

OUTLINE OF GLACIAL GEOLOGY. F. T. THWAITES. Published by the author, 41 Roby Road, Madison 5, Wisconsin. ii+129 pages, 3 plates, 111 text-figures.

THIS lithoprinted book originated in 1922 as a text for students and has been repeatedly revised. It is divided into four parts; mountain glaciers and glaciation, continental glaciers and glaciation, the Pleistocene glacial succession, and a miscellaneous part.

The author follows the commonly used classification of ice masses into valley (with piedmont) glaciers and ice caps (large and small) which bury the topography. This tends to ignore the large accumulation areas which often blanket, without really concealing, the form of the topography, for which Wright and Priestley's "highland ice" category is of value.

Part I deals briefly with valley glaciers, the physics of their movement, their classification, nourishment, and their erosional and depositional effects. There is a rather uncritical acceptance of the flow terminology of Demorest as proven or factual. The motion power of gravity flow has "little to do with the slope of the upper surface" of the ice and flow is said to be laminar along planes parallel to the base. "Extrusion flow occurs under very thick ice where a slope of the top sets up differential pressures." "This type of flow must account for the movement of the thicker part of valley glaciers." The name of Streiff-Becker is a notable omission from the extensive list of references.

In Part II the movement of continental ice sheets by extrusion flow and marginal obstructed flow is assumed or accepted. This is accompanied by a rather sweeping, large scale application of the stagnation concept:

"Stagnation. Whenever the supply of snow fails to make good losses by extrusion flow a glacier continues to expand its margins. Reduction in thickness then decreases plasticity of the deeper ice and motion becomes slower and slower as time goes on. Eventually there will be too little force to overcome internal resistance to flow and stagnation results."

The reviewer finds difficulty in envisaging the balanced metabolic processes of the ice sheet immediately prior to the onset of the postulated change of conditions. Moreover to the reviewer stagnation means that movement has ceased, so that it becomes a state that one associates with a particular method of decay, in which case a second essential is complete failure of supply to the stagnant part.

There is strong emphasis on the deposits of continental ice sheets. Indeed those of the central United States are really the main theme of the book. Deposits and their topographic expression are described in separate sections. "Till" comes under deposits, while "ground moraine" is "the area of drift which is not definite moraines or drumlins and has not been reworked by water." This complete exclusion of drumlinized drift from ground moraine may not be considered acceptable to many. It is certainly confusing, and in mapping—an aspect generally stressed by the author—will involve difficult arbitrary dividing lines. It is surely preferable to regard drumlins as a particular form within the ground moraine. Much of the drift plains constituting the ground moraine are said to have originated as "seas of glacial mud" (englacial material left by stagnation decay) "which flowed out over pre-existing topography."

The peculiarities of the topographic expression of outwash deposits are of great intrinsic interest. The author, who has himself made notable contributions to the field, gives a lucid account with admirable emphasis on field discrimination and diagnosis. One would, however, like some elucidation of the concept of glacier lakes which are permanently ice-covered.

Brief reference only can be made to Part III dealing with the Pleistocene succession principally in central United States. It is a good summary with thought-provoking discussion of many of the unsolved problems. Clearly by comparison with continental Europe the interglacial deposits are feebly represented. One may note that of the thousands of cuts through the contact of the Carey and Valdres (?=Mankato) deposits in eastern Wisconsin only two have revealed interglacial vegetation. In this section the introduction of the expression "subinterval" as equivalent of "interstadial" is not adequately justified.

The text is simply written and there are numerous clear line illustrations. Emphasis on interpretation of field evidence is admirable.

Extensive references (19 pages double column) are arranged under some sixty subject headings valuable for ease of reference for students, but involving some repetition. There are few references to works in languages other than English; American sources, not all of major importance, are preferred. Mannerfelt's classic paper on stagnation decay, with its substantial English summary, would be a welcome addition.

Although appreciative of the value of extrusion flow as an empirical concept in the interpretation of observed facts, the reviewer found the general sections on the difficult subject of glacier movement the least satisfying.

The book is to be welcomed as a clear presentation of mature views of a geologist of great experience in the study of deposits of continental glaciation.

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COMPENDIUM OF METEOROLOGY. Prepared under the direction of a Committee of the American Meteorological Society, 1951. ix + 1334 pages, figures, diagrams and index. American Meteorological Society, Boston, Mass.

THE object of this very large and compendious work, printed double-column on large pages is, quoting from the preface, to take stock of the present position of meteorology, to summarize and appraise existing knowledge, and to indicate avenues which need to be explored. Within are a hundred and eight papers covering almost every branch of a rapidly developing subject, from solar radiation to the significance of microseisms. The majority of the authors are American, but within each of the twenty-five sections there are generally one or more contributions from the rest of the world; for example, F. H. Ludlam of the Department of Meteorology at Imperial College contributes a paper on the physics of ice clouds and mixed clouds. Several papers appear likely to be of direct interest to readers of this journal. Within the section on cloud physics, U. Nakaya contributes a short but welcome account of our knowledge of the formation of ice crystals with particular reference to his classical work on artificial snow. V. J. Schaefer follows with a discussion of recent advances in experimental meteorology and, as might be expected, he gives a summary of work on the transformation by "seeding" of supercooled cloud into snow crystals. There are three papers on "Polar Meteorology." Very notably Arnold Court gives a comprehensive and valuable review of the present state of knowledge of the Antarctic atmospheric circulation, which, together with a similar paper on "Arctic Meteorology" by H. G. Dorsey, cannot fail to be of use to all interested in the alimentation of ice caps. In a succeeding paper F. K. Hare writes on Arctic climatology; both Dorsey and Hare devote space to the further burial of the Hobbs doctrine which, as Matthes pointed out in 1946, had many years earlier become the target of criticism by European authorities. Two later papers in the collection include one on the geological and historic aspects of climatic change by C. E. P. Brooks and a short contribution on climatic implications of glacier research by R. F. Flint, emphasizing the value of glaciers as indicators. Throughout, in these and other papers the policy has been to provide extensive bibliographies of recent work, a commendable feature. While notice of such an extensive collection must needs be short, readers of this journal will find a great deal to interest them in the many other ramifications of atmospheric physics; as a work of reference and a stimulus to further work it is an admirable production on which the sponsoring Society is to be congratulated.

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