but related, question. I felt, and still feel, that it was worthwhile to point out that my results might be relevant to this question, even though Meier thinks that this is unlikely.

I certainly support Dr. Meier's plea that high priority be given to further investigation of the flow of water at the bed of a glacier. The whole question of the distribution and flow of water in a temperate glacier deserves further study as soon as possible.

I wish to acknowledge the kindness of Dr. G. R. Elliston in letting me see the draft of a paper of his prior to publication. This has been most helpful.

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23 March 1965

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SIR,

Advance of Walsh Glacier

In May of 1952 the writer walked eastward up the north side of Logan Glacier (St. Elias Range, Yukon Territory), crossed Walsh Glacier and continued up Logan Glacier *en route* to King Peak. Only about 6 hr. were required to cross the 1·5 miles (2·4 km.) of stagnant ice of the Walsh Glacier terminus where it adjoins Logan Glacier.

In August 1964 he traveled down Logan Glacier and attempted to cross Walsh Glacier at the same place as in 1952. More than 10 hr. of extremely difficult walking was required to detour at least 3 miles (4·8 km.) farther down Logan Glacier because of impassable seracs and crevasses caused by a recent spectacular advance of Walsh Glacier.

Location. Walsh Glacier is located in the St. Elias Range between long. 140° 15′ and 141° 15′ W. and at lat. 60° 55′ N. near the Alaska–Yukon border (Fig. 1). Walsh Glacier is about 35 miles (56 km.) long and flows from east to west to its confluence with Logan Glacier in Alaska. The total area occupied by Walsh Glacier is about 160 sq. miles (415 km.^{2}). The accumulation zone is complex and consists of many small "feeder" glaciers with a total area not exceeding 70 sq. miles (180 km.^{2}). Most of the small tributary glaciers of the accumulation zone are north of the main ice stream, which flows slightly north of due west in almost a straight line for more than 30 miles (48 km.).

In 1952 the terminus of Walsh Glacier was stagnant and consisted of hills and pinnacles of ice covered with 2–4 ft. (0·6–1·2 m.) of moraine. Numerous melt-water lakes and streams also indicated a stagnant condition. The average elevation of the glacier surface was much lower than that of Logan Glacier. Vegetation, consisting mostly of willow and small flowering plants, had started to grow on large areas of stabilized moraine.

Studies of air photographs taken in 1951 show that upper Walsh Glacier had many well-developed medial moraine ridges consisting of a thick cover of rock debris on ice. The lateral moraine area of the north side of the glacier was quite wide and contained many melt-water lakes. Debris-free ice lanes between the medial moraines were relatively smooth and became more extensive farther up-glacier.

In 1964 the terminal area of Walsh Glacier had become a tremendous maze of chaotic seracs and crevasses with an average surface elevation at least 150 ft. (45·7 m.) higher than the pre-advance surface. The terminus of Walsh Glacier has pushed out and has over-ridden Logan Glacier for at least 2 miles (3·2 km.) beyond its former position (Fig. 2).

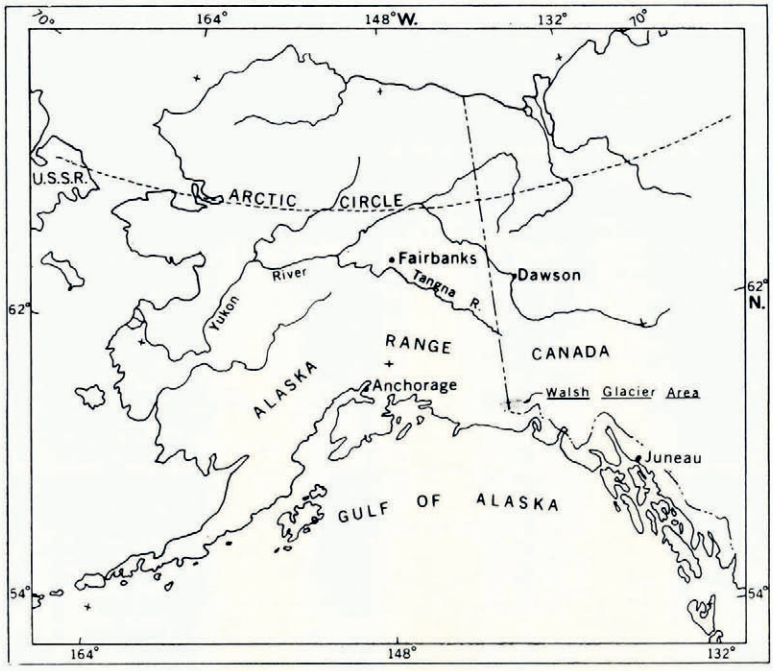

Fig. 1. Index map of Alaska and Canada showing the location of the Walsh Glacier area

