be taken into account in any quantitative theory of the effects of ultra-violet light.

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THE BORON CONTENT OF SEA WATER

DURING the last few years the concentration of boron in sea water has been the subject of a great deal of interest and not a little speculation on the part of workers concerned with certain phases of oceanographic chemistry. Attention to this element has been directed principally by a number of investigations of the buffer mechanism, *i.e.*, the factors that determine and regulate the hydrogen-ion concentration of sea water. In this mechanism are involved the salts of the various weak acids known to occur in sea water, namely, carbonates, bicarbonates, phosphates, arsenates, silicates and borates. However, according to the information available until very recently, only the salts of carbonic acid, and in a few localities also the silicates, are present in sufficient quantity to require notice in studying the buffer system. Nevertheless, it has been found that the behavior of the buffer mechanism in sea water is not in accord with the theory of carbonate solutions, even when allowance is made for the activity of the ions of the strong electrolytes present. To explain this discrepancy the possibility of the occurrence of buffer salts other than those of carbonic acid in appreciable quantities has been considered but, as previously stated, this possibility has not been supported by the existing analytical data. For the phosphate, arsenate and silicate reliable data have been available for a number of years, but for the borate content only one value has been reported, namely, in 1877 by Dieulafait[1] who estimated that water from the Mediterranean contains approximately 0.0002 g. per liter of boron. This is equivalent to about 0.02 millimoles of boric acid, a quantity of no significance in the buffer mechanism, since it is only 1 per cent. of the molar concentration of the total carbon dioxide.

There was also reason to suspect that the boron content of sea water varied considerably with locality because in 1859 Veatch[2] reported to the California Academy of Sciences that he had detected boron in water from along the coast between San Diego and the Strait of Juan de Fuca, but not in water from beyond fifty or sixty miles off the California coast. He found boron most abundant toward the South and concluded that in certain localities it enters the sea from submarine volcanic sources. The absolute quantities of boron found were not indicated.

The reason that the concentration of boron in sea water has not been adequately investigated long ago is that until recently there has been no satisfactory method for its determination. In 1932 Foote[3] described a titration method suitable for determining small quantities of boron in water but this was soon thereafter modified by Wilcox[4] who used a quinhydrone electrode for detecting the titration endpoint. Foote also determined the boron content of a sample of sea water from Ventura, California, and found it to be 4.27 parts per million.

In this laboratory the electrometric titration method of Wilcox has been used, with minor modifications necessitated by the difference in salt content between sea water and the water for which the method was developed, for analyzing about fifty samples of sea water obtained from various depths from the surface down to 500 meters off La Jolla and to 3,200 meters near the Hawaiian Islands and from the surface in several other localities, including northern California and Tortugas, Florida. In these samples the boron content varied from 4.30 to 4.80 mg. per kilogram, the average being close to 4.50 mg. This variation corresponded very closely with the variation in the salinity of the water, the average ratio between boron and halides being 0.000239, or, stated in other words, boron constitutes about 0.013 per cent. of the total solids in sea water. As boric acid this corresponds to about 0.4 millimoles per liter or, if boric acid is regarded as monobasic, to nearly 20 per cent. of the equivalent concentration of all the weak acid radicals present.

It is therefore probable that boron compounds play an important part in regulating the hydrogen-ion concentration of sea water and that some of the conclusions drawn from previous studies of the buffer system will need to be revised. These matters will be discussed in a subsequent paper.

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PERSISTENT STRANDS OF THE ROOT-ROT FUNGUS IN TEXAS

THE ability of the cotton root-rot fungus, *Phymatotrichum omnivorum* (Shear) Duggar,[1] to remain in the soil in a viable and infectious condition for a period of years, even when the fields are planted to

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[1] L. Dieulafait, *Comptes Rendus*, 85: 605–608, 1877.

[2] J. A. Veatch, *Proc. Calif. Acad. Sci.*, 2: 7, 1859.

[3] F. J. Foote, *Ind. and Eng. Chem., Anal. Ed.*, 4: 39–42, 1932.

[4] L. V. Wilcox, *Ind. and Eng. Chem., Anal. Ed.*, 4: 38, 1932.

[1] B. M. Duggar, "The Texas Root-Rot Fungus and Its Conidial Stage," *Ann. Missouri Bot. Gard.*, 3: 11–23, illus., 1916.