

## REFERENCE

Dewart, G. 1966. Moulins on Kaskawulsh Glacier, Yukon Territory. *Journal of Glaciology*, Vol. 6, No. 44, p. 320-21. [Letter.]

SIR, *The regime of the western part of the Ross Ice Shelf drainage system*

I am writing to you in connection with the article by Giovinetto and others (1966). In this paper the results of studies on the glaciers flowing through the Trans-Antarctic Mountains are very interesting.

Unfortunately there are two comments which must be made concerning the study of the regime of the drainage basin of these glaciers:

- (a) The delineation of the drainage basin is purely hypothetical.
- (b) The supposition that all the ice in this hypothetical basin flows exclusively through the glaciers mentioned, and that no ice crosses the western, southern or northern boundaries of this hypothetical drainage basin, cannot be justified at all.

It follows from this that a calculation of errors applied to the terms in the mass balance is nothing but an illusion, as it is not the error calculation which gives precision to a calculation, but the reality of the quantities one uses.

The positive budget they report is therefore of no significance.

*Centre d'Études Glaciologiques des Régions Arctiques et Antarctiques,*  
Face au 22, Quai Carnot,  
92 Saint-Cloud, France  
23 March 1967

A. BAUER

## REFERENCE

Giovinetto, M. B., and others. 1966. The regime of the western part of the Ross Ice Shelf drainage system, by M.[B.]Giovinetto, E. S. Robinson and C. W. M. Swithinbank. *Journal of Glaciology*, Vol. 6, No. 43, p. 55-68.

SIR, *Accumulation between Mount Chapman and "Byrd" station, Antarctica*

I had the opportunity to re-measure the snow accumulation along the line of the "Byrd" station-Mount Chapman ice-movement markers (Brecher, 1967) this past Antarctic season. It seems to me rather interesting to note that while the mean accumulation between "Byrd" station and array V (300 km. from "Byrd" station) has decreased markedly, from 16.1 g. cm.<sup>-2</sup> yr.<sup>-1</sup> for 1962-65 to 11.5 g. cm.<sup>-2</sup> yr.<sup>-1</sup> in 1965-66 (the value between arrays V and VI has remained unchanged), the variations of accumulation along the line correspond very closely for the two time intervals with a coefficient of correlation of 0.926. This could well be a topographic effect.

The decrease of accumulation with time has also been observed at "Byrd" station, where measurements of 100 stakes have shown a decrease from 11.0 g. cm.<sup>-2</sup> yr.<sup>-1</sup> to 9.4 g. cm.<sup>-2</sup> yr.<sup>-1</sup> for this same time period (personal communication from R. L. Cameron).

My paper (Brecher, 1967) contained some minor errors which should be corrected as follows:

- i. On p. 575, lines 8 and 9, the standard deviations should be 3.0 and 3.1, respectively.
- ii. On p. 575, Table I, the column heading "Standard deviation" should read "Standard error". The values were obtained from the following expressions:

$$\text{Standard error of mean} = \left\{ \frac{\sum v^2}{n(n-1)} \right\}^{\frac{1}{2}}$$

$$\text{Standard error of one observation} = (\sum v^2/n)^{\frac{1}{2}},$$

where  $\sum v^2$  is the sum of the squares of the deviations from the mean and  $n$  is the number of observations, and the observations are considered to be several measurements of the same quantity.

*Institute of Polar Studies,*  
Ohio State University,  
125 South Oval Drive,  
Columbus, Ohio 43210, U.S.A.  
7 May 1967

H. H. BRECHER

## REFERENCE

Brecher, H. H. 1967. Accumulation between Mount Chapman and "Byrd" station, Antarctica. *Journal of Glaciology*, Vol. 6, No. 46, p. 573-77.

