

SIR,

*Microparticles in "Byrd" station ice core:  
further comments on the paper by L. G. Thompson, W. L. Hamilton and C. Bull*

Once again, we agree with some of the viewpoints put forward by Thompson and others (1977). For example, we agree that the ice flow in the "Byrd" area must be of quite unusual character if the layer thicknesses claimed were true. Also we agree that detection of seasonal variations in the microparticle concentration in an ice core is not just a matter of increasing the sampling frequency. The appropriate sampling frequency must in any given case depend upon the signal-to-noise ratio. Using the minimum of 3 or 4 samples per annual layer is justified only in high accumulation areas with particularly favourable wind, fall-out and deposition conditions.

In our opinion, the authors' new figure 1 (above) suggests that this does not hold true for the "Byrd" area. In fact, it stresses the authors' statement that "conclusive proof is lacking that the short-period variations in microparticle concentration are annual". We feel this problem should be solved prior to discussing flow patterns or time scales based on any interpretation of dust profiles. It is true that there is some degree of similarity between the dust and  $\delta^{18}\text{O}$  variations in (according to Johnsen and others, 1972) a 15 500 year old increment (Thompson and others, 1975, fig. 1), but it is difficult to accept as "strong presumptive evidence", because the  $\delta$  oscillation is short and obviously atypical, while the dust profile is disturbed by numerous volcanic ash bands. Furthermore, Marshall (1962) suggested seasonal dust variations at 21 m depth, but he analysed only 0.65 m of firn comprising two annual layers as determined by visual stratigraphy observations. And, true enough, if seasonal dust variations are recognizable at Pole of Relative Inaccessibility, they may also be so at "Byrd" that has twice as much accumulation; on the other hand, the meteorological regimes at the two stations are quite different, and midway between them, at the South Pole, "there are difficulties in determining the annual layering" (Thompson and others, 1975), may be because the fall-out in this area (and at "Byrd"?) simply does not vary regularly with the seasons in an interpretable way.

Hence, we consider a feasibility study as particularly important in areas like "Byrd", closer to active volcanoes than to potential sources of continental dust. Marshall's excellent pilot study should be followed up by measuring a detailed dust-concentration profile through the upper firn from the surface down to strata that can be safely dated, e.g. by identification of total  $\beta$ -activity reference horizons. This is undoubtedly what Thompson and others (1975) have in mind, when stating on p. 441: "In the 1973-74 Antarctic field season one of us (L.G.T.) collected samples for microparticle analysis from areas near 'Byrd' station where the snow stratigraphy and chronology are well known". In several respects these analyses will render much more information than the new figure 1 above.

Finally, a short remark about matching the Camp Century and "Byrd" time scales. The technique used by Johnsen and others (1972) essentially implied the assumption that the Wisconsin glaciation began and ended almost simultaneously in the two hemispheres. The uncertainty on this point is one of the reasons why we are ourselves not satisfied with our "Byrd" time scale. We sincerely hope that Thompson and his co-workers will succeed in proving the applicability of the microparticle dating method at "Byrd", the more so as the range of the  $^{14}\text{C}$  ice-dating method does not exceed 25 000 years.

*Geophysical Isotope Laboratory,  
Københavns Universitet,  
Haraldsgade 6, DK-2220 København N, Denmark  
20 August 1976*

S. J. JOHNSEN  
C. U. HAMMER  
N. REEH  
W. DANSGAARD

## REFERENCES

- Johnsen, S. J., and others. 1972. Oxygen isotope profiles through the Antarctic and Greenland ice sheets, [by] S. J. Johnsen, W. Dansgaard, H. B. Clausen, C. C. Langway, Jr. *Nature*, Vol. 235, No. 5339, p. 429-34.
- Marshall, E. W. 1962. The stratigraphic distribution of particulate matter in the firn at Byrd station, Antarctica. (In Wexler, H., and others, ed. Antarctic research: the Matthew Fontaine Maury memorial symposium. . . . [Edited by] H. Wexler, M. J. Rubin and J. E. Caskey, Jr. Washington, D.C., American Geophysical Union, p. 185-96. (Geophysical Monograph No. 7.))
- Thompson, L. G., and others. 1975. Climatological implications of microparticle concentrations in the ice core from "Byrd" station, western Antarctica, by L. G. Thompson, W. L. Hamilton and C. [B. B.] Bull. *Journal of Glaciology*, Vol. 14, No. 72, p. 433-44.
- Thompson, L. G., and others. 1977. Microparticles in "Byrd" station ice core: reply to comments by S. J. Johnsen, C. U. Hammer, N. Reech and W. Dansgaard, [by] L. G. Thompson, W. L. Hamilton, C. [B. B.] Bull. *Journal of Glaciology*, Vol. 18, No. 78, p. 161-63. [Letter.]