hundreds of fine bands, are annual—the scale is all wrong. They cannot correspond to Vareschi's ogives, which seems to confirm Mr. Fisher's view that two distinct ogive types exist. The plough-furrow (parallel-banded) structure described by Vareschi and illustrated by Dr. Godwin from a picture taken by Mr. Seligman seems to be similar to the fine Norwegian bands. Curiously enough they run in orthogonal directions.

The Chairman: The hour is growing late and I must bring the meeting to a close. It has been very interesting to hear of yet another application for pollen analysis, for which we have to thank Dr. Godwin as a result of his many years of work in that line. The only comment I have to make on the problem of banding is that the belts towards the side of the glacier, where the banding is nearly vertical and in the direction of flow, might be explained as follows: since bands of this kind are seasonal and move downwards and outwards under the pressure of succeeding layers, it would be natural to expect that towards the side of the glacier they would be tilted upwards to an even more marked degree than towards the snout of the glacier.

In your name I thank Dr. Godwin most heartily for his excellent paper.

The meeting then terminated.

ICE MARGIN FEATURES, LEIRBREEN, NORWAY

By G. de Boer (University College, Hull)

An interesting set of ice margin features, including shoreline terraces and an overflow channel recently deserted by the waters of a glacier-dammed lake, was seen in September 1947 during a field meeting of the Cambridge University Department of Geography in the Jotunheim district of Norway.

About 2 km. east of Krossbu, in the western part of Jotunheimen, and at an altitude of about 1500 m., a broad rocky spur projects into Leirbreen. The terraces lie on the southern flank of the spur where a lobe of ice had held up a lake in the lower part of a wide, shallow gully (see Fig. 4, p. 335). Two well marked shore terraces, and a number of lesser ones, showed that the lake had emptied in several stages (Fig. 1, p. 334). The two main terraces—depositional features composed of a fine yellowish silt—were about 2 to 2·5 m. wide and 2·5 m. apart vertically. The upper terrace (Terrace I) showed many signs of its longer exposure to erosion after emergence than the lower one. Just below the latter were the merest traces of about twenty minor terraces. Below these a slightly gullied bank of silt, carrying a few stranded blocks of ice, sloped down 6 m. to a small pool occupying the mouth of a tunnel formed in the projecting ice lobe. Streams following the edge of the ice entered this pool from both sides.

Corresponding features, due presumably to melting, could be traced on the ice lobe that had formed the opposite shore of the lake. The cross-section shows that the surface of the ice lobe had been reduced to what might reasonably be interpreted as a melt platform submerged at the lower (Terrace II) stage. The steepening of the ice slope at the back of this "melt platform" probably represents the little cliff also formed by melting at this stage. No doubt the slope was much steeper and more cliff-like before melting reduced it to its present rounded form.

This change of slope continued into a deep groove where the edge of the glacier became vertical (see Fig. 2, p. 334). The suggestion that the melt platform was formerly backed by a low ice cliff, which was rounded off by melting after the draining of the lake, is not inconsistent with the survival of the ice groove. The surface of the glacier was quite gently inclined and so was fully exposed to the sun. In addition, water melted higher up on the glacier surface and, running down

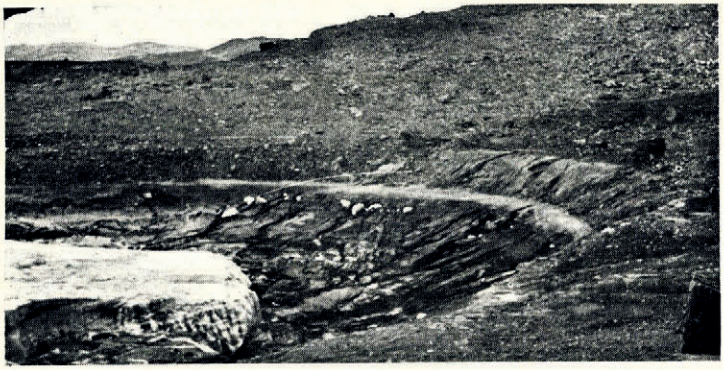

Fig. 1. General view of terraces on Leirbreen, Jotunheimen Melt platform in left foreground. (See also Figs. 5 and 6, p. 335)

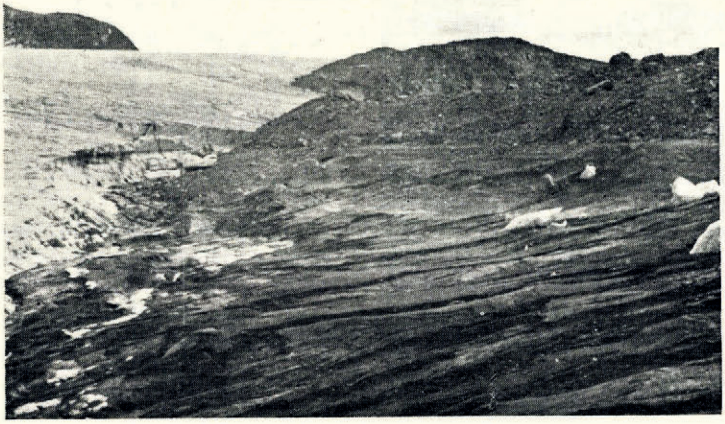

Fig. 2. Detail of gullied slope. Relation of Terrace II to ice groove in middle distance

