

## CORRESPONDENCE

The Editor,  
*The Journal of Glaciology*

SIR, *Subglacial Streams and Extrusion Flow*

Some observations I made on 11 August 1946 on the Sentinel Glacier, Garibaldi Park, British Columbia, may be of interest to you. In that year the normally unbroken *névé* surface was marred by a dark scar which proved on closer examination to be a trail of black sediment laid down by a stream of water which had burst through the snow pack about midway up the glacier, see photograph, Fig. 1 (p. 282), and plan, Fig. 2 (below). This point lies at about the firn line, but since the precipitation of the previous winter had been unusually heavy the glacier was snow-covered at that time to an altitude about 100 m. below it. Very little rock is exposed in this sector of the glacier at higher levels. At the source of the stream the firn had broken along a circular fracture between 15 and 30 m. in diameter and the enclosed block had subsided somewhat less than 1 m. The stream had initially emerged at the lower lip of the fracture but at the time of my examination the water had cut a trench, then about 2 m. wide, at the rim and possibly 6 m. deep. It was barely possible to see the bottom of

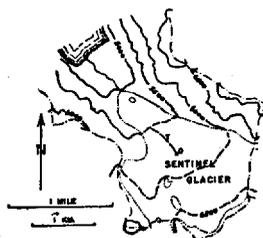


Fig. 2. Sentinel Glacier, Garibaldi Park, British Columbia, with 1947 ice limits (dotted) and watershed limits (dash-dot line), showing location of the outburst of meltwater (O) and trail of debris (T). Contour interval 500 ft. After manuscript map, B.C. Dept. of Lands and Forests

the trench and it was impossible to estimate the volume of water still flowing along it, although it was clearly considerably greater than that of the surface streams flowing across the bare ice near the lower end of the glacier. The trail of mud and debris extended downslope for a distance of about 550 to 600 m., descending in this distance fully 100 m. No such outburst had been previously observed on this glacier and none was observed in 1947.

The source of the water must have been within the glacier itself for no gathering ground for such a volume of water could exist on the few acres of bare ground upslope. Though the water may have been derived originally from the surface or the *névé*, it must have flowed at sufficient depth to pick up the accompanying debris. It seems possible that such a discharge of melt water from a firn area may regularly exist in glaciers but would remain undetected unless some unusual circumstances caused it to burst forth on the surface of the glacier. This observation is, I believe, of value since it may provide an alternative explanation to "extrusion flow" for the discrepancy found by Streiff-Becker between the annual accumulation of snow and the annual discharge of glacier ice on the Claridenfirn.

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