Particularly strong opposition comes from Canada. Mr. J. C. Mackey, Chairman of the Snowcraft Committee of the Rocky Mountain Zone of the Canadian Amateur Ski Association, writes that in his experience 95 per cent. of wind slabs are found on the windward side of a mountain, and mentions that the two chief guides in Banff National Park, Engler, a Swiss, and Kutschera, an Austrian, both confirm this. Mr. Don Munday, the well-known Canadian mountaineer and skier, has told me that in his view slabs in the Rockies are found mostly on exposed ridges. It has been suggested that the western Canadian conditions of extreme cold—the winter average is said to be in the neighbourhood of zero Fahrenheit—induce a new factor, but I doubt it.

Dr. Winterhalter believes that the fact that more wind slabs are found on the lee sides of a mountain may be due rather to the bigger accumulation, which one would naturally expect there, facilitating the metamorphosis, but adds, "... often after windy weather you can see slab avalanches on all sides of a mountain, leeward and windward alike."

May I here again express the hope that a research be carried out by the authorities at the Weissfluhjoch. This would mean the collection of very simple data from a large number of districts. It may be that the results will show that it is impossible to dogmatize too much, but if, on the other hand, it is found that certain principles can be laid down, and I believe this will be the case, the result will prove of the greatest value.

INSTRUMENTS AND METHODS

Under this heading it is intended to describe any new apparatus or method of research likely to be of value to glaciologists. The Editors will be pleased to receive contributions for this section.

SUB-SURFACE TEMPERATURE MEASURING EQUIPMENT*

DURING the United States Antarctic Service Expedition of 1939–41† resistance thermometers were used for measuring sub-surface temperatures at "Little America." The temperature-sensitive elements consisted of copper resistance coils wound on a brass tube (Fig. 1, Pl. IV). The finished coil, wound with 0·0035 in. diameter wire, was about $\frac{3}{8}$ in. in diameter and 2 in. long. The resistance of the coil in each thermometer was accurately adjusted to 100 ohms at 20°C. Each coil was connected to the conductors of a 3-lead rubber-covered cable to form a thermometer of the Siemen's compensated type.

Each coil was protected by a closed end brass tube about $\frac{1}{2}$ in. in diameter and $4\frac{1}{2}$ in. long (Fig. 2). The end of the brass tube that carried the coil (arrow *a*, Fig. 1) was soldered to the inside of the closed end of the protecting tube in order to enhance the heat transfer between the latter tube and the coil. The protecting tube was attached to the cable by rolling the brass into the rubber covering at three points (arrow *b*, Fig. 2). This, in addition to a wrapping of waterproof tape over the coil, provided the required protection against moisture.

The temperature readings were made with portable instruments of the balanced Wheatstone bridge type (Fig. 3). Each instrument had two scales each 10 in. long, graduated in intervals of 0·2° C. One scale was from −70° to −28° C. and the other from −32° to +10° C. The resistance

* These details are published by permission of the Director, National Bureau of Standards, U.S.A.

† See *Journal of Glaciology*, Vol. 1, No. 1, 1947, pp. 23–31.

coils of the instruments were wound with constantan instead of the conventional manganin wire because it was found that the temperature coefficient of resistance of constantan was less than that of manganin at the lower temperatures. The instruments were provided with external battery terminals in order that the operator might carry the battery in his pocket if the ambient temperatures were too low for the battery to function properly.

Provision was made for connecting individual resistance coils direct to an indicator by means of the flexible weather-proof rubber-covered lead wire or for connecting several coils to an indicator through enclosed rotary selector switches.

The following equipment was supplied :

- 42 resistance coils with leads ranging in length from 5 to 55 m.
- 4 selector switches (two with 10 points and two with 12 points) for use at four different stations.
- 2 portable indicators which could be taken from one station to another or to the location of an individual resistance coil.
- 2 constant resistance coils (Fig. 4) with a negligible temperature coefficient of resistance for checking the accuracy of the instruments at −30° C.

Tests with the thermometers, before they were shipped to the Antarctic, showed that temperature measurements made with any one of the resistance coils connected to either of the indicators were accurate to better than 0·1° C. throughout the range −70° to +10° C. Tests made with the coils and indicators after they had been returned from the Antarctic did not reveal any significant deterioration or loss of accuracy. Part of the equipment is now (September 1946) actually being used in measuring the temperature in oil wells in Alaska.

Notes on the above Equipment

The equipment used to measure the temperatures at various sub-surface levels in the Ross Shelf Ice, Antarctica, in 1940–41, by the members of the U.S. Antarctic Service Expedition was very satisfactory in every respect. Similar equipment is recommended for use by future investigators of the properties of glacier ice.

During six months of the time in which observations were taken, the Wheatstone bridge and selector switches were installed in the Snow Cruiser for convenience and comfort. During the last four months, the selector switches were mounted in a board-lined cave near the area where the leads to the thermohms went below the surface. The Wheatstone bridge was kept in the science building and was carried to the cave by the observer, where it was connected to the switches for each series of measurements. This was during the warmer summer months, and it was seldom necessary to carry the battery in a pocket in order to keep it warm and functioning properly.

When observations were made over a long period of time, it was necessary to keep an accurate check on the snow surface level, as the depths to the thermohms were found to vary correspondingly. The thermohms in the uppermost 2 m. of shelf ice were reset on two occasions. Those placed more deeply became well frozen in and could not be moved.

