

REVIEWS

AN ELECTRICAL CREVASSE DETECTOR. JOHN C. COOK. *Geophysics*, Vol. 21, No. 4, 1956, p. 1055-70, 9 figs.

In 1953 and 1954 the U.S. Army sponsored several efforts to find a suitable method of detecting crevasses, and the only promising one was that developed by Mr. Cook at the Southwest Research Institute (Texas).

The latest form of the detector, whose early development is described in the above article, is being used by the Americans on a snow vehicle in the Antarctic. Long interconnected booms extend forward in front of the vehicle and slide four large spherical sectors of polished metal across the snow surface. The spherical sectors are electrodes making good contact with the snow, two feed in an audio-frequency current and the potential across the other pair is continuously recorded inside the vehicle.

If the input is kept constant, the measured potential is a function of the effective impedance (mainly capacitance according to the author) of the underlying snow and ice. Hence any anomaly in the snow, such as the air void of a crevasse or a change in the density and structure of the snow, produces a change in the output voltage.

The method is similar, as the author indicates, to some of the methods of electrical surveying of the ground, but its development and application for snow surveying is novel. With a snow surface there is the considerable advantage of being able to slide the electrodes across the surfaces to obtain a continuous record of the background variation and thus of picking out the crevasse anomalies more readily.

An approximate theoretical solution is given of the voltages and currents for a system of four hemispherical electrodes equally spaced in a line on the snow surface. The snow or ice is considered to be a dielectric and there is no crevasse. The solution is very approximate, as the author states, for the input needed to produce a given output was several times greater in practice than the theory predicts. Perhaps the dielectric constant is in error.

The first field trials were made in the summer of 1955 on the Greenland Ice Sheet. Both stationary and mobile tests were carried out, using sheet metal sledges 4 ft. (1.2 m.) square as electrodes. The stationary test on melting snow used an input of 200 volts and 1.5 milliamps. at 400 cycles per sec. and gave a signal of 0.5 volt with an electrode spacing of 35 feet (11 m.). Over 250 miles (400 km.) were traversed at speeds from 2 to 20 miles (3 to 30 km.) per hour, using a "weasel" as one electrode. The electrode spacing was 20 ft. (6 m.). Several traces of the output against distance are illustrated, and the crevasse anomalies are well defined. Output profiles were reproducible, known crevasses 4 to 20 ft. (1.2 to 6 m.) wide were revealed and others were found.

Attempts were then made to obtain the optimum conditions for detection. Several hundred traverses were made of selected crevasses with electrodes in different arrays and spacings and at different electrical frequencies. Electrode spacings of 7 to 180 ft. (2.1 to 55 m.) were used successfully. The shortest spread giving good discrimination between the crevasse anomaly and background variations had unequal spacings of 20, 40 and 20 ft. (6, 12 and 6 m.) between the four electrodes. For short spacings, electrodes in a line moving broadside on to a crevasse gave double the anomaly of the electrodes moving in line across the crevasse. The best frequency on wet snow was 200 cycles per sec. but on dry snow 60 cycles per sec. or less was best. The best anomalies were obtained at sub-freezing temperatures, but dry snow produced frictional "noise" amounting to 0.2 volt at 20 miles (30 km.) per hour.

A small portable headphone detector for use with a skier was also tried out. The skier is the leading electrode and the other three electrodes are towed behind. The skier might be used to safeguard a heavier vehicle following him, but not himself.

Apart from the usual problem of interpretation associated with all types of geophysical surveying, the method presents one inherent practical difficulty. The electrodes need to traverse the crevasse in advance of the bodies they are intended to safeguard and it is difficult to push a train of electrodes from behind without elaborate guides. The latest development shows that this is practicable with a large vehicle, otherwise one has to risk sending a skier or a dog team with electrodes.

The method may be capable of measuring the width of a crevasse and the thickness of its snow bridge, which might give a clue to the carrying capacity. This is asking a lot, but it is unfortunate if a crevasse is detected which is amply bridged. There is then the embarrassing problem of deciding whether to delay by bridging it artificially, whether to use explosives to see how big a hole needs to be filled, or whether to chance a crossing.

Further developments and more systematic tests of the method with moving heavy vehicles across glaciers will be followed with much interest by all concerned.

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THE WHITE DESERT. JOHN GIAEVER. Translated from the Norwegian by E. M. Huggard. London, Chatto & Windus, 1954. 304 pages, maps, text-figures, 31 plates. 24 cm. Price £1 5s. *od.*

THIS book contains the official account, by its leader, of the Norwegian-British-Swedish Antarctic Expedition to Queen Maud Land. The success of the expedition depended to a large extent on the way its members, drawn from three nations, got on with one another. Captain Giaever writes with enthusiasm of the ease with which this international co-operation was attained, and attributes it to the efforts of each and every member. The reader is left to guess the immense part that Giaever himself must have played in cementing the expedition together. His understanding and tolerance are soon apparent, and his modesty is well illustrated by his qualms as to his ability as a "non-scientist" to lead a mixed bunch of scientists in a two years' exile.

The object of the expedition was to carry out research on the coastline and inland ice of Queen Maud Land with particular reference to a mountain range some 200 miles from the ice front.

In February 1950 the expedition ship *Norsel* deposited the party on the ice shelf at Maudheim where the main base was established. Meteorological and glaciological observations were started immediately and, in addition, the first winter was spent in planning and preparing for the spring and summer sledging trips. When daylight returned Giaever saw the various parties off and the reader soon feels the loneliness and wanderlust experienced by those left at Maudheim. This was intensified in 1951 by the tragic drowning of three of the party. The second winter was spent in much the same way as the first with the added drama of a brilliant eye operation performed by the expedition doctor. The weasels and sledges were again prepared and the second summer saw the continuation of the field work. In December 1951 the *Norsel* returned and brought the expedition home.

Appendices deal with the air operations and the journeys of the glaciological, survey, geological and seismic parties, each written by the respective specialists. In the main they are descriptive accounts of the journeys and the work done, and they do not profess to give much in the way of scientific results. The glaciological party made measurements of snow accumulation and ice movement, determined the limits of the local ice shelf, and searched the nunataks for evidence of glacial advance or recession. They found evidence of considerably greater ice masses in earlier times but no evidence of recent recession comparable with that in the Northern Hemisphere. The geologists, by visiting the countless nunataks, performed their usual trick of returning with heavier loads than they set out with. The seismic party penetrated 375 miles inland from Maudheim, passing beyond the mountain range onto the inland ice; the book contains a profile based on their soundings which indicates a fjord-indented coastline beneath the ice.