

## SOME FEATURES OF THE INDIAN OCEAN SURFACE CURRENT SYSTEMS\*

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HYDROGRAPHIC data of about 500 deep casts obtained by several participating ships during the International Indian Ocean Expedition have been utilised in the valuation of the surface currents in the Indian Ocean during winter and summer seasons. The data have been averaged over 5° squares for the purpose of estimation of the surface currents using geostrophic approximation and 1500 m depth has been chosen as the reference level roughly coinciding with the boundary of the main thermocline. The resulting surface current systems are shown in Figs. 1 and 2.

It is shown that the variations of currents dependent upon the monsoon winds take place only to the north of the equator.

During the NE monsoon season, North Equatorial current seems to exist only in the eastern part of the ocean. In this season almost closed circulation patterns are typical for the Arabian Sea as well as the Bay of Bengal, both of which appear to be dynamically separated from the rest of the Indian Ocean.

On the whole, the ocean surface circulation is represented by a composition of quasilatitudinal stream flows with large scale curls between them. The zones of tropical divergence near the equator and the sub-tropical convergence seem to remain nearly in the same position during both the seasons.

Intrusion of Antarctic Circumpolar Current into the Southern Indian Ocean, particularly during winter, takes place from South-west to North-east almost upto the South Equatorial Current.

### DISCUSSION

K. R. SAHA : The surface currents as drawn, give an impression that surface water is diverging from the equator. Would you kindly comment on this drawing?  
Is there any ocean current off the Somali coast during the NE monsoon season corresponding to the well-known Somali Current of the SW Monsoon season?  
From the Ocean currents as drawn, could you comment on the distribution of ocean surface temperature?

V. G. NEIMAN : Geostrophical approach gives us no answers as to the dynamical regime at the equator.  
During the NE monsoon season, there is a coastal current with a northward velocity component off the Somali coast as can be seen from the chart.  
The distribution of surface temperature will nearly correspond to the dynamical charts. These charts are practically based on temperature as well as salinity data.

\*Key-note address given at the 'Symposium on Indian Ocean and Adjacent Seas—Their Origin, Science and Resources' held by the Marine Biological Association of India at Cochin, from January 12 to 18, 1971.

[2]

