Journal of Oceanography and Marine Research

OPEN ACCESS Freely available online

Editorial

Development of Oceanography

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EDITORIAL

Most of our understanding of the ocean comes from observing it and then attempting to apply physical principles to explain what is observed. Occasionally, a concept is developed from first principles and its existence as an important ocean process is verified by observation. Double diffusion is an example (see "Double Diffusion: Salt Fingers"; but most often in the development of oceanography, it has been the reverse. Measurements are made, and understanding follows. As our ability to observe the ocean improves, so does our understanding. It is important, therefore, to have some knowledge of how the ocean is observed. Generally speaking, observing the ocean can be broken into three periods that were dictated by the development of equipment. Prior to about 1930, oceanographers used hydro casts to describe the steady state ocean. These pioneers knew that there was a great deal of variability, there simply weren't enough measurements to describe it this could be called the steady state or under sampled period. Between about 1930 and 1970, as the number of observations increased, the slowly varying ocean was described. During the last 50 years, developments in electronics, computers, and satellite sensors have provided major advances in how we observe the fully variable ocean, but the fundamental measurements of temperature, salinity, and depth are still critical. Until the 1960s, the standard of temperature measurement was the reversing mercury thermometer. The problem was how to read the thermometer at a depth of a few tens of meters, let alone at several thousand meters in the deep ocean. There is no practical way to bring the water to the surface without it changing temperature at least a small fraction of a degree; and, of course, there is no practical way to send an observer into the deep ocean to read the thermometers. Late in the nineteenth century the deep-sea reversing thermometer was perfected. This is a thermometer with a small, specially designed capillary, which allows the mercury to be squeezed through the capillary in one direction but cuts off the flow of mercury once the thermometer is tipped upside down. The reversing thermometer is sent to some depth, allowed to come to equilibrium, and then reversed. It can then be brought back to the surface and the in situ temperature read. Carefully constructed and calibrated reversing thermometers are accurate to ± 0.02 °C. They were generally used in connection with water collecting bottles, which were sent down "open" at both ends so water could be flushed through freely, but then closed as they, and the thermometers, were reversed. While not much used any more, the reversing thermometer and closing sampling bottle provided the foundational subsurface data for studying the deep ocean. The primary disadvantage of reversing thermometers mounted on closing bottles is that one can make only a finite number of observations (generally no more than 25 bottles with their thermometers were hung on a wire at one time). However, the accuracy of the thermometers was such that they were used for a number of years as a calibration control on continuously recording electrical thermistors as they were being developed.

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Received date: December 02, 2021; **Accepted date:** December 10, 2021 ; **Published date:** December 22, 2021

Citation: Regan R (2021) Development of Oceanography. J Oceanogr Mar Res. 9:029.