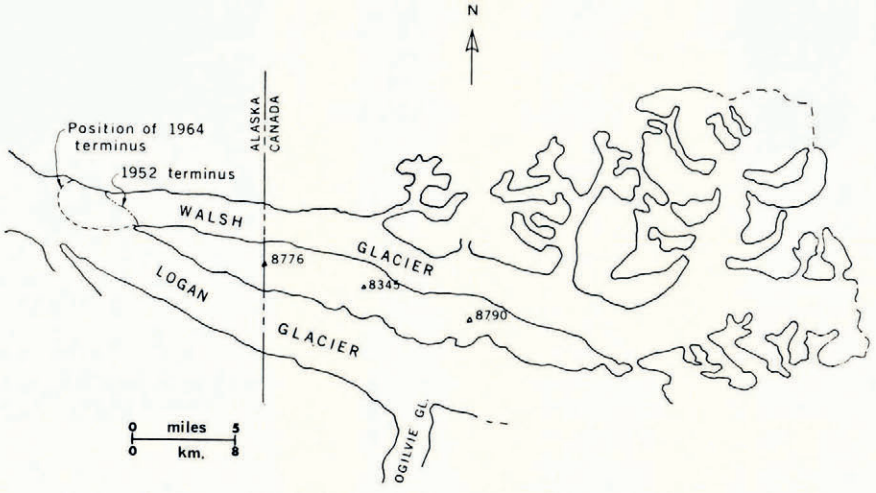

Fig. 2. Sketch map of Walsh Glacier showing positions of the terminus in 1952 and 1964

Upper Walsh Glacier is now intensely broken and much of the former thick moraine has become incorporated in the jumble of seracs and crevasses. Lanes of smooth ice, melt-water lakes and streams, and other features typical of a near-stagnant condition have all been destroyed by advancing ice.

The time at which Walsh Glacier began its advance is, unfortunately, unknown. The advance is obviously recent and the ice is still probably moving at an unusually high rate. It seems possible that the advance is related to the earthquake of 27 March 1964. Other glaciers in this area have recently been

reported as showing signs of unusual movement (Post, 1964). The bush pilot at Chitina, Alaska, first noticed the advance in July 1964 (personal communication from Howard Knutson). It is hoped that additional studies of recent photographs may provide more definite information on the rate and time of origin of the unusual advance of Walsh Glacier.

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SIR,

Fumarolic ice towers on Mount Erebus, Ross Island, Antarctica

On separate occasions the authors each had the opportunity to ascend Mount Erebus (3,721 m.), Ross Island, the only known active volcano in Antarctica. The ascent by F. C. Ugolini and H. Janetschek in February 1962 was made to study and collect soil samples and biological specimens. The work by G. Holdsworth and G. Lewis in February 1964 aimed at collecting sulphur samples from fumaroles and snow samples at various altitudes.

Although the two parties took different routes, both traversed the extensive area of active and inactive fumaroles at 3,500 m. elevation on the north-west side of the mountain. The fumarole areas offer an unusual spectacle of large ice towers and mounds (Fig. 1). The towers vary in size but they are commonly 6 to 10 m. high and 3 or 4 m. or more in diameter. An aerial view (Fig. 2) shows that some towers have a roughly circular aperture in the crest. Many of the fumaroles were not active during 1962 and 1964, which is in contrast to the situation during the 1908 ascent (David and Priestley, 1914, p. 208–17), but in 1962 a few vents close to the ground were emitting gases. The ice towers are clearly formed by the

Fig. 1. Inactive fumarolic ice towers (1962)