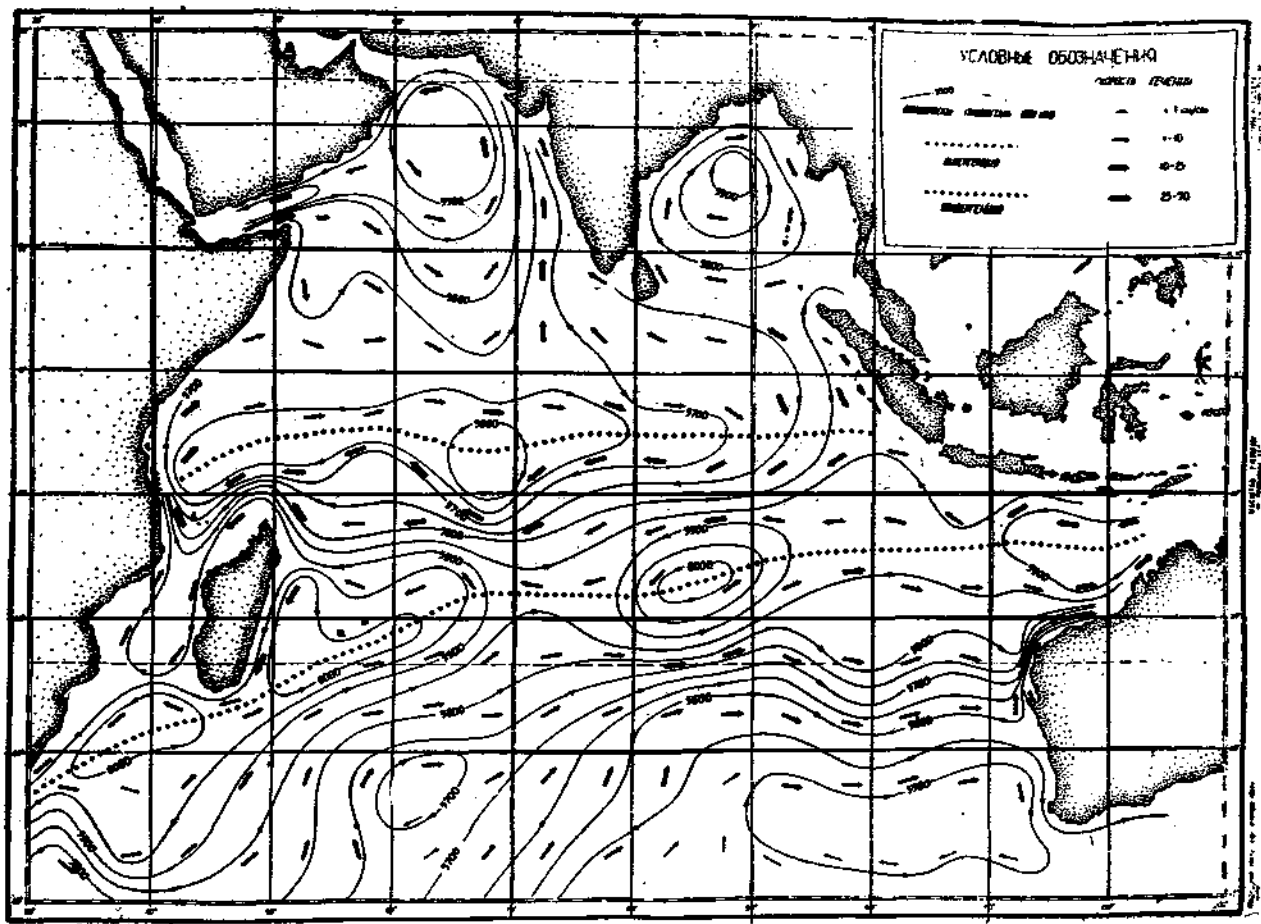


Fig. 1. Winter

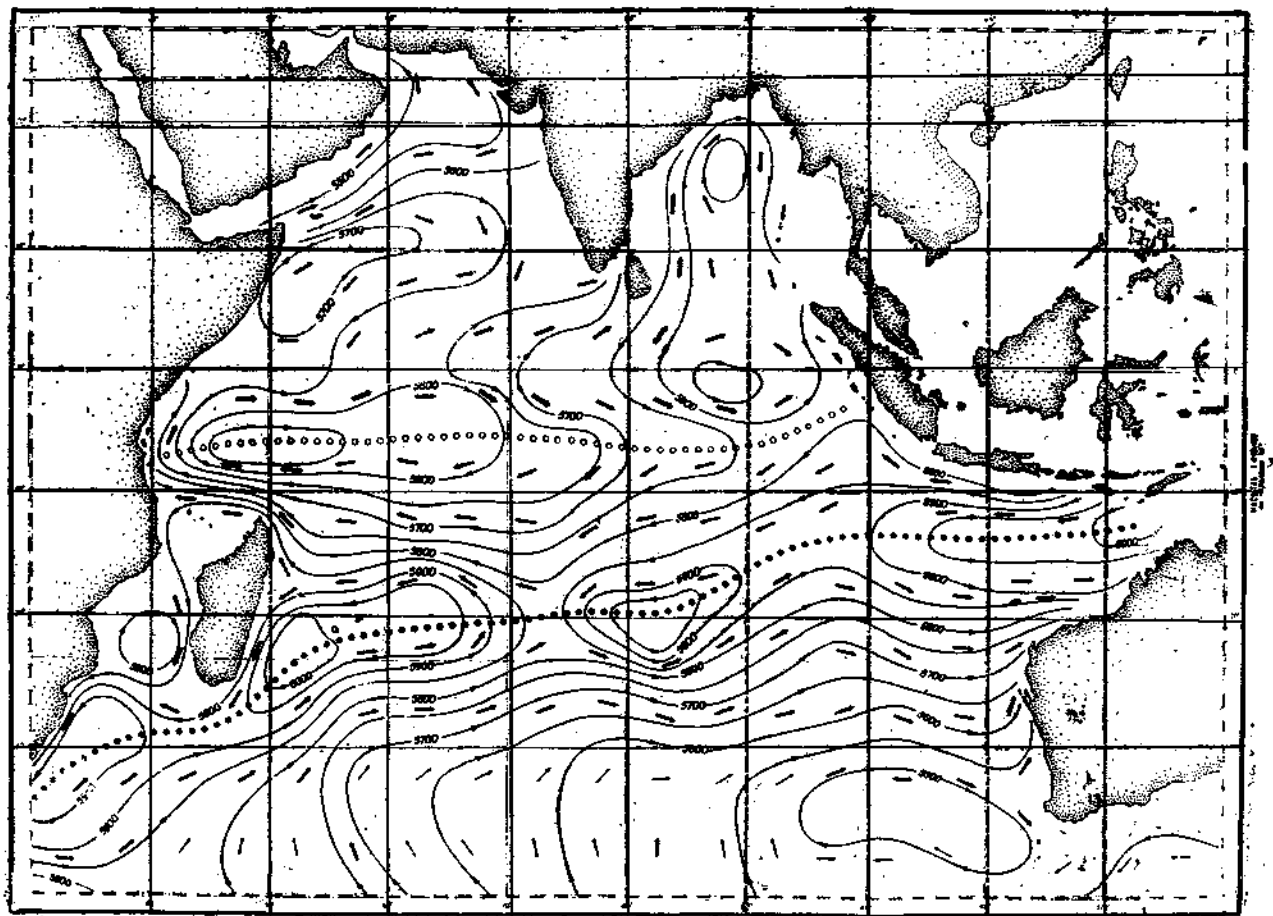


Fig. 2. Summer

- V. V. R. VARADACHARI : What is the method used here in establishing the level of no motion?
- V. G. NEIMAN : Several methods are available for choosing a particular depth as the level of no motion or as the reference level. For the present study covering the whole of the Indian Ocean, the depth 1500 m chosen here approximately agrees with the depth of the main thermocline and the geostrophical approximation seems to give the best results.
- P. S. SRIVASTAVA : The level of no motion has got a slope as it proceeds northwards. Has this been taken into account while calculating the geostrophic currents?
- V. G. NEIMAN : The same reference level of 1500 m is chosen for the entire ocean. A change in the chosen depth for the reference level gives rise to different transport and velocity values. The pattern of general circulation and the gradient of velocity would not change.
- Lt. CDR. V. KRISHNAN, IN : In the winter monsoon, you have shown some interaction of currents north of the equator in the western part of the ocean. Did you, in this part of the ocean, observe any tidal cycles or turbulence which are normally present in the areas of interaction or merging of currents?
- V. G. NEIMAN : The present picture of circulation pattern is based on data averaged over 5° square and over the season. Such process of averaging would smooth out changes of small periods.
- G. S. SHARMA : You have stated that there are three equatorial current systems during winter and two systems in summer and that the two systems are the North Equatorial current and the South Equatorial current. But, I doubt if the easterly moving current system is a current system of the equatorial counter current merged with the South-west Monsoon Current. Is it an equatorial current? because the internationally accepted nomenclature is that the westerly flowing current north of the equator is called the North Equatorial Current. The stream-line divergence shown on the summer monsoon chart along the equator may be only a limitation of your dynamical computation at the equator, as the observations of Dr. Krauss and Dr. Taft show the absence of upwelling along the equator in summer, apart from my own analysis of the data in the equatorial region of the Indian Ocean.
- V. G. NEIMAN : On the chart for the SW monsoon, there is a W to E transport in the northern part of the Ocean. I name it as North Equatorial current. I am afraid to say anything about water movement directly at the equator on the basis of geostrophic approach.
- E. C. LA FOND : The charts presented contain a lot of information and reveal many interesting features. Equatorial upwelling and under current exist near the equator.