that these limits are accurate to about ±3 m.y. The agreement confirms the assumptions[3] made regarding the age of oceanic basement in JOIDES drill holes. The Cretaceous normal interval and its limits are potentially very important global time markers.

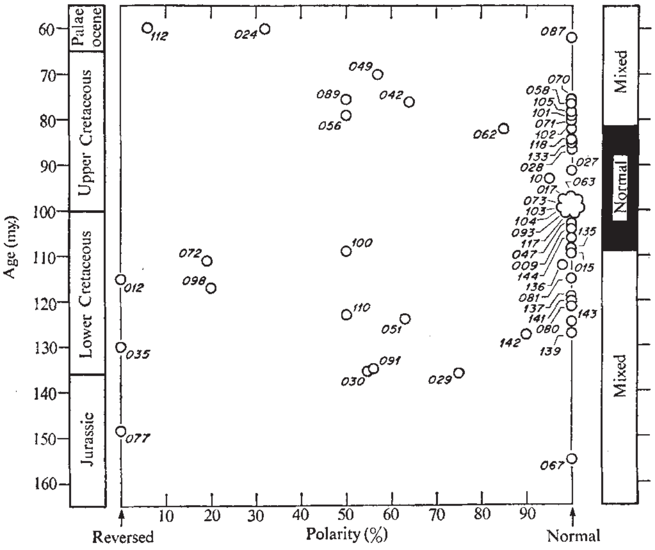

Fig. 2 Reversals in the later Mesozoic as indicated by the land evidence. The percentage of normal polarity in rock formations is plotted against the geological age of the beds. The numbers refer to the compilation of Hicken *et al.*[9] and to a later compilation in preparation. The age has been estimated either radiometrically or by assigning an age from published stratigraphic information using the time scale of the Geological Society of London. The Cretaceous normal interval is shown in black with mixed polarity intervals on either side.

The discrepancies between our time limits and those of Helsley and Steiner arise from improvements in the data coverage. The differences with the time limits of McElhinny and Burek arise chiefly because they chose to include within their "normal" interval prominent reversals before and after what we define as the Cretaceous normal interval. Their procedure makes the identification of the limits of their interval in sea record difficult because the majority of reversals within their interval cannot be assigned, with any confidence, to particular anomalies at sea. This difficulty is greatly reduced if the interval is defined (as implied by Helsley and Steiner) as that time for which no authentic field reversals are known from land and no anomalies occur at sea, because it is reasonable as a working model to identify the latest reversal(s) in Lower Cretaceous on land with the last anomaly at sea (M-1, Fig. 1), and similarly to identify the first reversal(s) in the Upper Cretaceous with the first anomaly at sea. This model apparently works to an accuracy of ±3 m.y., because the land and sea chronologies are compatible. In the future reversed intervals of very short duration may be established within the Cretaceous normal interval, but these need not disturb the chronology, just as the discovery of similar brief polarity event[7] within the 60 m.y. long Late Palaeozoic reversed interval[8] has not disturbed that chronological unit.

Finally, we note that the interpretation of Larson and Pitman[3] implies "a pulse of rapid spreading" in Atlantic and interval. Is this a coincidence, or is there a correlation between Pacific with rates as high as 18 cm yr^{-1} between 110 and 85 m.y., contemporary, within the errors, with the Cretaceous normal events occurring in the Earth's core (or core-mantle interface) and surface diastrophism?

The compilation of reversal frequency was made from a catalogue of palaeomagnetic results which can be had on request from Mrs Jean Hastie at our address.

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Variability of the Thermohaline Staircase

STEP-LIKE structures in temperature and salinity beneath the Mediterranean water have been observed in the Eastern Atlantic[1-6]. In Fig. 1 we show the stations where steps have been found in the area to the west of Gibraltar. Salt fingering as a result of double diffusive processes has been suggested as a possible cause for the generation of such step-like structures[7]. During cruise No. 23 of RV Meteor in 1971 we intended to study the small scale features of such structures[8]. Some previous observations[6] in August/September 1970 had revealed an extensive zone where a "thermohaline staircase" existed (Fig. 1). We therefore selected stations in this area and close

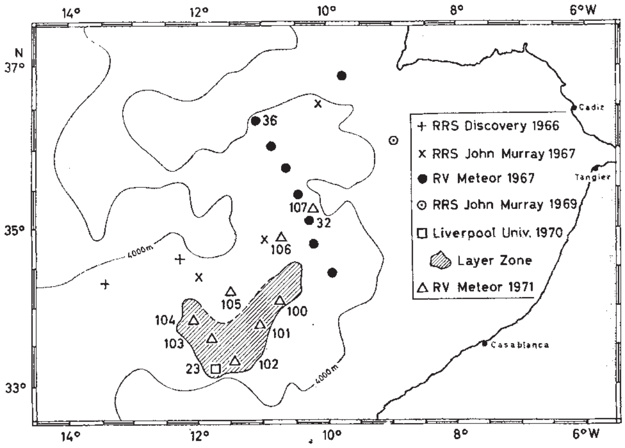

Fig. 1 Map of area where thermohaline staircase phenomena were observed.

to it for the proposed study. A high resolution *in situ* conductivity–temperature–depth meter of the "Kieler Multi-Meeressonde" type was used for the vertical profiling of temperature and salinity.

The results of the measurements on stations 100 to 107 are shown in Figs 2 and 3. For comparison the step-like structures found below the Mediterranean water at neighbouring stations 32 (1967, ref. 4) and 23 (1970, ref. 6) are also included. The typical thickness of layers observed earlier was 20 m, with typical decreases in temperature, ΔT, of 0.2° C and in salinity, ΔS, of 0.3% across the interfaces. Only on station 107 (Fig. 3) were similar values found in 1971, but the structure was not as regular as observed in preceding years.

