The paper by Dr. J. W. Glen[4] appears to substantiate the relation between the formation of ogives and the mechanism of movement within the ice fall, and surely any theory must take into account the formation of ogives under the different conditions mentioned above.

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17 *December* 1956

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3. Thorarinsson, S. Letter. *Journal of Glaciology*, Vol. 2, No. 14, 1953, p. 295.
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SIR,

Mr. Ives is, of course, correct in pointing out that ogives which form below a severed ice fall cannot be related to the original stratification in the ice field above, but the new stratification—predominantly seasonal—developed in the avalanche fan must surely be present in these ogives. The most helpful studies which Dr. King and Mr. Ives made of ogives in Iceland certainly point to the reality of overthrusting and shearing in rotating the ice layers at the foot of the steep Morsárjökull avalanche fan, and probably at the foot of the ice fall on the same glacier system.

Having at first mistaken sedimentary layering in Norwegian cirque glaciers for tectonic layering, I may now be underestimating the frequency of purely tectonic layering below an ice fall, but I can assure Mr. Ives that I am not underestimating the reality of rotation at the foot of ice falls or other steep slopes on glaciers. This may involve overthrusting along discrete surfaces and also shearing without such discrete fractures. However, I still think that the major problem remains of distinguish ing between the contribution of sedimentary layering—primary or secondary—and of tectonic layering to these structures. The complete obliteration of the seasonal layers formed in the *névé* must, I think, be very rare except at a severed ice fall or on a glacier with very complex and active overthrusting and shearing.

I am grateful to Mr. Ives for reminding me that, in thinking too much of Austerdalsbreen in what perhaps should have been a more general discussion, I over-simplified the matter.

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SIR, *The Correct Rammsonde Formula*

In his derivation of the theory of the Rammsonde, Haefeli[1] gave two formulae for the ram resistance:

$$W_1 = \frac{Rh}{s} + (R+Q) \text{ for a completely elastic impact,}$$

and

$$W_2 = \frac{Rh}{s} \cdot \frac{R}{R+Q} + (R+Q) \text{ for a completely inelastic impact.}$$

He proceeded to use the first formula, because it is somewhat simpler, and everyone since has followed his example.

However, impacts in snow or firn are almost completely inelastic. When the weight strikes the top of the tube, an elastic wave travels down it. A completely elastic impact would occur only if the

cone at the far end were standing on a completely elastic and finite material; in such a case the wave is completely reflected, and on returning to the top of the tube it causes the weight to move upwards. There is thus a very significant rebound, which can be calculated using the impulse law.

This is obviously not the case in practice. The rebound is very small even when the cone is resting on an ice layer, and is zero when the cone is in soft snow. The amount of energy lost is variable and unpredictable.

This fact has no important consequences if we use the Rammsonde qualitatively, but is most important if we use the Rammsonde resistance for quantitative studies, as does Bull [2]. The only correct method of using a Rammsonde would seem to be:

(1) to use W_2 instead of W_1 for the ram resistance,

(2) to put a ring of soft material (rubber or lead?) at the point of impact to ensure that the blow is always inelastic.

The omission of the factor $R/(R+Q)$ in the first term of the ram resistance formula leads Bull to very high values of the frictional resistance. In fact, as Haefeli says: "by choosing the cone diameter slightly larger than the outside shaft diameter, the friction between shaft and snow can be practically disregarded".

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DUPLICATE PAPERS

A new list of duplicate papers in the Library of the Society available for distribution to members can now be obtained from the Editor. As this service is becoming increasingly popular early application is advisable.

GLACIOLOGICAL LITERATURE

THIS selected list of glaciological literature has been prepared by J. W. Glen with the assistance of T. H. Ellison, W. B. Harland, Miss D. M. Johnson, G. T. Warwick and the Staff of the Scott Polar Research Institute. Its field is the scientific study of snow and ice and of their effects on the earth; for the literature on polar expeditions, and also on the "applied" aspects of glaciology, such as snow ploughs, readers should consult the bibliographies in each issue of the *Polar Record*. For Russian material the system of transliteration used is that agreed by the U.S. Board on Geographic Names and the Permanent Committee on Geographical Names for British Official Use in 1947. Readers can greatly assist by sending reprints of their publications to the Society, or by informing Dr. Glen of publications of glaciological interest.

GENERAL GLACIOLOGY

[INTERNATIONAL GEOPHYSICAL YEAR.] International Geophysical Year, 1957–58: Antarctica 1955–56. *Polar Record*, Vol. 8, No. 53, 1956, p. 182–87. [Progress and plans. Map shows stations planned.]

GLACIOLOGICAL INSTRUMENTS AND METHODS

MILLECAMPS, R. Sur l'application de la photogrammétrie terrestre à l'étude de la Mer de Glace. *Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences* (Paris), Tom. 242, No. 1, 1956, p. 159–61. [Description of photogrammetric method used to determine daily motions on the Mer de Glace.]