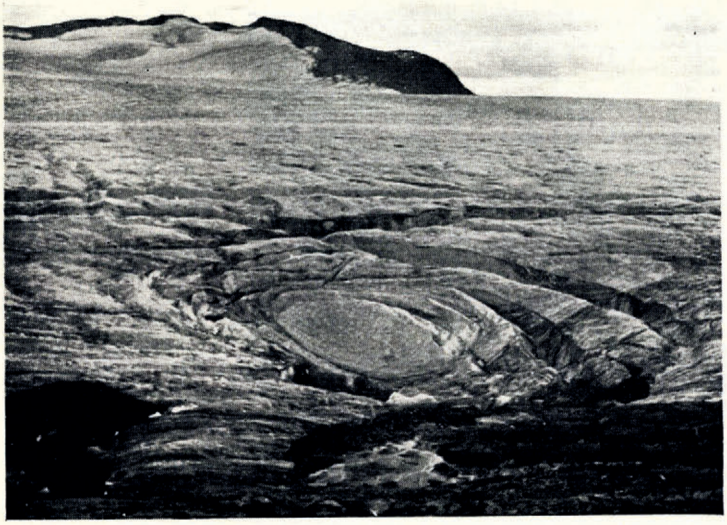

Fig. 3. Concentric crevasses presumably over a collapsed ice cavern. (See also Fig. 5, p. 335)

Photographs by I. J. Pook

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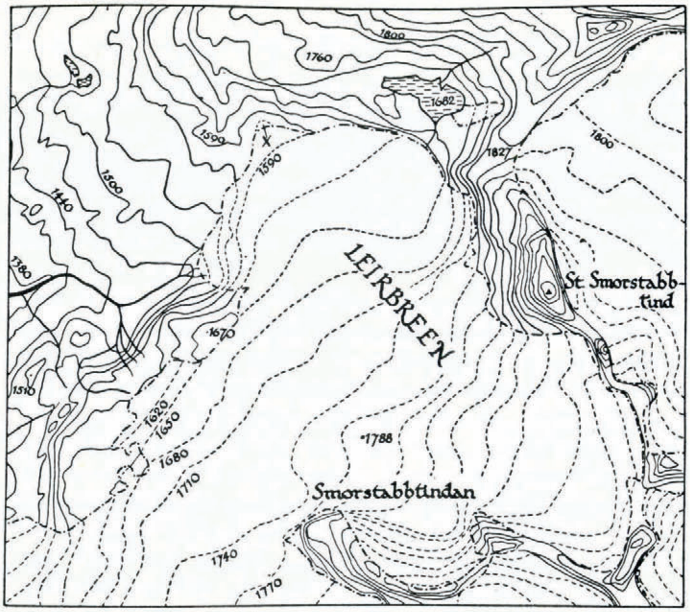

Fig. 4.

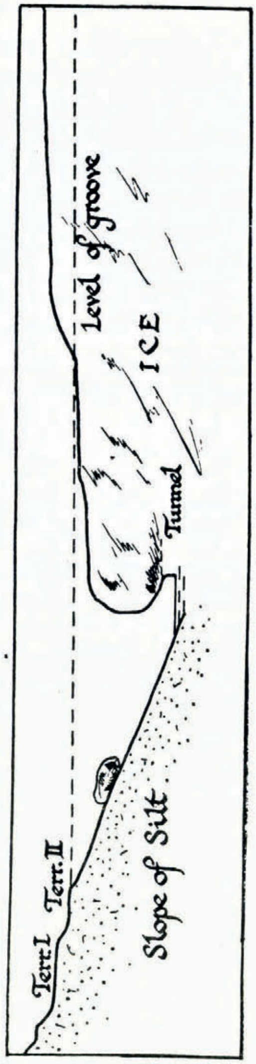

Fig. 6.

