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.

[1] L. Dieulafait, *Comptes Rendus,* 85: 605–608, 1877.
[2] J. A. Veatch, *Proc. Calif. Acad. Sci.,* 2: 7, 1859.

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

[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.

nonsusceptible crops or kept in clean fallow, has been a question of much concern to investigators of this disease.

A partial solution of this problem was afforded when King and Loomis[2] announced the discovery of a sclerotial stage of the fungus in 1929. In the same year Dana[3] described the occurrence and infectious nature of smooth or "horse hair" strands following an 18-month clean fallow. Ratliffe[4] also reported upon a prolonged saprophytic stage of the fungus, which had hitherto been regarded by some as an obligate parasite.

During the years of 1931 and 1932 opportunity was afforded on the U. S. Cotton Breeding Field Station at Greenville, Tex., to further study the habits of the fungus in nature. Extensive searches in the soil for the source of carry-over infection was made in a number of infested plots which had been handled under different cropping and tillage conditions, and therefore permitted at least a minimum estimate as to the age and nature of the carry-over infection.

The colloidal nature of the Wilson and Houston clay soils, in which the examinations were made, presented an unusual opportunity for studying both the fungus and plant root development in their natural state of growth. An examination of a very large number of primary centers in continuous cotton plots in 1931 and 1932 revealed the fact that the carry-over infection was not due entirely to sclerotia and that the most of the infection over-wintered in the soil as strands rather than in the sclerotial stage. Examinations in a plot which was in clean fallow for the first year yielded numerous viable strands throughout the summer and fall of 1932. These strands were located, as a rule, along the old dead roots of the plants that they had destroyed the year before, or previously.

On a plot which had been in oats in 1930 and 1931, and kept in clean fallow after the crops were harvested, viable old strands were found throughout the summer of 1932, in and near primary centers of infection. These strands were found *in situ* upon the decayed remains of the old cotton roots which they had destroyed three years or more before. In some cases they were occupying the empty root channels of former plantings. When these strands were removed from the soil and placed in moist chambers, they readily put out new growth. Old strands found interlacing a colony of sclerotia in a plot which had been in clean fallow for 5 years were also viable. The age of the strands associated with colonies of sclerotia can not be determined accurately as they may have been the product of regenerated growth, from the original colony, subsequent to the fallow treatment.

The growth of the hyphae which usually took place from the ends of the old strands was characterized by radiating or parallel growth of elongated cells which freely anastomose during the early growth stages. As this growth developed, the conjugation of cells became less frequent and the more typical type of acicular hyphae with right-angled branches appeared. Histological studies showed that the older strands possessed an outer corticle ring of thick-walled, irregular shaped cells inside of which were large, elongated, thin-walled, septate cells. In younger strands the elongated cells may be smaller and the corticle layer very rudimentary or even absent.

The knowledge that strands of the root-rot fungus, in addition to the sclerotia, remain in a viable and infectious condition in the soil for several years, is worthy of note. In contrast to the more deeply seated infections of the far southwest, the strands at Greenville, Texas, were found most abundant in the surface foot of soil which render them more accessible to tillage operations or to soil disinfectants.

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[2] C. J. King and H. F. Loomis, "Further Studies of Cotton Root-Rot in Arizona with a Description of a Sclerotium Stage of the Fungus," *Jour. Agr. Research*, 39: 9, p. 641–676, illus., 1929.

[3] B. F. Dana, "Recent Development in Root-Rot Investigations," *Farm and Ranch*, 48 (46): 22–23, 1929.

[4] G. T. Ratliffe, "A Prolonged Saprophytic Stage of the Cotton Root-Rot Fungus," U. S. Dept. Agr. Circ., 67, 8 pp., illus., 1929.

THE MOST NORTHERN OCCURRENCE OF MESQUITE ON THE GREAT PLAINS

IN 1897, while collecting invertebrate fossils from the Comanche Cretaceous in southern Kiowa County, Kansas, I found a small shrub about five feet in height, which at that time was unknown to me. The next year, 1898, Dr. Lester F. Ward, the noted phytopaleontologist whom I was then assisting in collecting dicotyledonous leaf impressions from the Cheyenne sandstone, identified this shrub as mesquite (*Prosopis*). This was, I believe, the first and, so far as I am now aware, the only recorded occurrence of mesquite growing in Kansas.

The location is in the so-called "Black Hills," about four miles southeast of Belvidere, and ten miles west of Sun City. More specifically, it is in the southeast corner of Township 30 South, Range 16 West, at about 37° 20′ north latitude. Dr. Ward's interpretation of this mesquite growing so far from its natural