SIR,

*The drumlins of East Down, Ireland*

In spite of the considerable advances in our knowledge of drumlin formation resulting from field investigations and from physical studies of the basal flow of ice sheets, the origin of drumlins is not yet fully understood. Any new method of attack is therefore to be welcomed, such as the use of a computer on air photographs of a drumlin landscape (Vernon, 1966, p. 401). Since the conclusions drawn from this exercise conflict, in some respects seriously, with those arrived at by field mapping before air photographs became available (Charlesworth, 1939), it becomes necessary to examine the discrepancy.

The problem falls into two parts: first the origin of the drumlins, secondly and much more importantly, the source and flow direction of the ice that created them. In the field work for the 1939 map (Charlesworth, 1939), based on the one-inch Ordnance Survey maps, all recognizable drumlins were mapped; their number in Vernon's area was roughly 1470. Vernon chose "only those features with a definite elliptical shape". His drumlins numbered 873. By so limiting the selection, Vernon of necessity failed to get a true average length/breadth ratio or density per unit area. The arbitrary selection also affected the spacing and the density pattern in bands both transverse and parallel to the ice flow and his conclusion that most drumlins "occur singly with no obvious relations to others" which is not true (Charlesworth, 1939, map).

Vernon concludes that the drumlins are concentrated in linear groups across and parallel to the ice flow that possibly represent "waves in the ice forming belts of low pressure favourable to drumlin formation". The conclusion is, however, weakened by the arbitrary selection and his implicit assumptions, viz. that the region is perfectly flat and that the rocks throughout are uniform in hardness, texture and composition. Both assumptions are contrary to known fact. Irregularities, whether inherited or ice-created, abound in the rock surface and the rocks vary constantly and rapidly over the 40 miles (64 km.) in the direction of the dip. Most significantly, the rocks strike roughly parallel with Vernon's bands.

Clearly, while pressure waves may have occurred, no compelling evidence has been submitted that they existed in this area. An hypothesis which completely ignores two of the controlling factors in drumlin formation, the variations in the rock surface and in the composition and other characters of the local rocks, does so at its peril. A jury must bring in a Scottish verdict of not proven.

The directions of the drumlins on Vernon's map and my map are in general agreement; contrary to Vernon's (1966, p. 405) statement, my drumlins in the area east of Bangor trend north-south as his do. The only discrepancies are first, in Vernon's area VI where his trend is east-west and mine roughly west of north (in accord with the contours of the six-inch maps), and secondly in the area north of Newtownards where Vernon's trend is north-west to south-east but on my map is north-south, in agreement with the independent witness of the Geological Survey Memoir (Lamplugh and others, 1904, p. 120) for both striae and drumlins in that area, and strangely enough with Vernon's own direction of the striae which is also north-south (Vernon, 1966, fig. 2).

Vernon concludes from the direction of the drumlins that the "picture is radically different from that given by Dwerryhouse (1923) and Charlesworth (1939), both of whom postulated a dominance of Scottish ice over north-east Ireland". A glance at the two maps in question shows this statement to be a gross misrepresentation of two quite clear text-figures which represented the Irish ice as occupying the Lough Neagh basin and proceeding along the valleys of the Main and Lower Bann.

Vernon asserts that the striae, drumlins and erratics "all indicate a strong flow of Irish ice over north-east Ireland at least during the drumlin-forming stage of the late glacial period" and that the "Scottish ice, if present at all, was present only on the north of the Ards Peninsula". However north-east Ireland be defined, it must surely include the eastern parts of the two north-east counties, Down and Antrim. Not one geologist in more than a century of research has ever found a single erratic in these two areas which was not either local or from Scotland. The Geological Survey Memoirs, including that of Belfast (Lamplugh and others, 1904) and the new edition of the Ballycastle area (Wilson and Robbie, 1966) prove unmistakably that the Scottish ice alone has over-ridden these areas. This is in agreement with the direction of the drumlins in the Lagan Valley which "trend east-west or slightly south of west" (Lamplugh and others, 1904, p. 96), with the marine shells in the Belfast area (Lamplugh and others,