Journal of Glaciology, Vol. 8, No. 53, 1969

CORRESPONDENCE

The Editor,

Journal of Glaciology

SIR,

Secondary polygons in Iceland

In his letter, R. W. Groves (1968) mentions secondary polygons within primary ones, discovered by him on a summit plateau of a 998 m high peak in north-west Iceland. As Mr Groves thinks that this species of patterned ground is "possibly hitherto undescribed", I wish to point out that I have already described this type of polygon (Thorarinsson, 1953). I observed these polygons in Berufjördur, east Iceland, about 20 m above sea-level, and I later observed the same type of polygon in several other places in Iceland, both in lowland and highland areas.

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SIR,

Calving from floating glaciers: comments on Dr N. Reeh's paper

Reeh's treatment of glacier calving (Reeh, 1968) invites some comment. He chooses for corroboration of his theory in the first place the Rink Gletscher, but seems to be unaware that the catastrophic calvings of this glacier have been described in detail, photographed and even filmed (Sorge, 1933[a], [b]). Jakobshavn Isbræ might also occasionally calve like Rink Gletscher; this is a possible explanation of the big waves which sometimes enter the harbour of Jakobshavn. But nobody has to my knowledge yet seen one of its big calvings, and this glacier cannot safely be adduced (Reeh, 1968, p. 231) as a support of the author's theory. It might also be pointed out that the manner of calving of the Rink Gletscher, a big detachment at roughly fortnightly intervals, is not typical for the fast-moving ice streams of Greenland which generally shed their ice surplus day by day through the formation of individual icebergs in a manner not covered by the theory.

Apart from the fact that Rink Gletscher is in a special position, the question arises whether it represents a "floating glacier" at all. The depth of the fjord into which Rink Gletscher calves, diminishes from 1 100 m at 12 km to 850 m at 3 km and 650 m at 500 m from the calving front (Sorge, 1933[b]). If the fjord retains the same depth, the thickness of the floating glacier cannot exceed 740 m of which 90 m can be above sea-level. According to Reeh's figs. 12 and 13 this height is already approached at 1 km or less from the front. The longitudinal section (fig. 14) deviates about 30° from the axis of the glacier; in the direction of the flow lines (Carbonnell and Bauer, 1968) the near-horizontal part would be considerably shorter. (In a publication received after the first submission of this Correspondence it is flatly stated (Carbonnell and Bauer, 1968) that "le front [of Rinks Isbræ] ne flotte pas". The same is claimed about Jakobshavn Isbræ (Bauer and others, 1968; Carbonnell and Bauer, 1968) which one might rather expect to float in view of the very small inclination of only 24′ of its lowest part.) It would have been interesting if the author had tried to apply his theory to the undoubtedly floating glacier tongues of north Greenland (Koch, 1928).

The theory demands that the front should bend downward before calving. This is true in some cases whilst in others the outermost part of a floating ice shelf is raised (Swithinbank, 1957). A picture of a detaching part of the front of Jakobshavn Isbræ which seems partly higher and partly lower than the intact part, is shown by Bauer and others (1968, fig. 24). It might in this connection be pointed out that, contrary to a perhaps naive expectation of what a forward bending frontal part would do, at both observed big calvings of Rink Gletscher the detached part of the front of about 500 Gg tilted backward (Sorge, 1933[b]). The other big calving that has been described (Drygalski, 1897, Bd. 1, p. 392) also

showed an original backward tilt of the iceberg. Bauer and others (1968, p. 89) shows icebergs close to the front of Jakobshavns Isbræ which have tilted backward. Reeh does not deal with the question, but a backward tilt would probably have to be expected if the break was near the line at which the ice starts to float.

The author states himself in his Conclusion that his theory is not verified by the calving of the Antarctic ice shelves although one should expect them to be more likely to conform than the laterally confined ice streams of Greenland. We find indeed floating glacier tongues like those of the Mertz and Ninnis Glaciers and ice shelves like the Amery Ice Shelf which attain lengths of not once but 100 times their thickness before they calve.

Incidentally, although the author is right that storm waves can hardly explain the calving of big icebergs, this might be different with tsunamis which have wavelengths of many kilometres and influence the whole water body. They occur sometimes at Antarctic ice fronts (Barré, [1953], [Tom.] 2, p. 179).

One might wish that Mr Reeh could develop his learned and elaborate theory to a state in which the processes leading to and happening during calving are fully covered.

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Sir, *Calving from floating glaciers: reply to Professor F. Loewe's comments*

In his comments Professor Loewe claims the following things:

1. The manner of calving of Rink Gletscher and Jakobshavn Isbræ is not typical for the ice streams of western Greenland.
2. Rink Gletscher and Jakobshavn Isbræ are not floating glaciers and therefore cannot be used to prove the theory of calving proposed.
3. The front of a floating glacier is not always bent downwards as predicted by the theory.
4. The often observed backward tilting of the icebergs detached at the calvings should be in contradiction to the downward bending of the front predicted by the theory.

My attitude to these points is as follows:

1. I agree that the manner of calving of Rink Gletscher and Jakobshavn Isbræ is not typical for the ice streams of western Greenland, but I think that the reason is that these glaciers have floating fronts, in distinction to the main part of the ice streams terminating in Disko Bugt and the Umanak district in western Greenland.