CORRESPONDENCE

The Editor,
Journal of Glaciology

SIR, *Depth hoar on Arctic glaciers*

A coarse-grained, low-density layer of snow forms in late summer or early winter in both the accumulation and the ablation zones of Arctic glaciers and on glaciers elsewhere; it usually contains depth-hoar crystals, and forms a convenient stratigraphic annual marker (Benson, 1959, p. 51–52). Benson attributes the formation of the layer to a combination of strong wind and steep temperature gradient in the autumn, causing loss of mass by sublimation and evaporation. He uses the discontinuity between this layer and a finer-grained, denser and harder layer above as his annual boundary in pit profiles in the accumulation zone; in other words, the depth-hoar layer is the *top* component of his annual accumulation.

The purpose of this letter is to point out that in the ablation zone of a glacier the depth-hoar layer which forms immediately above the ice surface in, say, the 1962 spring is naturally regarded as the *bottom* component of the 1961–62 accumulation; no one would regard it as the accumulation of the 1960–61 budget year deposited after the end of the ablation season. In the accumulation zone, therefore, consistency and convenience in making computations of mass balance require that the bottom, not the top, of the depth-hoar layer be regarded as the annual boundary. Although the same processes operate, the depth-hoar layer does not of course form simultaneously on all parts of the glacier; it forms earliest in the highest accumulation areas and latest near the glacier terminus. It follows that the budget year should be considered as ending on different dates at different altitudes, which is not the same as saying that the budget year ends at the time when the snow-line on the glacier has reached its maximum recession.

Geophysics Section,
Defence Research Board,
Ottawa, Canada.
11 December 1961

G. HATTERSLEY-SMITH

REFERENCE

Benson, C. S. 1959. Physical investigations on the snow and firn of northwest Greenland during 1952, 1953, and 1954: interim report. *U.S. Snow, Ice and Permafrost Research Establishment. Research Report* 26.

SIR, *Patterned ground under ice fields**

The description which Dr. Stephenson gives of the occurrence of patterned ground adjacent to small ice fields in Antarctica (Stephenson, 1961) is in some ways similar to a situation which I recently noted while comparing air photographs of small ice fields in northern Baffin Island, District of Franklin, N.W.T., Canada.

Air photographs of a small ice field were made in 1949 and 1958 and comparison reveals that an average marginal recession of 180 m. took place in the nine-year interval. In the area thus exposed large high-centred tundra polygons with diameters of about 50 m. can be seen (Fig. 1). Similar polygons are visible on both sets of photographs extending over much of the surrounding country. No marked variation in size with distance from the ice field can be seen although some tundra polygons are elsewhere reported to form initially as large features and to divide up into progressively smaller polygons with age (Black, 1952). A close examination of the 1949 and 1958 ice margin using a high magnification stereoscope indicates that the large polygons are actually melting out from under the glacier ice giving a slightly "scalloped" appearance to the ice margin. Goldthwait (1951) described patterned ground including fissure polygons (tundra polygons) immediately adjacent to the Barnes Ice Cap in central Baffin Island and considered them as partial evidence of the expansion of the Barnes Ice Cap in the recent past, asserting that the patterned ground could not have been disturbed by glacier movement for many decades. Patterned ground has been reported emerging from beneath receding glacier ice in northern Ellesmere Island (Smith, 1961), in addition to the examples in Antarctica described by Stephenson (1961).

As Dr. Stephenson points out some of these features may pre-date the formation of the ice fields and

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