Another expedition was planned to Mount Whitney (14,506 ft.), highest point in the United States of America, and the following letters were received:

"Dear Dr. Church, 10 Nov. 1951

Kehrlein, Gene Serr, Tarble, and I were on the summit of Whitney from about 18 to 22 July. It was a stimulating experience. We haven't worked up all our data yet, but I am fully convinced that evaporation, even at high elevations, is a small fraction of the ablation, being greatly exceeded by melt. . . .

WALTER WILSON."

"Dear Doctor, January 14, 1952

The report on our work on Whitney is being carefully worked up by Walter Wilson for the *Transactions*. Yes, you are right. Our experiment will represent conditions during the summer melting period. It showed about 90 per cent. melting and the balance pretty well equalized between condensation and evaporation. I would hate to spend a long period on Whitney's summit on any experiment—it stormed most of the time we were there, continuous high winds, rain, sleet and cold with frequent enough lightning to keep us on edge, most inhospitable. . . .

OLIVER."

[European research on this subject includes works by: Lütschg, O. *Ueber Niederschlag und Abfluss im Hochgebirge*, Schw. Wasserwirtschaftsverband, Verbandschrift No. 14. Zürich, 1926, p. 310 *et seq.* Odell, N. E. Ablation at high altitudes and under high solar incidence. *Am. Journ. Sci.*, Vol. 239, 1941, p. 379–82. Troll, C. Schmelzung und Verdunstung von Eis und Schnee in ihrem Verhältnis zur geographischen Verbreitung der Ablationsformen. *Erdkunde*, Bd. 3, Ht. 1, 1949, p. 18–29.—*Ed.*]

SIR, *Surveying on Glaciers*

While on a visit to Norway this summer, I saw a very striking example of the effect of atmospheric refraction. Quite early one morning, in brilliantly clear weather, I set up a theodolite in order to examine it, and amused myself by looking at surrounding mountain peaks through the telescope. I directed the telescope on to the summit of Galdhöppigen (the highest point in Norway), then looked at some other part of the instrument, and on looking again through the telescope I noticed that the instrument had apparently moved. Further examination disclosed that the supposed movement was the effect of change of refraction on the apparent elevation of the top of the mountain. The change was so rapid that the object seemed to move somewhat faster than the apparent movement of the Sun due to the Earth's rotation.

I was at Juvass, at an altitude of 1840 metres, on the shore of the small lake there. The line of sight passed over about three-quarters of a kilometre of ice-cold water, then for a kilometre or so over a sidelong slope of snow and rock facing east-south-east. The minimum height of the line above this surface was about 20 metres. The rest of the line was well above ground all the way, to a total length of about five kilometres.

The phenomenon described must have been caused by an exceptional combination of conditions in the presence of snow, rock and clear weather, but it points to the necessity for precaution in any work involving the observation of vertical angles. Observations should be arranged so as to minimize the effects of any changes of refraction.

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25 *October* 1952

J. E. JACKSON

REVIEWS

DAS KLIMA DER VORZEIT. Martin Schwarzbach. Stuttgart, Ferdinand Enke Verlag, 1950. viii, 211 pages, 70 text-figures.

IN 1930 Kerner-Marilaun's book *Paläoklimatologie* was published in Berlin; since then no other critical discussion of the recent progress made in the study of past climates has been published in German. Schwarzbach has attempted to fill this gap, and well he has done it. As the book is based entirely on published matter it contains nothing new for a reviewer to report; it therefore only remains to describe the contents and the method of presentation.

As the author says in his preface, the book has much more the nature of a text-book or a hand-book than its predecessors such as Kerner-Marilaun's book mentioned above or C. E. P. Brooks' *Climate through the Ages*. It is therefore hardly the book for a beginner; but for anyone fairly well up in the earlier work it is a pleasure to read; for Schwarzbach has all the skill in marshalling his facts which has given German scientific hand-books so great a reputation.

Starting with two short chapters on the history of palaeoclimatology and the climate of the present time, the author gets down to a long and valuable summary of the methods used by palaeoclimatologists and of the kind of evidence, chiefly geological, which has to be used. This clears the way for the main part of the work—the story of the changes of climate in the history of the earth.

His method of presentation is convenient: a section is devoted to each of the main geological formations; each section commences with a short account of the geology of the formation, which is followed by a discussion of the evidence for the climatic factors, temperature, humidity (rainfall and aridity), wind, etc.; and is then brought to a close with a survey (*Gesamtbild*) occupying only a few lines, seldom more than ten. The sections are so short that it is possible to read the longest in a sitting, so that one has the details in mind when one comes to the survey, which is what one usually wishes to remember.

The book closes with a chapter on the theories which have been put forward in such profusion on the causes of the changes in climate; this occupies only 31 out of 192 pages. The author gives in the preface the following explanation of this meagre allowance: "the chapter on the cause of the climate changes is relatively short because, interesting as this subject is, to-day we still build on quaking ground—the collection of observations and facts is the pressing need of palaeoclimatology," and heads the chapter with a quotation from Goethe: "*Sei ruhig—es war nur gedacht.*"

GEORGE C. SIMPSON

OBSERVER'S HANDBOOK. Meteorological Office, Air Ministry. London, Her Majesty's Stationery Office, 1952. 216 pages, 42 plates, 30 diagrams. 12 shillings and 6 pence net.

As quoted in the introduction, this book "sets out the details of observational procedure in accordance with international recommendations," and there is no doubt that this has been well achieved. To anyone wishing to set about the observation of any items concerning the weather in such a way as to make his data strictly comparable, not only among themselves but with data from other recognized authorities, this book is a necessity. Glaciologists should be particularly interested where the observation of snowfall is concerned, and this subject is discussed in considerable detail. On page 50 definition is given of granular snow and of the terms *slight*, *moderate* and *heavy* snowfall, which could be usefully circulated to observers in the B.G.S. Snow Survey.

Chapter 6 deals with the *State of the Ground* and most certainly concerns the glaciologist. Two scales of code figures for recording the state of the ground run concurrently, one the Washington Scale and the other the Crop Weather Scale. The former, introduced on 1 January 1949, has apparently replaced the latter at normal climatological stations. This is most unfortunate for future study or research into this climatological element, because the same code figure is used for "ice, slush or firm or settled snow" so that only the observer himself will ever know with which his area was covered. The older code scale, retained at Crop Weather stations, may not have been faultless, but is certainly more explicit in its description and one feels that the Washington Conference might have formulated a more precise scale.

On pages 115 and 117 details are given of the measurement of snowfall by rain gauges and its corresponding depth expressed as rainfall. The measurement of snow lying on the ground is also dealt with.

The book is well printed, with good illustrations, and the format is excellent, complete with useful appendices and an index.

D. L. CHAMPION