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CORRESPONDENCE

The Editor,
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SIR,

The November 1986 survey of the Grand Moulin on the Mer de Glace, Mont Blanc Massif, France

The Grand Moulin, a large pothole on the Mer de Glace, was explored in November 1986 by the combined efforts of several groups, including: the "Drôme-Terre d'Aventure" caving club; "FR3-Montagne", a television documentary series focusing on the mountain environment; the Laboratoire de Glaciologie et Géophysique de l'Environnement, C.N.R.S., Grenoble.

The Grand Moulin re-forms every year at virtually the same place, i.e. at about 2000 m elevation, near the base of the compression zone following the seracs at the confluence with glacier Leschaux, and slightly up-stream of the first crevasse stretching upwards from the sides of the glacier at an angle of 45°. This pothole is carved out of the ice by the surface melt-water run-off from a 0.3 km^2 catchment, channelled by a supraglacial stream 4–5 m deep and 2–3 m wide, with a mid-summer discharge of 1–2 m^3/s.

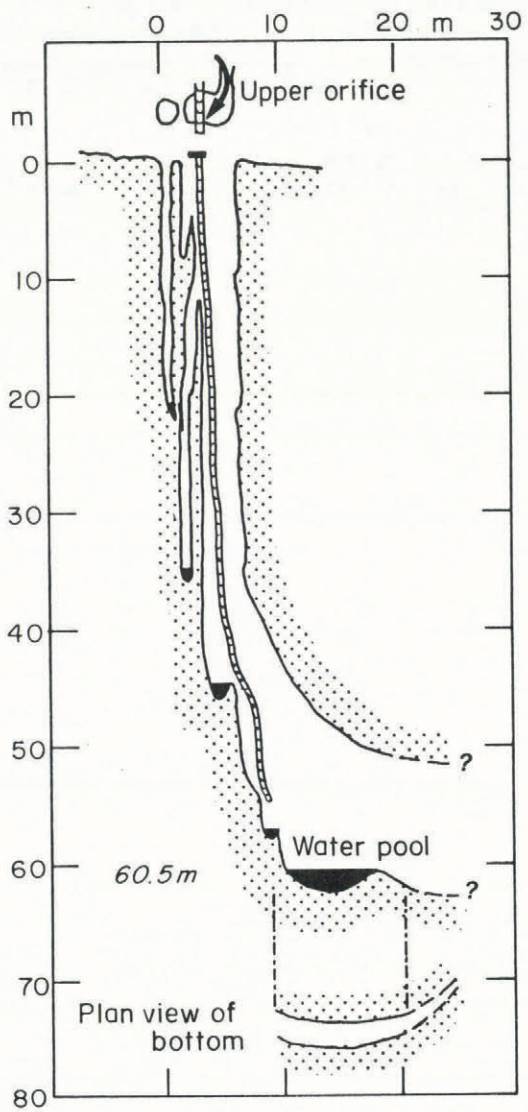

Fig. 1. Cross-section of the pothole explored by Fontaine on 9 September 1897 (from Vallot, 1898).

As the ice flow at this location has a velocity of about 100 m/year, a series of old potholes from previous years occurs down-stream of the new Grand Moulin formed in any given year.

As early as the end of the last century, Fontaine carried out several surveys at this location on the advice of Vallot (1898), aiming to characterize the flow of water within the ice and to reach the glacier bed. A surface sounding revealed a depth of 86 m for the Grand Moulin, but the large volume of water flowing into it made exploration impossible. An adjacent pothole, recently left dry, was therefore explored down to a depth of 60.5 m (Fig. 1).

At the bottom of the vertical part, Fontaine was able to explore a horizontal gallery in the form of a narrow vertical crevasse for a distance of about 10 m. A lake at the bottom of this crevasse made it impossible to continue further.

To the best of our knowledge, this was the last topographical exploration of a Mer de Glace pothole to be made until now. Recent progress in caving techniques and equipment nevertheless gave new hope for deeper exploration of the Grand Moulin itself, in particular by choosing a time of year when the water inflow would be low.

