Reviews.

A. Defant. "Schichtung und Zirkulation des Atlantischen Ozeans. III. Lieferung. Die Troposphäre." Wiss. Ergebn. Deutsch. Atlant. Exped. a. d. Forsch.- und Vermessungsschiff "Meteor" 1925—1927. Bd. VI, Teil I, S. 289—411, Abb. 49—76, Beilage XXXVI—LIV a. Berlin und Leipzig, 1936.

This paper treats for the most part descriptively the structure of the troposphere layer of the Atlantic oceans. As defined by Defant and his associates this layer includes all oceanic water warmer than 8° C. Wüst has published a similar comprehensive examination of the colder, deeper, stratosphere layer and the two papers (comprising Volume VI, Part I, of the "Meteor" reports) are closely related, both because of the scheme of subdividing the voluminous material and also in their methods of presentation and arrangements. In these two studies the whole water-mass of both halves of the Atlantic are for the first time treated by modern methods as one unit.

Defant first analyses the observations from 717 reliable stations scattered over the whole area between 45° N. and 45° S. For these stations he has constructed depth curves (down to the lower limit of the troposphere) for temperature, salinity, and density (σ_t). He has recorded in a 44-page table the depths and mean values of the several subdivisions of the troposphere and the intensity of the vertical gradients separating them. Thus for each station, among other factors, the following have been determined:

The average value observed and the mean thickness of the relatively homogeneous surface layer;

The depth and intensity of the maximum gradient in the boundary layer;

The lower limit of this stable zone;

The existence of a salinity maximum wherever it occurs in the troposphere layer.

To demonstrate the importance of these factors and their significance in terms of circulation a large number (28 text figures and 21 coloured plates) of instructive diagrams have been constructed showing in horizontal and vertical projection the internal structure of the warmer waters of the whole Atlantic.

It might seem at first glance that seasonal and annual variations near the surface would somewhat detract from such a large-scale combination of observations. However, it must be borne in mind that the troposphere layer under the author's definition is limited on the north and south by the subarctic and subantarctic convergences. Thus a relatively small part of the area under consideration is influenced by a marked seasonal cycle. Moreover, the internal structure of the troposphere layer becomes more complex in the

tropics and subtropics, so that in the regions for which this study is of greatest significance the variations are at a minimum.

Even a superficial examination of the many excellent diagrams discloses at once that frequently in the past the observational material has been quite inadequate to show up the very sharp and complex stratification present in tropical waters at depths of less than 200 metres. Because in general the water-bottles have not often been spaced at sufficiently close intervals, the observations from individual expeditions have given little indication of the complicated pattern that D e f a n t's masterful analysis at once brings out. In particular, the author has charted the areas having a salinity maximum just below the surface layer and from this one standpoint has amassed overwhelming evidence that in both the northern and southern Equatorial Current there is an equatorward transfer of saline water at depths between 80 and 120 metres. Even in the belt occupied by the Equatorial Counter-Current, saline subsurface water is drawn in from each side. The author again points out that the position and internal structure of this important current is closely connected with the fact that the heat equator and the geographical equator do not coincide.

After a rather short discussion of the circulation of the troposphere layer in relation to the vertical changes in oxygen content and the distribution of plankton, which are topics more fully dealt with in other volumes of the "Meteor" reports, the author proceeds to present his data in vertical section. Temperature, salinity, and density are described for each of the "Meteor" profiles, and then for a north-south section in mid-ocean. Finally the same factors are plotted along the axis of the Equatorial Counter-Current, along both the northern and the southern subsurface movements which transfer saline water downward and away from the belts of maximum surface salinity, and also along the axis of the southern Equatorial Current where it is flowing north of the equator.

It is impossible here to touch on even a small percentage of the important new findings encountered in a paper of this scope. It is hoped that we have indicated that D e f a n t has again added to his already long list of fundamental investigations in physical oceanography.

For readers who are not familiar with the present-day major technical problems that beset the investigator who seeks to work out the directions and relative velocities of subsurface oceanic currents, a word of caution may be added. This new paper by D e f a n t, as well as the other "Meteor" reports, assumes at the outset that the boundary between the ocean troposphere and stratosphere, which by definition follows the axis of the oxygen minimum layer, can for this reason be considered as a layer of minimum motion. In other words, D e f a n t and his associates believe that the lower limits of the Equatorial Currents are slanting ones, increasing in depth poleward from about 200 metres in low latitudes to about 600 metres in the horse latitude belts. They have brought forward considerable evidence to support this point of view. Nevertheless, their evidence is largely indirect, and while this is not an appropriate place to discuss this important controversial point, the reviewer believes that a good case can still be made for the older theory that the major oceanic currents continue to roughly parallel the surface movements down to at least 2,000 metres. If the latter standpoint should finally be proven correct and the layer of oxygen minimum is really following the surface drift, though at a much slower rate, it would become necessary to modify the relative velocities and motions which some of D e f a n t's diagrams show for the superficial layers within the latitudes of the trade winds.

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