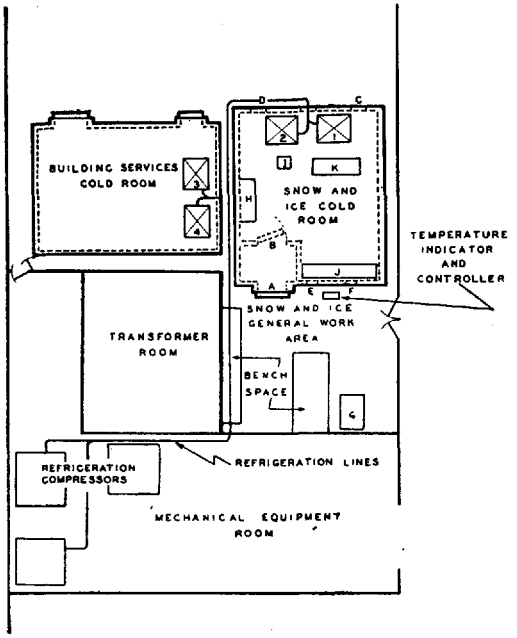

Fig. 1. General layout of cold rooms and associated refrigeration equipment

Work to be Carried Out in the Immediate Future

The initial program to be undertaken within the cold room will be modest because of the shortage of staff. Work has begun on measuring the ultimate strengths of ice in tension and compression and the influence of temperature and rate of loading. This will be followed by studies on the elastic and plastic behaviour of ice. This work is to form the foundation for an approach to the problems of determining the bearing strengths of ice sheets, the loads which can develop against structures from static ice, and the loads which can be exerted against structures by flowing ice.

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A GLACIER WATER-SPOUT IN SPITSBERGEN

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On 14 July 1953 some members of the Oxford University West Spitsbergen Expedition saw a glacier water-spout near the foot of the Von Postbreen, Tempelfjorden. Its spouting lasted only a few seconds. On closer investigation the source was seen to be at a point where a small melt stream crossed a closed crack in the ice and had developed a glacier mill at the crossing. The spout repeated itself several times whilst the party watched, and it was photographed.

The point where it occurred was about 2 km. from each side of the glacier, and some 6 km. from the snout. The height was about 200 m. above sea level. There was no medial moraine, the nearest moraine being the lateral moraine 2 km. away. The glacier surface at this point was level, being situated between the two steeper parts of the Von Postbreen, as indicated in the longitudinal profile, Fig. 1 (p. 639).

The melt-water stream was small, about 75 cm. wide and 15 cm. deep. It poured into a circular, vertical glacier mill, about 40 cm. in diameter. The glacier mill was a perfectly regular cylinder. It had developed in a crack in the ice that ran transversely across the glacier. Below the crack there were the remains of an old water-course, the original course of the stream before the glacier mill had developed. The water falling down the mill occupied one-third to one-half of its cross-sectional area.

The stream and glacier mill were watched for an hour from 7 p.m. During this time the spout repeated itself six times at exactly 10-minute intervals. The characteristics of each spout were the same. They were:

(1) After the preceding spout the stream flowed normally for 9 min. 20 sec.
(2) From 9 min. 20 sec. to 9 min. 50 sec. the mill filled up two or three times with water, but then subsided to normal. There was a considerable amount of bubbling in the water as the mill filled.
(3) 9 min. 50 sec. The mill filled up as before, and then gushed to a height of 2 m. in a solid jet, poised at that point for about 1 sec., and then shot in a spray to 7 or 10 m. It remained at that height for 8 or 9 sec. and then subsided abruptly.
(4) The volume of water that left the mill at each spout was negligible compared to the amount that had fallen down during the preceding 9 min. 50 sec.

Four weeks later the place was visited again. A great deal of melting had taken place, and the mill was larger. It was now possible to see that at a depth of about 4 m. its sides opened out, giving the impression of a cavern. This cavern could have been present at the first visit, but would not have been seen, as falling water obscured everything below 2 or 3 m.

At a point 10 km. from the snout of the glacier another spout was seen from a distance.

It seems probable that the cause of the spout is the intermittent generation of hydrostatic pressure within the glacier, for which the glacier mill provides an outlet. This pressure may be created by the melt stream that falls down the mill, or by another unknown melt-water stream that connects with the system already described. The extreme regularity of the spout makes a syphon system a possible cause. The glacier mill may connect with an intra-glacial melt-water channel that is periodically filled and emptied by a syphon system at some point higher up the glacier. This syphon would have to be at least 10 m. higher than the lip of the mill, in order to give the necessary hydrostatic pressure. The slope of the glacier at the point of the spout is slight, and such a syphon would have to be at least 400 or 500 m. away. Fig. 2 (p. 639) shows a possible scheme of channels.