On this basis, an expedition composed of five caving experts, two cameramen and a glaciologist was undertaken on 6 and 7 November 1986. The results of the survey carried out by this team are shown in Figure 2. The morphology of the main pothole was found to be very similar to that of the 1897 pothole, differing only in terms of details. Both are characterized by an almost vertical part at the top, more or less cylindrical in shape, and leading at the bottom into a narrow and winding vertical fault. Only the depths are notably different, the 1986 pothole reaching 71.5 m compared to a depth of 60.5 m in 1897.

However, this time the caving experts were able to advance further into the narrow passages extending from the bottom of the vertical part, exploring an additional 40 m and reaching a depth of 100 m. The lower part of the gallery leads into a narrow fissure meandering downwards in 5–8 m high steps, separated by pools of water 1–2 m deep.

The exploration ended at the point where the passage width was insufficient for even the slimmest caver to pass, although the gallery appeared to continue in the same manner as above. This gallery trended from the bottom of the vertical part of the pothole in the down-stream direction of the glacier, parallel to the ice-flow lines. The shape of these potholes is very similar to those formed in karst limestone formations, even though the former are carved out by the flow of water in 1 or 2 years while the latter are formed over much longer periods of time.

The ice observed during the 1986 exploration was very pure in appearance, only marked by alternating veins of white and blue ice, with a foliation inclined at approximately 30° with respect to the vertical as observed at the surface in crevasses (Vallon, unpublished). As opposed to the September 1897 exploration, which was conducted at a time when the water inflow was high, the November 1986 survey encountered flow rates of only a few liters per second, fortunately carried by another pothole located just up-stream and parallel to the main pothole.

The lower part, at depths exceeding 100 m, was probably already in the process of closing for 1 or 2 months due to the absence of the strong water currents that had formed it. This is supported by measurements made in reconnaissance galleries by E.D.F., the French electrical

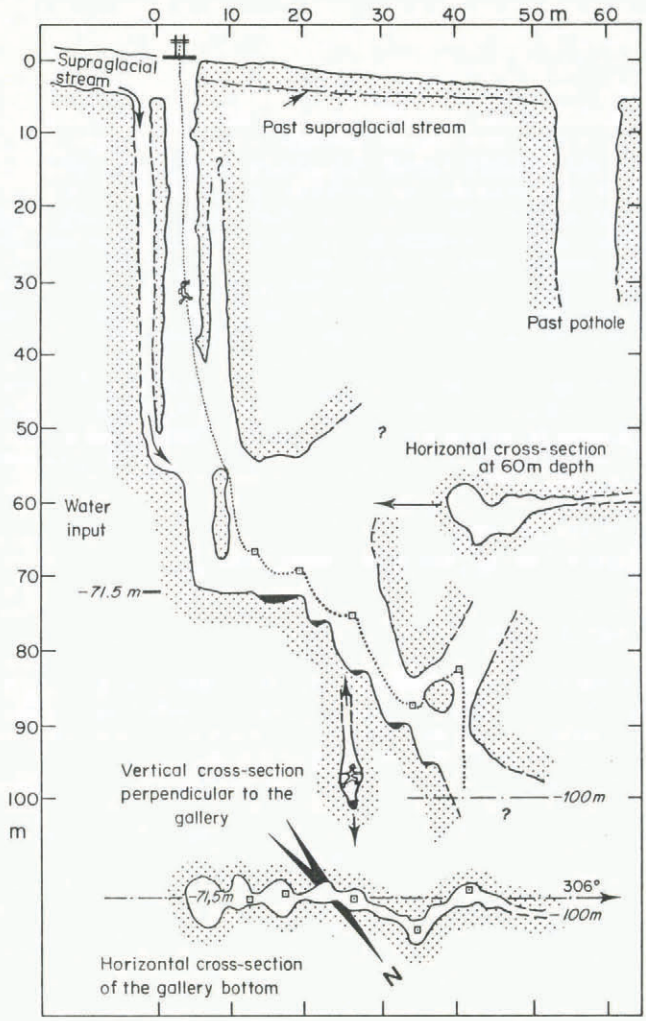

Fig. 2. Vertical and horizontal cross-sections of the Grand Moulin of the Mer de Glace from the 6–7 November 1986 survey.

