LETTERS TO THE EDITORS

OCEANOGRAPHY

Measurements of the Pacific Equatorial Countercurrent

As part of *Doldrums*, the third of three International Geophysical Year oceanographical expeditions of the Scripps Institution of Oceanography, direct current measurements were made in the centre of the equatorial countercurrent, 7° 52′ N., 107° 30′ W. The techniques were similar to those used three months previously, when measurements were made of the Cromwell current at the equator, 140° W.[1]. In the top 300 m. observations were made by suspending a propeller-type current meter (a modified Roberts meter) from a drifting ship and measuring the apparent velocity at different depths from the flow of water past the meter while at the same time observing by radar the drift of the ship from a fixed reference point—a taut wire buoy anchored in 2,200 fathoms. Below 300 m. measurements were made by following the drift of Swallow current floats[2].

Calculations of the geostrophic current as well as other considerations have led to a picture of the countercurrent as a shallow current the maximum velocity of which is to be found somewhat below the surface, but the flow of which is confined almost entirely to the region in and above the sharp tropical thermocline. Direct current measurements made on *Doldrums* modify this picture. The highest velocities in the countercurrent are found above the thermocline, and the peak velocity is found beneath the surface but in the mixed layer. However, the countercurrent does not vanish beneath the thermocline but continues to flow east at speeds of 15–20 cm./sec. Fig. 1 is a plot of the east–west current component as measured on *Doldrums*. The current profile above 200 m. is a composite of 12 Roberts meter stations taken over a two-week period; below 200 m. the curve is drawn to the six Swallow current float measurements summarized in Table 1. The depth of the thermocline as measured by the bathythermograph is also shown.

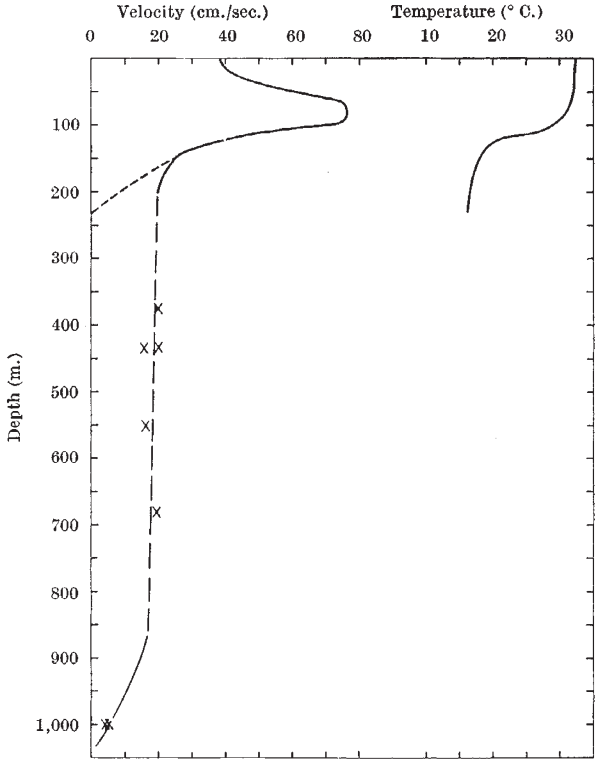

Fig. 1. Current and temperature profile in Pacific equatorial countercurrent, 7° 52′ N., 107° 30′ W. Transport calculation above and below the thermocline were made relative to the dashed line

Table 1

Date	Hours tracked	Depth (m.)	Velocity (cm./sec.) — direction (toward)
August 12	7·2	370	20 — 080°
15	12·5	680	20 — 100°
16	16·0	590	16 — 085°
17	14·2	1,000	5 — 085°
18	7·3	1,000	5 — 135°
26	14·9	430	16 — 115°

The results summarized in Fig. 1 indicate that the countercurrent transports more water below the thermocline than above it. The width of the countercurrent during this period was 250–300 km. Making some allowance for a decrease in the current near its edges a rough estimate of the transport of the countercurrent based on this one profile is 20×10^6 m.³/sec. for the region above the thermocline and 30×10^6 m.³/sec. for that below the thermocline. The estimated transport above the thermocline agrees with that given by Sverdrup[3] for the countercurrent ($20–25 \times 10^6$ m.³/sec.).

The problem of water balance and mass transport in the equatorial Pacific must be re-examined and at least one detailed north–south section of direct current measurement stations is required. The measurements of the Cromwell current in May, 1958, showed[1] an eastward transport of 30×10^6 m.³/sec. The present observations imply that there is an additional transport of 30×10^6 m.³/sec. in the countercurrent below the thermocline. These additions more than triple the total eastward transport in the equatorial Pacific as given by Sverdrup[3].

John A. Knauss
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[1] Knauss, J. A., and King, J. E., *Nature*, **182**, 601 (1958).
[2] Swallow, J. C., *Deep Sea Res.*, **3** 74 (1955).
[3] Sverdrup, H. U., Johnson, M. W., and Fleming, R. H., "The Oceans" (Prentice-Hall, New York, 1942).