Before each thermohm was installed, its reliability was checked at two points : the freezing-points of pure water and of triple-distilled mercury.

F. Alton Wade

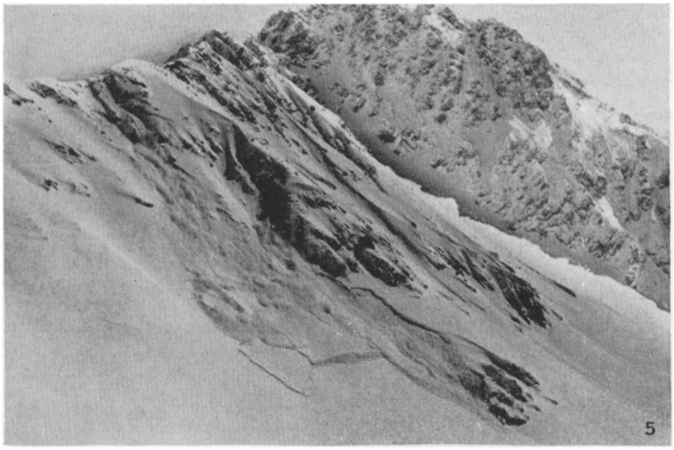
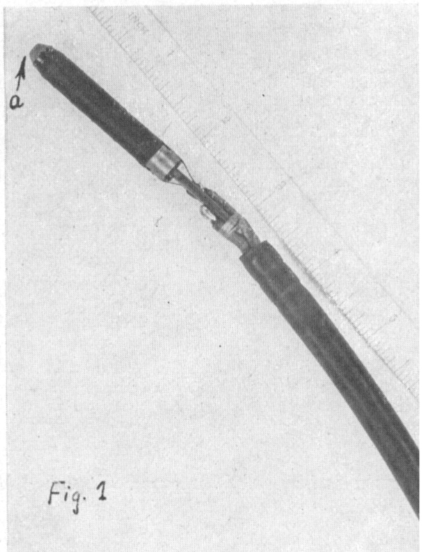
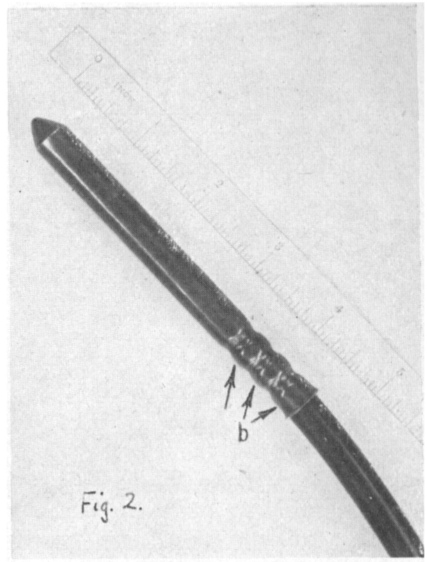


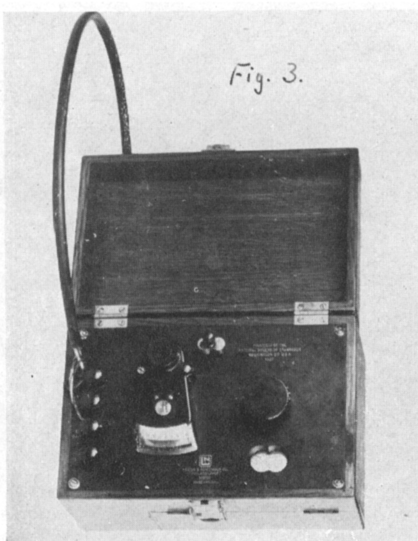
Fig. 4. The Haupter Täli, Davos, showing wind-slab avalanche on lee side of buttresses. Wind had blown from right to left

Fig. 5. Turnerkamp, Zillertal with Hornkees. The arrow shows where wind slab had collected at the foot of a cliff. Wind had blown towards cliff

https://doi.org/10.3189/S0022143000007656 Published online by Cambridge University Press







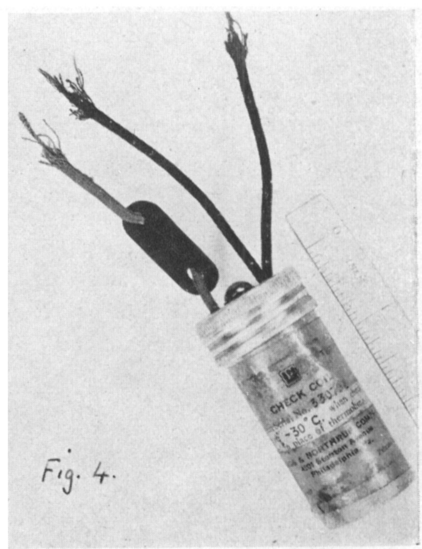


Fig. 1. Copper resistance coil wound on brass tube. End at arrow a *soldered to inside end of protection tube*

Fig. 2. Brass protection tube rolled into rubber covering of leads at arrows b

Fig. 3. Portable Wheatstone Bridge Indicator with cover open

Fig. 4. Resistance coil for checking indicators

https://doi.org/10.3189/S0022143000007656 Published online by Cambridge University Press