utility, down to depths of 100 m beneath the snout of the Mer de Glace. The diameter of these galleries was reduced by two-thirds the initial value in 3 weeks (Charpentier and others, unpublished). Therefore, to explore further into the pothole galleries, expeditions have to be launched at an earlier date, ideally near the beginning of September, but it would also be necessary to deal with the higher water-flow rates encountered at that time of the year. The exploration of such large glacial potholes is an exploit of wide and highly varied interest. In addition to the opportunity it presents to caving enthusiasts in their never-ending search for new and more difficult challenges, and to talented film-makers in their quest for images of rare beauty, it offers glaciologists the opportunity to determine several characteristics of the flow of water within the ice and the depth to which the fissures and faults allowing this flow may extend. Furthermore, such investigations provide a description of the composition of the ice (foliation, crystallography, etc.) and its variation with depth, results which otherwise could only be obtained by working in a large-diameter bore hole.

It is true that there is little hope of reaching the glacier bed, which is at a depth of about 300 m according to seismic soundings carried out in 1966 (Gluck, 1967); however, there is a very good chance of extending such explorations farther and deeper than ever before.

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3 December 1986

REFERENCES

Charpentier, G., *and others*. Unpublished. Observations sous les glaciers d'Argentière et Mer de Glace, by G. Charpentier, M. Collioud, and R. Vivian. Société Hydrotechnique de France. Réunion de la Section de Glaciologie, 2–3 Mars 1972, Paris.

Gluck, S. 1967. Détermination du lit rocheux sous la Mer de Glace, par séismic-réflexion. *Comptes Rendus de l'Académie des Sciences*, Sér. D, Tom. 264, p. 2272–75.

Vallon, M. Unpublished. Contribution à l'étude de la Mer de Glace: pétrographie. [Doctorat d'État thèse, Université de Grenoble, 1967.]

Vallot, J. 1898. Exploration des moulins de la Mer de Glace. *Annales de l'Observatoire du Mont Blanc*, 3, p. 183–90.

SIR,

Basal water and high-pressure basal ice

An unfortunate set of circumstances prevented certain improvements from being made to my paper "Basal water and high-pressure basal ice" (*Journal of Glaciology*, Vol. 32, No. 112, p. 455–63) before its publication. These improvements had been suggested by one of the reviewers, who pointed out that in unpublished work Charles F. Raymond had also considered the problem addressed in my paper. The purpose of this note is to draw attention to Raymond's work which was not possible for me to do in my published paper.

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4 December 1986

SIR,

The 1985 surge and ice dam of Glaciar Grande del Nevado del Plomo, Argentina

Glaciar Grande del Nevado del Plomo, which trends in an almost west–east course, is one of the glaciers in the most glacierized area of the Río Mendoza basin (Corte and Espizúa, 1981). In this glacierized region originates the Río del Plomo, which is the main tributary of the Río Tupungato. It flows into Río Mendoza but does not form it alone.

This glacier is situated at lat. 33°08′ S., long. 70°01′ W., occupies a large cirque south-east of Nevado del Plomo (6050 m), and flows down to 3550 m a.s.l. (after surging 3165 m a.s.l.). This area was very well mapped at a scale of 1 : 25 000 by Helbling, using terrestrial photogrammetry, during his field work with Reichert in 1907–12. More recent Argentine and Chilean maps only reproduce Helbling's map, with some errors (for instance, Nevado del Plomo is incorrectly referred to as Cerro Juncal). Since 1912, the glaciers at the head of Río del Plomo have receded considerably, the different tributaries becoming distinct. Therefore, there was no totally correct map of this area until the 1983 and 1985 1 : 10 000 photogrammetric interpretation of the 1974 air photographs by the Instituto Argentino de Nivología y Glaciología (except for Corte and Espizúa's sketch map without names or contour lines).

Glaciar Grande del Nevado del Plomo had surged in 1934, when a flood caused by the outburst of an ice-dammed lake with a calculated volume of 60×10^6 m^3 produced many disasters (Helbling, 1935; Razza, 1935; Lliboutry, 1956). There is also evidence that during the eighteenth century it could possibly have surged (Prieto,

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