

## CORRESPONDENCE

The Editor,

*Journal of Glaciology*

SIR, *Deducing thickness changes of an ice sheet: comments on the paper by J. F. Nye*

We have read with great interest the article of Nye (1975) in which he corrects an error in our earlier paper (Federer and others, 1970) and proposes a better model for calculating the surface lowering of the Greenland ice sheet. A surprising fact is that the movement of the reference points in the shaft of 40 m depth at Jarl Joset Station does not agree with Nye's prediction. If his model were applicable, the value of  $\partial h/\partial t$  should be constant (or a plot of  $\delta h/\delta t$  versus depth should at least approach a steady value at the lower layers). According to Nye's equation (3)

$$\frac{\delta h}{\delta t} \rho(z) = a^* \rho_w - V(z) \rho(z)$$

the second term on the right should not be constant. From our measurements, however, we find that  $V(z)\rho(z)$  is constant for a dozen reference points from 5 m to 40 m depth (Sury and Haefeli, 1975).

Nevertheless the measured movement of the lowest reference point can be used to calculate the surface lowering according to Nye's model and to compare this value with the final result of the survey, now reported by Seckel (unpublished) in his thesis. From this it is seen that the measured surface lowering is  $1.0 \pm 0.2$  m from 1960 to 1968. The difference between this and the earlier value (1.74 m) is due, among other things, to improved values of the horizontal surface velocity  $v_r = 17$  m a<sup>-1</sup> and an increased surface slope  $\tan \alpha \approx 0.35\%$ . Thus the values in our earlier paper (Federer and others, 1970) must be corrected as follows:  $v_x \tan \alpha \approx 0.06$  m a<sup>-1</sup>;  $V_r = v_r - v_x \tan \alpha = 0.45 - 0.06 = 0.39$  m a<sup>-1</sup>; and  $V_r^* = 0.27$  m a<sup>-1</sup> (not 0.29 m a<sup>-1</sup>).

The yearly mass deficit (1959-68) now becomes  $a^* - V_r^* = 0.193 - 0.27 = -0.077$  m a<sup>-1</sup>. The surface lowering according to Nye's model

$$\frac{\partial h_v}{\partial t} = -\frac{0.077}{0.69} = -0.112 \text{ m a}^{-1}$$

Thus the theoretical value of the surface lowering between 1960 and 1968 of 0.89 m is in good agreement with Seckel's measurement of  $1.0 \pm 0.2$  m. This suggests that Nye's model can eventually be used for layers which are not too close to the surface.

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- Nye, J. F. 1975. Deducing thickness changes of an ice sheet from radio-echo and other measurements. *Journal of Glaciology*, Vol. 14, No. 70, p. 49-56.
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SIR, *Ice from different latitudes*

"Not many years ago, Ice was in many parts of the world looked upon as a rarity, and one, too, attainable only at certain periods of the year. Now, however, it takes its place among the necessities of civilized life, and is to be met with at all seasons, in every land where comfort and luxury are known. By the persevering enterprise of our Atlantic neighbours, the 'Wenham Lake' and 'Fresh Pond Ice' are as extensively known, and as highly prized, as 'Barclay and Perkins XX', or the Sparkling Wines of Champagne."