THE NORWEGIAN–BRITISH–SWEDISH ANTARCTIC EXPEDITION, 1949–52

I. SUMMARY OF THE GLACIOLOGICAL WORK

PRELIMINARY REPORT

By VALTER SCHYTT

Senior Glaciologist of the Expedition

IN March 1950 a pattern of aluminium stakes was set out near the wintering base, Maudheim, in order to study both the regime and the differential movements of the shelf ice. This stake pattern covered about 40 sq. km., and frequent readings were made of the amount of accumulation. From February 1950 to January 1952 the mean value for the accumulation of snow over this area was close to 150 cm. (water equivalent about 750 mm.). Apart from a minute amount of evaporation, there was no ablation. Surface melting was only noted on a single occasion, in December 1951.

The stake pattern was triangulated completely in April–May 1950 and in December 1951, and partly during the winter of 1951. Although the computation is not yet complete, it is clear that considerable differential movements took place: the two kilometre-long base line had stretched at the rate of about 30 cm. a month.

Temperature measurements in the snow were begun at the end of March 1950, and after a time daily readings were made at various depths down to 100 metres. The large temperature variations at the surface—from 0° C. in summer to the winter's minimum around −45° C.—were quickly damped down as the depth increased, so that at 5 m. the whole swing covered only about 4°, at 10 m. 1°, and at 20 m. but 0·05°. The mean value about which these snow temperatures swung also proved to be a fair value for the mean annual air temperature. From a steady $-17\frac{1}{2}^{\circ}$ at a depth of 20–30 m. the temperature slowly began to rise, so that at 100 m. it was about 1° warmer. At a point 80–90 m. deeper, that is to say, at the bottom of the ice where it is in direct contact with the sea water upon which it floats, the ice temperature must be yet another 15° warmer.

Most of the time at the base was spent in core drilling and in examining the cores obtained. Here was an opportunity to study for the first time the processes by which snow is altered to ice in a climatic region where melt water plays no part in the metamorphosis. From what has so far been worked out it can be said that the crystal size increased steadily from about 0·5 mm.^{2} at a depth of 5 m. to about twenty times this size at 100 m. Density increased from 0·50 immediately beneath the surface to 0·80 at 55 m., and then asymptotically approached the value for pure ice (*i.e.* about 0·91). With the help of this study of density, together with the surveyor's levelling work to establish the height of Maudheim above sea level, and Professor Sverdrup's observations of sea temperature and salinity at the front of the ice shelf, we were able to calculate the ice depth with some accuracy. The resulting value—180–190 m.—is in complete accord with seismic soundings made, and serves to verify them.

In co-operation with the meteorologists, continuous observations were made of the solid precipitation. The so-called frost smoke consisting of minute and very simple ice crystals ("diamond dust") was frequently to be seen and was of special interest. A study of these tiny crystals threw much light on the crystal formations characteristic of the cirrus level, and on their relation to supersaturation conditions and sublimation nuclei.

During October and November 1950 a route was marked out between Maudheim and an Advance Base 300 kilometres to the south-east. 138 bamboo stakes were distributed along it. The snow level on each stake was measured each time a sledging party covered the route during the next 14 months. The result was a good accumulation profile over the first 300 km. inland.

https://doi.org/10.3189/S0022143000025739 Published online by Cambridge University Press

Although the observations are not yet worked out, it is clear that large variations in accumulation occur from place to place. In particular, all surfaces with a west-facing downslope showed negligible accumulations. During the second year one could find weasel tracks in these areas that were a year old, together with remains of former camping sites up to 14 months old. In some places there was in fact ablation, a result purely due to wind erosion, so that the surface consisted of hard, smooth, crack-covered blue ice. It was, however, very seldom that we had to travel over bare ice in Dronning Maud Land; maps will show that 99 per cent or more of the surface layer of the area consisted of snow.

During sledging journeys ordinary glaciological work was carried out side by side with a detailed study of the first 2–3 m. depth of snow. This gave further information on the accumulation, since in a shaft dug at Maudheim (to a depth of 10 m. and down to snow from the year 1935) we had found a method of identifying the yearly snow layering.

In addition, temperature measurements in the snow were made at practically every camping place during the field season. By comparing these with the results obtained at Maudheim, we were able after the first summer's field work to calculate that the mean annual air temperature at a height of about 2000 m. above sea level in the main mountain area was −32° C. During the second summer this work was continued, with the interesting result that at a height of about 2700 m. on the polar plateau we found that the mean annual temperature was −40° C. Since the temperatures there were read to a depth of 12 m., this value can be considered very reliable.

Concerning the glacierization of Dronning Maud Land as a whole, it can be said that no glacial retreat corresponding to that in northern latitudes is at present taking place. The evidence for this is primarily that on even the very smallest nunataks (rocks which, in fact, project only a few metres above the inland ice) there is a comparatively rich covering of lichens. Since it is known that the migration of lichens takes a considerable number of years in a European climate, and since we have no reason to believe that plant migration in the unfavourable climate of Dronning Maud Land should proceed faster than it does in Europe, we can say that these rocks have lain bare for many years. Moreover, it is clear from these observations that the ice is not at present measurably in retreat. Detailed work in the mountain areas showed further that while there is no retreat in the glacierization there is also no increase.

MS. received 26 *September* 1952

II. SUMMARY OF SEISMIC SHOOTING INVESTIGATIONS IN DRONNING MAUD LAND[1,2]

By G. DE Q. ROBIN
Physicist to the Expedition

INTRODUCTION

ALTHOUGH some seismic shooting measurements[3] of ice thickness were carried out by the Byrd Antarctic Expedition of 1933–35 around the region of the Bay of Whales, the order of magnitude of expected thickness over most of the Antarctic continent remained uncertain. Estimates varied from hundreds of metres to a few thousand. One of the tasks of the Norwegian–British–Swedish Antarctic Expedition, 1949-52 was to make a series of measurements of ice thickness along a line from the coast through the inland mountains and on to the high inland plateau. The main part of this task was carried out during an eleven-week journey from October 1951 until January 1952.

https://doi.org/10.3189/S0022143000025739 Published online by Cambridge University Press