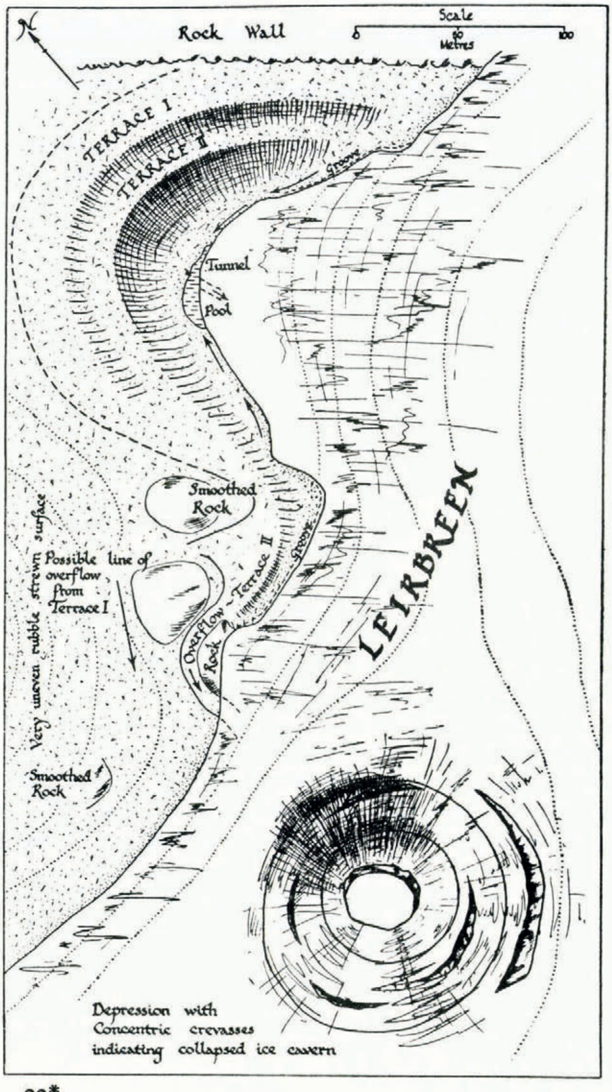

Fig. 5.

Fig. 4. Sketch-map of Leirbreen, Jotunheimen, showing ice margin features at X. Contours 30 m. Scale 2 cm. = 1 km.

Fig. 5. Ice margin features

Fig. 6. Diagrammatic section across terraces

the slope over the edge of the cliff, may have further helped to round off the angle. The groove, on the other hand, was cut into the face of a vertical or slightly overhanging cliff which faced north, so that it was largely protected both from sun and rain. The melt platform and ice groove suggest that the surface waters of the lake were more active in causing melting than were the waters at greater depth.

The lower end of the lake at Terrace II stage led to a short overflow channel, about 36 m. long and 9 m. wide. The side of the channel nearer the glacier was a rock wall about 2 m. high. The other side consisted of an almost vertical face of rubbly material resting upon a bed of clay approximately a metre thick, which was either a boulder clay or a deposit formed during a higher stage of the lake. This rested on a footing of solid rock into which the overflow had been incised. The floor of the channel was strewn with blocks of rock of all sizes from tiny fragments to slabs of a cubic metre or more. There was no sign of sorting by stream action. Some, but not all, of this angular material may have reached the channel floor by downhill creep from the rubble-strewn slopes above. At its lower end, the channel curved back towards the glacier, beneath which an ice tunnel continued the drainage line. Concentric crevasses surrounding a circular depression (see Fig. 3, p. 334) a short way out on the surface of the glacier lay on the same line and probably marked a collapse in the roof of the sub-glacial drainage tunnel.

This example from Norway is instructive because such glacial lakes were widespread in Britain during the late stages of the Ice Age and left their mark on the flanks of the Pennines and elsewhere. The terraces here described, being built of silt, are obviously very transient features. This may help to explain the rarity of shorelines associated with British overflow channels. Support is also given to the suggestion that the absence, or unexpected smallness, of certain channels in an otherwise complete sequence of overflows is due to drainage into the ice front. Edwards,[1] for example, has offered this explanation for some of the difficulties in Kendall's reconstruction of the marginal drainage along the western side of the Vale of York.[2]

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2. Kendall, P. F. and Wroot, H. E. *The Geology of Yorkshire*. Printed for the authors, 1924, p. 543.

GLACIOLOGICAL CONFERENCE OF THE AMERICAN GEOGRAPHICAL SOCIETY

In January 1949 the American Geographical Society, the Arctic Institute of North America, and the American Alpine Club jointly sponsored a series of meetings to discuss various aspects of glaciology. During the meetings Mr. Walter A. Wood showed a film dealing with the Arctic Institute's expedition in 1948 to establish a research station and conduct glaciological studies on the *névé* of the Seward Glacier in the St. Elias Mountains of Alaska.

A conference to discuss various aspects of glaciological research was held. Representatives of the Society, the Arctic Institute, the Department of Geology at Columbia University, the United States Geological Survey, the Office of Naval Research, the Bureau of Mineral Research at Rutgers University, the Departments of Geology at Tufts and Lafayette Colleges, and the American Alpine Club attended.

Three prepared statements were presented. Mr. P. D. Baird, director of the Montreal Office of the Arctic Institute and Secretary of the International Commission on Snow and Ice, gave a