INSTRUMENTS AND METHODS

A NEW TYPE OF ABLATOGRAPH

Glaciological work generally demands the determination of ablation, and in many cases it is desirable to obtain a continuous record.

The first recording instrument for such a purpose was designed by Professor H. W:son Ahlmann (1927) for use during his investigations on Styggedalsbreen in Jotunheimen. Later Dr. O. Devik (1929) designed an improved type which was manufactured at the Trondheim Technical High School. The latter instrument has been described in detail by Ahlmann (1935), who has used it on a number of his expeditions.

The ablatograph described in the present paper employs the same working principle as the last one mentioned but is of another design; this is shown in Fig. 1 (below). A horizontal wooden beam is fixed to two aluminium tubes which are driven into the ice. On Norwegian glaciers it has proved necessary to drill the tubes down to at least 2 m., to avoid any independent movement into the ice as a result of heat conduction and melting. A piece of wood must be fastened to the lower end of the tube in order to obtain a greater cross-sectional area, and to reduce conduction from

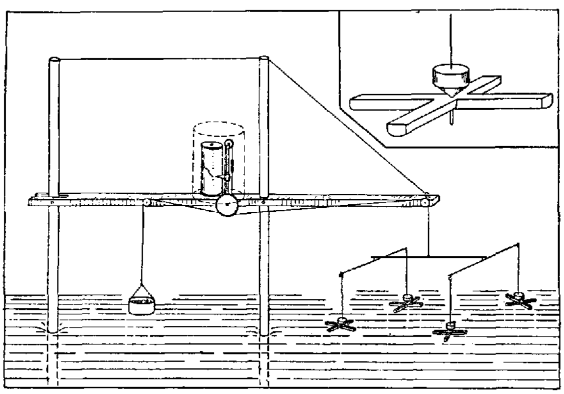

Fig. 1

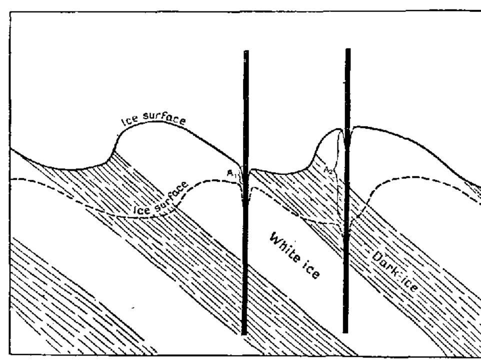

Fig. 2

above. In 1951 tests were made on Nigardsbreen, one of the outlet glaciers of Jostedalsbreen. The instrument and a bamboo pole were placed about 10 m. from the edge of the glacier. The bamboo pole was driven down to 2·5 m. and served as a basis for comparison, on the assumption that it would not move independently of the ice. The tubes were bored down to 2 m. and were sighted by a theodolite from a mound beyond the edge of the ice. No independent movement was observed within a 48-hour period. A 2·5 cm. aluminium tube, 3 m. long, with no piece of wood attached to its end, and drilled down to 1 m., sank no less than 45 mm. in the same 48-hour period.

As a matter of precaution the ice around the tubes has on several occasions been covered with insulating material in order to prevent any enlargement of the bore holes that would affect the stability of the equipment.

The recording instrument itself is very simple, consisting of a vertically mounted drum recorder and a pen using ordinary recording ink which travels along a grooved vertical rod. In the initial design a weight was used to counterbalance the pen, but later on a continuous belt, broken by a spring for maintaining correct tension, proved more suitable.

In an instrument of this kind the most difficult problem is to design a satisfactory float which follows the melting surface as closely as possible. Ahlmann (1935) has dealt with this problem:

> "The condition that the float shall give the snow- or ice-level correctly would be fulfilled if a substance could be found with properties so similar to those of snow or ice that it would always remain exactly on the surface and not, owing to greater absorption of heat, melt this and sink below it.
>
> "Such a float we did not, however, succeed in designing, and it will probably be very hard to do so. The best float we have so far used is a whitepainted wooden hemisphere, in the centre of the flat part of which the string was fastened. Our hemisphere had a diameter of 9 cm., which has proved the most suitable in high latitudes. For measurements in lower latitudes the diameter should be adapted to the local radiation."

Another difficulty encountered is caused by the frequent inhomogeneity of the ice. Dark and light parts alternate, often in layers. If the layers are tilted, the rate of melting at the same locality will vary according to the appearance of dark and light layers during melting. This is more clearly illustrated in Fig. 2 (p. 431).

In Norway and Spitsbergen Norsk Polarinstitutt has used a different type of float which has proved suitable in many ways and will, therefore, be described in detail.

In order to reduce any recording error caused by the inhomogeneity of the ice, a float composed of four individual floats was built for the measurements on Nigardsbreen. This was later improved and used in Spitsbergen in 1952. The float is composed of four thin wooden crosses, 15 cm. in diameter and painted white. Each can turn around a pin fastened to the bottom of a weight (see Fig. 1). The weight is fastened to a thin rod 20 cm. long. The four crosses are connected through a system of vertical and horizontal rods. By this method the average of the ablation at four points will be recorded. The crosses are 50 cm. apart.

The use of a very distinct white paint will prevent any melting of the crosses into the ice. On the other hand a small protuberance or boss of ice may form below a cross when immovable, but because the cross can rotate independently its arms will keep slipping off sideways, thus reducing the ice boss to a minimum. At the centre of the cross the metal pin fastened to the relatively dark weight will conduct enough heat to prevent a boss forming in this small central area.

The float is suspended by a brass wire which runs round a small, metal pulley at the end of the horizontal beam and along the beam to the drum recorder. The brass wire is wound several turns round the wheel of the drum recorder, then along the beam to another metal pulley, ending with a counterweight which keeps the whole system in proper tension. As a suitable counterweight we have used a small container filled with as many stones as are necessary to allow the float to rest properly on the ice or snow. It would have been simpler to place the float directly below the drum recorder, but the arrangement described here reduces the effect of any shade from the device as well as any direct strain on the drum recorder.

During windy weather the device may be steadied by driving down a third pole placed so that the three poles form a triangle. The poles may be joined by wires or wooden bars to form a sturdy frame.

The device may easily be altered for use as a limnigraph or tide gauge, merely by substituting a different float. This was done during the Norsk Polarinstitutt Spitsbergen Expedition in 1952.

The instrument with accessories is manufactured at the Institute of Physics, University of Oslo, Blindern, Oslo.

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6 *February* 1954

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