A melt-water stream from some point higher up the glacier empties into a large cavern in the ice which is emptied by a syphon. The descending limb of the syphon is almost vertical, and connects with the bottom of the mill by an almost horizontal channel at least 400 or 500 m. long. Assuming a regular inflow, the upper ice cavern would fill during the 9 min. interval between each spout. The syphon would then prime and the cavern empty. If the descending limb of the syphon is almost vertical, the conditions for priming would be the best and the time of priming would be very regular. When the syphon primes, water will flow down the channel; most of it will continue along its normal course, but a little will be forced up the mill to give a spout. If the volume of water in the cavern at the time of priming is approximately equal to the volume of the channel between the crest of the syphon and the bottom of the mill, then the syphon will break when the water reaches the point of entry of the mill. The spout will only continue as long as there is a head of pressure, and there will only be a head of pressure as long as there is water in the descending limb of the syphon. As the descending limb is almost vertical the head of pressure will rapidly be reduced and the spout will be of very short duration. As soon as the descending limb has emptied the spout will cease, surface water can again flow down the mill, the water in the lower channel slowly drains away and the cavern fills again with water.

When the syphon primes the onrush of water will compress the air in the channel, and this would probably force some water back up the mill to give the preliminary filling up and bubbling that was observed.

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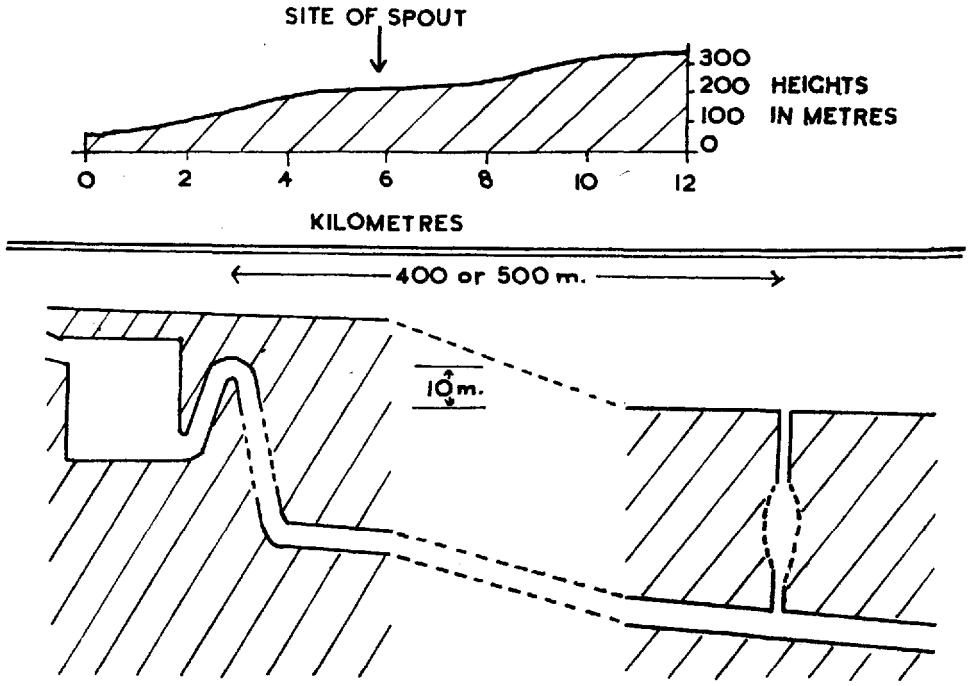

Fig. 1 (above). Profile of part of the Von Postbreen

Fig. 2 (below). Suggested scheme of water channels inside the glacier

Note

In the September 1955 issue of *Die Alpen* (Jahrg. 31, No. 9, Varia p. 179) there is an editorial note on an almost identical water-spout observed on the Findelen Glacier (Valais) in October 1954. In this note the cause suggested for the necessary pressure is the movement of the glacier but it is not apparent how this would operate, particularly in view of the regularity described in that account and by Mr. Rucklidge.

Reference to water-spouts in glaciers is also made in R. von Klebelsberg's *Handbuch der Gletscherkunde und Glazialgeologie* (Vienna, Springer-Verlag, 1949), p. 136–37, 375, 494 and 832, also in an article by A. R. Glen in the *Geographical Journal*, Vol. 98, No. 2, 1941, p. 71-2 and in *The arctic voyages of Adolf Erich Nordenskiöld*, London, 1879, p. 68. *Ed.*