the integral being extended over the whole area of the glacier. p_0 must be equal to the weighted mean of $\frac{1}{2}(p+a)$ if the glacier is in equilibrium. This is possible in the case shown in Fig. 1, for the curve $\frac{1}{2}(p+a)$ is roughly a straight line except at its ends, where the weight is negligible, but in the case shown in Fig. 2 (p. 510), $p_0=a_0$ is certainly less than the weighted mean of $\frac{1}{2}(p+a)$, even if the glacier is in equilibrium.

That the glacier is in balance can only be seen on curves of $p \cdot \frac{dS}{dz}$ and $a \cdot \frac{dS}{dz}$ as functions of z (Fig. 3, p. 510). The areas between the curves and the z-axis represent the total ablation and accumulation of the glacier. If the glacier is in equilibrium the two shaded areas in Fig. 3 must be equal, and will both be equal to the amount of snow and ice crossing a vertical surface through the firn line in one year.

It would be of great interest to have further data on the accumulation and ablation at different heights.

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Santiago (Chile)
7 *July* 1954

L. LLIBOUTRY

COMMENTS ON PROFESSOR LLIBOUTRY'S LETTER

By R. FINSTERWALDER
(Technische Hochschule, Munich)

THE data upon precipitation p and especially ablation a in glaciated regions have so far been rather poor. The parabola with a maximum in the height where the ablation is nearly zero is an approximation for the superposition $p-a$ of the precipitation and ablation curves. This parabola has proved true to a certain extent in the Eastern Alps for precipitation[1] and also ablation measurements by our calculations of the height z_0 of the snow line. The method used by myself for fixing the height z_0 does not depend absolutely on this parabola as I have mentioned on page 310, Vol. 2, No. 15, of this *Journal*. But if it is possible to draw a parabola the calculation of the height of the snow line is very easy and quick.[2]

It is certain that the shapes of the curves $p-a$ for precipitation and ablation can vary in the way Lliboutry explains in his interesting letter. The shape can be a parabola as in Fig. 1 or nearly a straight line as in Fig. 2 or a curve of higher order. For fixing the height of snow line by the formula (5) on page 310 of my paper it is only necessary to shift the curve parallel to itself in the direction of the z-axis until $\Sigma f.a$, or in the writing of Lliboutry $\int (p-a)\, dS$, is zero. The fixing of the height z_0 of the snow line becomes more accurate the larger is the angle by which the curve $p-a$ cuts the z-axis.

The method shown by Lliboutry in Fig. 3 for fixing z_0 is very interesting. By shifting the two curves p and a in the direction of the z-axis one can obtain equality in the two shaded areas. In practice it would be necessary to draw very accurately in order to obtain a sufficiently accurate result by this graphic method.

I agree with Lliboutry also with respect to his closing remark. It would be very useful to obtain more data about the variation of accumulation and ablation with height.

REFERENCES

1. Koch, K., *and* Reichel, E. Verteilung und jährlicher Gang der Niederschläge in den Alpen. *Veröffentlichungen der Preussischen Meteorologischen Instituts*, No. 374, Abh. Bd. 9, No. 6. Berlin, 1930.
2. See the calculated examples in *Zeitschrift für Gletscherkunde und Glazialgeologie*, Bd. 9, Ht. 2, 1953, p. 228–29.

The Editor,
The Journal of Glaciology

SIR,

The Depth of Crevasses

The discussion on crevasse depths in the *Journal of Glaciology*, Vol. 2, No. 15, 1954, p. 339, leaves me in some doubt whether crevasses in temperate glaciers cannot exceed 30 m. in depth. On the Ebnefluhfirn in the Bernese Alps, at a height of about 3700 m., I once pulled a man from a snow