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# REVIEWS

W. S. B. Paterson. *The physics of glaciers*. Oxford, etc., Pergamon Press, 1969. viii, 250 p., illus. (The Commonwealth and International Library. Geophysics Division.) 35*s*. (cloth), 25*s*. (paper).

This excellent book is a clear, concise, and fairly comprehensive introduction to our present understanding of the physical principles underlying the behaviour of glaciers and ice sheets. Although Paterson assumes good preparation in mathematics (matrix algebra, and calculus up to partial differential equations) and physics (elementary continuum mechanics, heat flow, stress, and strain-rate), in accordance with his opinion, given in the introduction, that "a mere handful of mathematical physicists, who may seldom set foot on a glacier, have contributed far more to the understanding of the subject than have a hundred measurers of ablation stakes or recorders of advances and retreats of glacier termini", he never lets mathematical operations take precedence over physical arguments or observational facts. His theoretical developments are invariably accompanied by an explicit list of the approximations and assumptions made and a critical comparison of the results with field measurements. In addition, relevant papers in the original literature are cited throughout the text, and additional suggestions for further reading are appended to some of the chapters. As a result the book is highly suitable as a text on modern glaciology for beginning graduate students, particularly those planning to do research on glaciers.

The book begins with a brief historical review that introduces the topics of the subsequent chapters and serves to correct any false impression they may give that the only significant progress in glacier studies has been made in the last twenty years. This is followed by a chapter on the transformation of snow to ice, on the deformational properties of ice single crystals and polycrystals, and on the texture, fabric, and foliation of typical glacier ice. Next are chapters on mass and energy balance in glaciers. These are followed by three chapters on glacier flow. The first outlines the common methods for measuring velocity, strain-rate, and bed configuration; the second deals with the flow law of ice, the distributions of stress and velocity in various idealized glaciers, and the formation of crevasses; and the third discusses the important problem of basal sliding. This leads naturally to a chapter on glacier surges, which mainly serves to show how little we understand this puzzling instability of certain glaciers. Next is a chapter on the flow of ice sheets and ice shelves in which the emphasis is shifted from the situation at individual points to the shape of the ice sheet as a whole. This is followed by a chapter on distribution of temperature in glaciers and ice sheets, which wryly begins with a quotation from Disraeli, "This shows how much easier it is to be critical than to be correct". The last two chapters are on the response of glaciers to changes in mass balance and on the climatic factors that control the mass balance. Separate subject and geographical indexes conclude the book.

The internal structure of glaciers, the phase relationships and thermodynamics of glacier ice, and the erosion, transport, and deposition of debris by glaciers deserve more attention, even at the cost of some compression elsewhere in the book. Study of the striking systematic relationships among ice texture, fabric, and content of air, solutes, and solid debris is in my opinion no less relevant to understanding the physics of glaciers than analysis of the velocity and temperature fields.

These are but minor flaws, however, when compared to the over-all excellence and coverage of this much-needed modern introduction to the study of glaciers.

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