

## JOINT COLLOQUIA

17 April, 1958

## Erratum

A summary of this colloquium was given in the preceding (June) issue of the Australian Meteorological Magazine. However, Dr. Schwerdtfeger has pointed out that the studies of the semi-annual pressure oscillation were undertaken jointly by Dr. F. Prohaska and himself. This was indicated in the manuscript submitted to the Editor, but was omitted in error, giving the impression that Dr. Schwerdtfeger alone was the author of the studies referred to. The error is regretted and this statement is being made at Dr. Schwerdtfeger's request. Ed. (A.M.M.)

29 May, 1958

## Time scales of oceanic circulation

by R.B. Montgomery

Professor Montgomery, who is Associate Professor of Oceanography from Baltimore, U.S.A., and at present a Fullbright Research Scholar at the C.S.I.R.O. Division of Meteorological Physics stated that the atomic age was providing results and raising questions in terms of the time involved in various branches of oceanic circulation and mixing, whereas previously oceanographers had concentrated their attention on velocity and flux.

Radiocarbon analysis of sea water had been used as a basis for estimating the time elapsed since the water was in equilibrium with atmospheric carbon dioxide. For instance, Brodie and Burling (Nature, London, 181, 107, 1958) had reported elapsed times of 2500 yr and 1900 yr for two samples of deep water taken south of New Zealand.

The ratio of distance to speed yielded time. As an example, the length of the Antarctic Circumpolar Current (10800 n mi) divided by the estimated geostrophic speed at the core (0.25 kt) gave 5 yr as the (minimum) time for a water particle to complete the circuit around Antarctica. Krummel (1911, p. 677) had mentioned a drift bottle that may have completed this circuit in 7 yr. As another example, Wüst (Deep-Sea Res., 1955) estimated 5.3 yr for the ice-cold bottom water to travel the length of the South Atlantic Ocean from the Weddell Sea to the equator.

The ratio of volume to volume flux also yielded time. The volume of the ocean,  $1369 \times 10^6 \text{ km}^3$ , divided by the estimated evaporation from the ocean,  $40 \text{ km}^3/\text{hr}$  (Dietrich, 1957, Abb. 71), gave 3900 yr as a residence time for water in the ocean. The exchange of water across the equator in the Atlantic Ocean was stated (Sverdrup et al, 1942, table 76) to be  $32 \text{ km}^3/\text{hr}$  in each direction; the resulting residence time for water in the North Atlantic Ocean was some 600 yr. For the Arctic and Greenland-Norwegian seas (volume  $17 \times 10^6 \text{ km}^3$ ) the exchange of  $13 \text{ km}^3/\text{hr}$  (Sverdrup et al., p. 655) gave a residence time of 150 yr. For the Mediterranean and Black seas ( $4.2 \times 10^6 \text{ km}^3$ ) the Gibraltar Surface Current of  $6 \text{ km}^3/\text{hr}$  (Sverdrup et al., table 78) gave a residence time of 80 yr. For the Black Sea alone the residence time estimated in this way was 2500 yr (Sverdrup et al., p. 651).

Professor Montgomery stated that he had prepared a short paper on "Salinity and the residence time of subtropical oceanic surface water" for the Rossby Memorial Volume. It had been found that in each of the six oceans there was a subtropical surface lens of water of high salinity. The thickness of the lenses was about 200 m, and the salinity reached some 36.5 per mille in contrast with the prevailing salinity of 34.7 per mille. Hence, the salt lenses represented a water deficit of about 10 m. This water deficit, at a rate of 1 m/yr for the subtropical excess of evaporation over precipitation, would accumulate in 10 yr. This result represented an estimate of the residence time of the water within each subtropical surface lens of high salinity.

26 June, 1958

The vorticity theorem, and its application

in dynamic meteorology

by S. Karelsky

Mr. Karelsky of the Bureau of Meteorology discussed the vorticity theorem for the atmosphere as it applied to the spherical rotating earth under the following headings:

- (a) The general vorticity theorem for a rotating atmosphere in vector form.