the Phoenix and the anting of birds.

One thing is common to all the substances which cause the anting posture: this is heat or the impression of heat. In this remarkable book Burton compares the reaction of birds to different substances, examines the theories of anting and comes to the conclusion that anting must be regarded as a posture adopted in moments of unusually intense excitement. This may be stimulated autochthonously or through the agency of an external stimulus producing heat or the impression of heat in the mouth. Ant-bathing and thermophily are also shown to be closely related to anting proper and all these are related to such habits as the self-anointing of hedgehogs, the effects of catmint and other odorants on carnivores, as well as numerous idiosyncrasies of behaviour among individual birds and mammals, not excluding man himself.

The charm of the book lies not only in the emergence of a new theory to an old puzzle; the telling also stamps "Phoenix re-born" as an ornithological thriller of outstanding interest.

T. H. HAWKINS