

THE OCEANIC THERMOCLINE

Authors' Foreword to the Two Following Papers on the Oceanic Thermocline

Each of the two following papers attempts to provide a theoretical framework for explaining the oceanic thermocline, and the associated thermohaline circulation of the ocean. They were developed independently, and then the authors exchanged copies of their papers. As they stand, the two theories are not compatible; but the results of each are similar in certain respects, and apparently resemble the actual ocean insofar as we actually know it. Because of the basic differences in the two theories we have decided not to try to combine them into a single paper, but to publish them together in the same number of this journal, so that they should both appear in the literature simultaneously, and so that the marked contrasts in the basic formulation should be immediately evident to the reader.

Allan Robinson, Henry Stommel, Pierre Welander

The Oceanic Thermocline and the Associated Thermohaline Circulation¹

By ALLAN ROBINSON² and HENRY STOMMEL

Woods Hole Oceanographic Institution, Woods Hole, Massachusetts

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Abstract

A study is made of the thermal structure of an ocean which is dynamically geostrophic, bounded by an eastern coast, and driven by an imposed surface temperature distribution and wind-stress. The heat equation contains vertical diffusion in the form of a virtual eddy mixing parameter and non-linear terms of vertical and north-south advection. Comparison of the results with the North Atlantic shows an agreement with the observed temperature distribution in the thermocline region, including the deepening of isotherms in mid-latitudes. The value of the vertical component of velocity at the bottom of the thermocline is predicted, and a numerical value for the eddy-conductivity obtained.

I. Introduction

Ninety years ago the question of whether the wind-stresses or thermally produced differences of density are the predominant cause of oceanic circulation was a subject of public

debate.³ Since that time, this central issue of physical oceanography has been treated with more caution, and is only indirectly alluded to in present-day textbooks. That the

¹ Contribution No. 1003 from the Woods Hole Oceanographic Institution.

² Present address, Dept. of Physics, Harvard University. Part of the material presented here has been included in a doctoral thesis presented to the Dept. of Physics, Harvard University.

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³ The exchange of letters in NATURE during the 1870's between W. B. Carpenter and James Croll shows how futile simple verbal arguments can be in discussing such issues. The reader with a morbid interest in fallacious verbal theories may find it entertaining to look over the work of the English eccentric William Leighton Jordan, "The Ocean, its tides and currents and their causes", Longman's Green and Co., London, 1873.