

'The Castell Limestone, which appears to dip north at 50°–60° beneath the Llandeilo Flags, but is actually inverted is, in its unweathered state, dark grey-blue in colour. The individual limestone bands are rather variable, some being fine grained, massive and very uniform; others are more shaly, while others are more arenaceous. The limestone includes interbedded bands of shale up to 3 ft in individual thicknesses. The limestone group with its included shales is about 50 ft thick, and the apparent dips on the shore are 50° to NNW, but nearer 60° at the quarry entrance.'

(Then follows a faunal list)

'The graptolites fix the horizon of this limestone as about the same as that of the Mydrim Limestone of Carmarthenshire with which it also compares in lithology. An exact lithological comparison, and also the same type of Orthids, were found in the small limestone knob of Ty pica which rises from beneath the alluvial plain of the River Towy, Llandeilo.

'Somewhere to the south (of Porth Gain Quarry) there must be an overfold or more probably a fault which terminates the overturned beds and introduces the normal northward-dipping Llandeilo shales seen on the south side of the bay.'

It is clear from the above that by 1950 Professor Cox had abandoned the three tenets on which his work is now criticized, *i.e.* (1) that the sequence ascends from south to north, (2) that a near-invisible thrust-fault bounds the Castell Limestone, and (3) that the 'overlying' trilobite-bearing beds are of *D. bifidus* Beds age. Unfortunately Professor Cox's Ms was never worked up into proper memoir format and hence remained unpublished. His reference to 'Dr Robertson' is of course to Dr T. Robertson of Ullapool who was then Assistant Director (England and Wales) of the Geological Survey, and who appears to have been the first, by many years, to recognize the inverted character of the sequence north of Abereddy Bay.

This letter is published by permission of the Director, Institute of Geological Sciences.

References

- Black, W. W., Bulman, O. M. B., Hey, R. W., Hughes, C. P. & Waltham, A. C. 1972. Ordovician Stratigraphy of Abereddy Bay, Pembrokeshire. *Geol. Mag.* **108**, 546–8.
- Waltham, A. C. 1971. A note on the structure and succession at Abereddy Bay, Pembrokeshire. *Geol. Mag.*, **108**, 59–52.

Institute of Geological Sciences
5 Princes Gate
London SW7
21st July 1972

J. R. EARP

Time scale and ice accumulation during the last 125,000 years as indicated by Greenland O¹⁸ curve

SIR.—In a recent paper in this journal Mörner (1972) has strongly criticized the depth-age relationships applied to the deep ice core from Camp Century, Greenland (Dansgaard *et al.*, 1969, 1971). It is argued that logarithmic time scales must be wrong, because the ice flow parameters have changed during the last 125,000 years.

We are unable to see any relationship between Dr Mörner's criticism and our 1971 paper. For example, the time scale is not logarithmic. It is clearly stated to be 'independent of the C¹⁴ scale, of all ice flow parameters, and of their possible temporal changes' (p. 53). For the same reason, Dr Mörner's attempt to use the isotope curve to determine temporal accumulation changes makes no sense. A warning against this was stressed on

p. 54: Comparison between the isotope 'curve and other records allows no conclusion as to temporal variation of the rate of accumulation, because the present thickness of an old annual layer depends on several parameters not considered here, e.g. the temperatures to which the layer has been exposed since the time of deposition'.

We must conclude that Dr Mörner has not read the 1971 paper prior to criticism.

References

- Dansgaard, W., Johnsen, S. J. Møller, J., and Langway, C. C. 1969. One thousand centuries of climatic record from Camp Century on the Greenland Ice Sheet. *Science* **166**, 377–81.
- Dansgaard, W., Johnsen, S. J., Clausen, H. B., & Langway, C. C. 1971. Climatic record revealed by the Camp Century ice core. In Turekian, K. K. (Ed.): *Late Cenozoic Glacial Ages* (volume dedicated to R. F. Flint). Yale Univ. Press.
- Mörner, N.-A. 1972. Time scale and ice accumulation during the last 125,000 years as indicated by the Greenland O¹⁸ curve. *Geol. Mag.* **109** (1). 17–24.

Geophysical Isotope Laboratory
University of Copenhagen
Haraldsgade 6
DK-2200 Copenhagen, Denmark
31st August 1972

W. DANSGAARD
S. J. JOHNSEN
H. B. CLAUSEN
C. C. LANGWAY

Pleistocene chronology

SIR,—Dr N.-A. Mörner, in the *Geological Magazine* (109 (1) 17–24) and in other recent papers, makes use of what he calls an 'astronomical' or 'geological-astronomical' chronology. An occasional reference in the text shows that the scale is one put forward by Kukla in 1969, but the terms are used without qualification in figure captions and table headings, and in most instances in the text. To most geologists, a reference to an astronomical time-scale in connection with Pleistocene dating would suggest the scale proposed by Milankovitch and discussed by Zeuner, but Kukla's scale is a different one. Unless the scale intended is clearly indicated, the use of the Kukla time-scale in figures and tables is likely to lead to confusion.

Dr Mörner appears to reject 'for geological reasons' all radiocarbon dates exceeding about 32,000 years, but he does not make clear what these reasons are.

A simple test of the time-scale advocated by Dr Mörner demonstrates its unsuitability. He shows Würm I extending from 72,000 to 60,500 years B.P. Within this period there are, in different regions, apparently reliable radiometric dates on coral spanning the range 67,000 to 62,000 years. This indicates comparative warmth, a conclusion supported by a number of radiocarbon dates on terrestrial material. Unless this radiometric evidence can be shown to be erroneous, it is not possible to accept the dating of the greatest severity of the early Würm glaciation at about 66,000 years, as required by this so-called astronomical scale. Dansgaard's dating of the Greenland ice-core also suggests that most of the period between 70,000 and 62,000 years B.P. was of more than average warmth.

P. EVANS

30 Meadway
Berkhamsted, Herts
22nd October 1972