

the U.S.S.R., the Ice Age glaciations, and the present-day ice cover of the district. These are all illustrated with excellent photographs.

The description of the Fedchenko Glacier is of special interest, even though, in this particular case, much literature already exists. It is the largest glacier in the U.S.S.R. extending for 46 miles (74 km.). It receives 37 tributary ice streams.

In addition to the many maps and photographs, the various regions described are shown in a carefully prepared key map at the end of the book.

It has only been possible in a short review to enumerate the most outstanding features of a really remarkably fine piece of original work and its equally excellent translation made by Dr. N. D. Gershevsky of the University of Washington, and admirably edited by Mr. J. E. Williams of Stanford University.

G. SEIGMAN

ADRIAN E. SCHEIDEGGER. *Theoretical geomorphology*. Berlin, Göttingen, etc., Springer-Verlag, 1961. 333 p. DM. 48.\*

THE science of *geomorphology*, in its more restrictive sense, is primarily concerned with the study of surface features, which are due to processes originating outside the solid Earth (exogenetic processes). In its widest sense, it naturally includes both the description of present-day landscapes and the elucidation and explanation of their histories. Until relatively recently geomorphology has been a purely descriptive science spattered only by occasional mathematical outbursts contributed by physicists, geophysicists and mathematicians in their search for reasonable and rigorous explanations of the more commonplace features of the Earth's surface. To many geomorphologists the introduction of a mathematically expressed law, an integral or an equation relating to a land-surface feature is foreign, but as this science evolves and advances it is inevitable that geomorphologists must think, record and analyse their observations in a more rigorous fashion.

In his book, Dr. Scheidegger has valiantly attempted the long overdue union of field observation and equation, which he has achieved with some measure of success. In discussing the six main topics of the book—mechanics of slope formation, river bed processes, development of drainage basins, theory of aquatic effects, nival effects (why not a less cacophonous and better-known expression?) and theory of aeolian features—the author has found it necessary to review briefly the resultant forms described in the literature and to introduce the reader to relevant basic physical principles, the understanding of which is essential before delving into the major part of the book. For instance, amongst other principles the physical properties of ice, the theory of plasticity and the various flow laws of ice are quoted.

In some thirty pages, devoted to "nival effects", the reader is taken carefully through a critical discussion of theories concerning ice ages, followed by the theory of longitudinal flow and sliding of glaciers, the dynamics of glacier snouts, the formation of transverse crevasses and the geomorphological effects of longitudinal glacier motion. Three-dimensional ice movement (including a brief reference to ice caps), pingos and "nival" solifluction all find their place in the discussion. In this remarkably short space the author has succeeded in stating and illustrating clearly all the relevant arguments and equations that he has combed from the more important recently published (and older) literature. The theory of glacier motion is disseminated through the pages of countless journals in English and a dozen foreign languages, but here there is an adequate summary to encourage the young glaciologist to deeper reading.

Although the origin of the shape of drumlins and pingos is considered at relative length, the reader might be disappointed to find that more important geomorphological features, such as the transverse profile of glaciated valleys, eskers, moraines and glacial cirques, are briefly

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dismissed. In view of the vast current literature on all these subjects, they could warrant more attention in a future edition of the book.

Although the critic could well suggest a more unified approach to the discussion of each topic by bringing descriptive observation into closer contact with the mathematical analysis, it is clear that a considerably enlarged volume would be required to cover the ground adequately. The selected references, given at the bottom of each page, should assist the reader in this respect. In spite of certain difficulties of expression and odd printing errors (especially in the mathematics), the author has succeeded admirably in breaking through the barrier that has long baffled the average geomorphologist, and it is hoped that this will lead to the clearer understanding and investigation of many more of the lesser known surface features of the Earth.

R. J. ADIE

A. E. M. NAIRN, *ed. Descriptive palaeoclimatology*. New York and London, Interscience Publishers Inc., 1961. 380 p. £4.

GLACIOLOGISTS are naturally concerned with the establishment of the evidence, the areal extent and the quantitative characteristics of the vicissitudes that the Earth's climate has undergone throughout geological time. Fifteen authors have collaborated in this most useful and authoritative book. The majority are primarily geologists, drawn from a wide field; four from the United States, three from England, two each from Germany and Japan, and one from Canada, Scotland, South Africa and Australia. The editor in his introduction emphasizes that the pooled knowledge of many scientists has gone into the probing of the generally accepted evidence of past climates with results that demonstrate the need for caution. The plan of the book includes three interesting chapters on the palaeoclimatic significance of desert sandstones, evaporites and red beds, and outlines essays on the climatic history of large areas, for example M. Schwarzbach summarizes that of Europe and North America and L. C. King writes on Gondwanaland.

Glaciologists can emphatically be commended to the second chapter; in 37 pages H. H. Lamb provides an admirably comprehensive discussion of fundamentals of climate from the standpoint of a meteorologist, conscious of the need to relate the energetics and the behaviour of the general circulation to changes in the extent and characteristics of land and sea. This very fine contribution deserves careful reading. Elsewhere R. F. Flint's short but salutary chapter on the geological evidence for cold climates is noteworthy; it is appropriately cautious, and for example enthusiasts will find a reminder that sediments that appear to be due to solifluction can be formed in other ways. Some may find R. Kräusel's chapter on palaeobotanical evidence over-compressed; less than five pages are given to the Quaternary, and it is a little surprising to find that in a list of 154 references Faegri's work is not named. It is instructive to read elsewhere the cautionary views that have been put forward with regard to the interpretation of ocean cores; and continental drift is clearly a subject on which active discussion continues.

Most of the chapters are abundantly furnished with references; one author lists 334. There are some misspellings here and there, and there are differences of practice between one author and another. There are useful author- and subject-indexes, although one can find that some of the authors mentioned in the text are lacking. The book is of handy size and impeccably produced. It can be strongly recommended to all glaciologists who wish to begin the exploration of this fascinating field, or to learn what progress has been made.

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