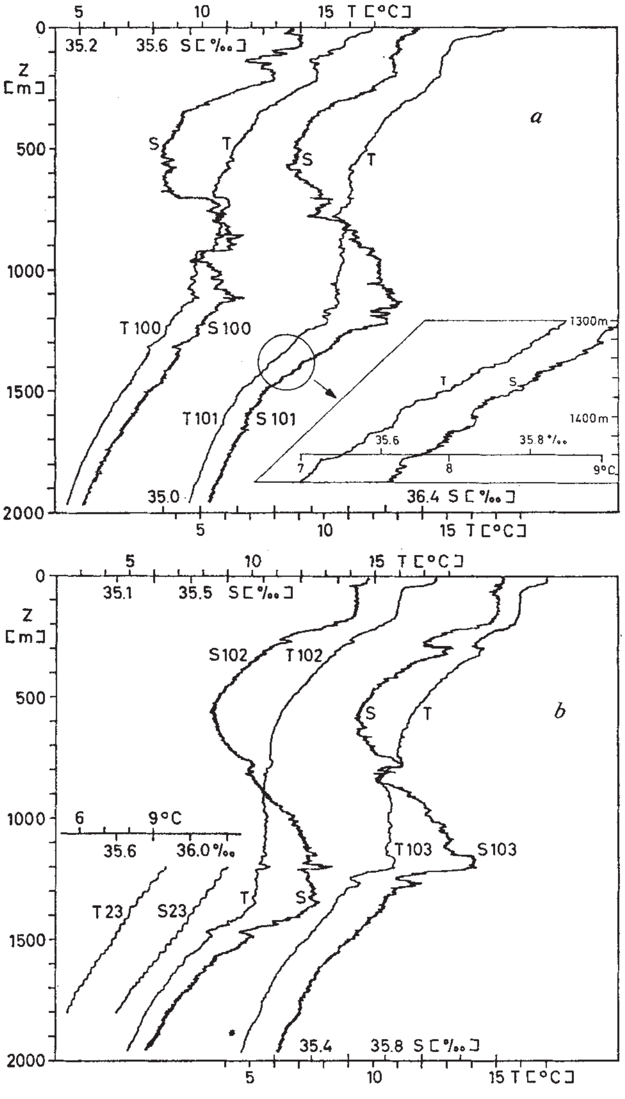

Fig. 2 Vertical temperature and salinity distribution at Meteor stations 100–103 (*a*) and related station 23 (*b*) as reported by Tait and Howe.

It seems, however, that there are thermohaline staircases with scales of the layer and interface (h) and the temperature and salinity differences of typically 10% of the earlier observed values. This can be seen on the enlarged portions of the profiles given on the right of Figs 2 and 3. The flux of salt and heat varies as a function of $\Delta S/h$ and $\Delta T/h$, respectively[9]. Although the size of the steps and the layer thickness differed by one order of magnitude between earlier and recent observations, the above ratios are essentially the same.

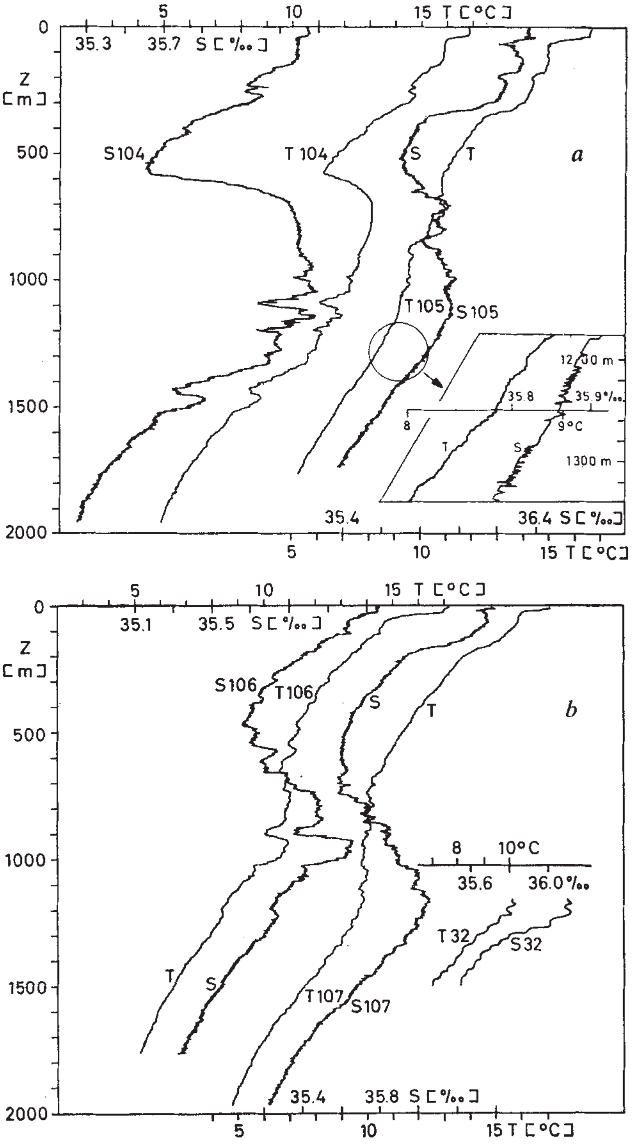

Fig. 3 Vertical temperature and salinity distribution of Meteor stations, *a*, 104–107 (1971); *b*, 32 (1967).

Thus the vertical fluxes seem to be essentially unchanged in spite of the variability in scales of the thermohaline staircase.

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