The book is avowedly written for the non-expert. It would make an ideal present for the science sixth-former. At ease in an armchair the intelligent layman, the public administrator, and the geographical student will find much to interest him. Even the expert will profit by observing the efficacy of homely similitudes and the telling diagrams in popular form. The diagrams are well conceived and excellently drawn and the ration of both these and of the photographs is generous. The book is quite unlike the shorter more specialized accounts that the Pelican books have accustomed us to ; it has much more in common with the popular scientific writings of the nineteenth century. On every page the author evokes our wonder at the marvels of inanimate Nature.

Inevitably the treatment is somewhat uneven though the author turns the edge of criticism by claiming the right to select material of most interest to a beginner or a keen amateur. The quality and presentation of the chapter on water in the oceans is clear evidence of the author's special study of marine geology. The material in the other chapters can be found in a few text books coming from Europe and North America, but the treatment and selection is always interesting and bears the author's own stamp.

The glaciologist will find that the treatment of snow and glaciers in the chapter on water in the solid state is interesting for the beginner, but the specialist will recognize that the author has taken little or no account of recent work, and that some of the references are so old as to be unsuitable for "the further reading" recommended. The opening and closing of crevasses (annoyingly translated as "crevices" in one place) is forcibly brought home to the reader by the description of people whose fallen bodies have been recovered in a flattened state, but the presentation of the mechanics of opening and closing of the crevasses is scarcely realistic.

The author keeps his promise to observe the utmost economy in the use of technical terms. Unfortunately the translation of some of these terms is badly at fault or non-existent. The translator (May Hollander) would have benefited from the advice of English technical experts. German words are often used in the terminology of snow avalanches, *e.g.* "*Wächte*" instead of "cornice" (Fig. 6). "Snowslips" (p. 132) and "gelated" (p. 137) are not English, and "impenetrable" is not descriptive of the permeability of clay to water (p. 191). "*Schneebrett*" which is translated as "floe avalanche" (Fig. 6 and p. 134) is the well-known "wind slab avalanche". There are some misspellings, "steared" (of a ship, p. 30, Fig. 7), "laminary" (p. 260) and the usual translator's pitfall "tensions" instead of stresses or forces (p. 145).

W. H. WARD

SCHNEE UND LAWINEN IN DEN SCHWEIZERALPEN, WINTER 1952/53, No. 17 (1954), Davos-Platz. Buchdruckerei Davos AG, 120 p., illus.

THIS annual report of the operations of the Federal Snow and Avalanche Research Station at the Weissfluhjoch deals with:—Weather conditions, snow, avalanches and the damage caused by them throughout the Swiss Alps. There are notes on the sliding of snow, on the problem of snow pressure, and on sundry other scientific and practical work done by the Station. The value of the many tasks completed there under the competent leadership of its Director, Dr. M. de Quervain, is very great.

CORRESPONDENCE

The Editor,
The Journal of Glaciology

SIR, *Ice movement and temperature distribution in glaciers and ice sheets*

G. de Q. Robin's article in the *Journal of Glaciology*, Vol. 2, No. 18, 1955, p. 523, represents an important advance in the understanding of the temperature distribution and energy balance of extended ice formations on a level base. Sorge's observations of the firn temperature at Eismitte to

a depth of 15 m. in 1931 had already hinted at the surprising absence of a temperature increase with depth[1] which has been clearly shown in the much deeper bores of the French Expedition to the same region in 1949–51[2]. Sorge had suggested (p. 269) that the horizontal removal of heat by the moving ice was the most likely reason for the nearly isothermal state of the firn layers; but this anticipation by no means diminishes the merit of Robin's work which for the first time puts the explanation of this surprising feature on a firm footing and opens the way to a more detailed study of the phenomenon, once more extended observations of the physical state of the upper layers of the ice cap become available.

Robin assumes in his derivation of equation (7) for the vertical temperature distribution in an ice cap that the horizontal temperature gradient is negligible. As according to Table I the vertical temperature lapse rate in a thick ice cap is also very small, one does not at first sight easily see what becomes of the heat which continuously emanates from the ground, and it might have been useful to show that even with the very small horizontal temperature differences allowed ($<10-8°$ C./cm.) the necessary heat transport can be accomplished.

It has previously been discussed among glaciologists that the vertical temperature distribution must be influenced by the fact that the ice below the surface has been deposited at a greater height and consequently under a lower temperature; but it is important to find in Robin's paper this vague impression replaced by a numerical expression. Further observations of the temperature distributions in deeper layers which are planned during the International Geophysical Year will enable us, following the line indicated by Robin, to separate this effect from that of climatic changes.

It is likely that the strong temperature lapse at Borg and West Station are not so much due, as suggested by Robin, to shear or thinning of the ice as to the heating of the lower layers by the infiltration and refreezing of melt water in crevasses.

It might finally be mentioned that simultaneously with Robin P. Jaspersen (Über Schmelzvorgang und Wärmehaushalt im Zentralgebiet des Inlandeises, *Eiszeitalter und Gegenwart*, Bd. 6, 1955) in a very elementary discussion also arrives at the conclusion that the greatest fraction of the heat gained in the central parts of a stationary ice formation is lost to that region and that it is doubtful whether any melting occurs at the bottom of the ice.

F. LOEWE

University of Melbourne,
Department of Meteorology
5 *December* 1955

REFERENCES

1. Brockamp, B., *and others. Glaziologie.* Leipzig, F. A. Brockhaus, 1935. (Wissenschaftliche Ergebnisse der deutschen Grönland-Expedition Alfred Wegener 1929 und 1930/1931, Bd. 3.)
2. Holtzscherer, J.-J., *and* Bauer, A. *Contribution à la connaissance de l'inlandsis du Groenland . . . 2e partie (no. N.II.3), synthèse glaciologique.* Paris, Expéditions Polaires Françaises, 1954.

COMMENTS ON DR. LOEWE'S LETTER

By G. de Q. ROBIN
(Physics Department, Birmingham University)

I WOULD like to thank Dr. Loewe for his kind remarks and for drawing attention to the earlier comments of Sorge on this subject.

Dr. Loewe's suggestion about the effects of melt water at Borg and West Station may well be correct and further field observations are needed to solve this point. The essence of the point concerning heat transport outwards from the centre of the ice sheet, is that this is coupled with the mass transport of ice and is similar to advective heat transfer in meteorology. The various equations are included to show that this effect, due to downward and outward spreading of the ice, may be sufficiently great with large ice sheets to make the normal process of thermal conduction negligible near the surface. In such a case the horizontal temperature gradient could be zero or even negative (decreasing outwards) with the necessary outward transport of heat still taking place.

CONCLUSION OF VOLUME 2

This issue closes Volume 2 of this Journal. Full particulars will shortly be available in regard to an index, title page and binding cases. Back numbers may be had on application to the Secretary in Cambridge.