DISCUSSION

"RED WATER" ALONG THE WEST COAST OF THE UNITED STATES IN 1938[1]

ALTHOUGH "red water" in many seas in widely separated parts of the world is a well-known natural phenomenon commented upon by explorers, oceanographers and travelers over a period of many decades (or even centuries) its occurrence has not been recorded very frequently in most localities. This is particularly true of the Pacific Coast of the United States, where not more than a score of occurrences have been recorded in a period of twenty years or more.

Those familiar with the origins and histories of outbreaks of "red water" know that the actual frequency of occurrences is not accurately represented by this rarity of reports, but in the present state of our knowledge of the sea it is impossible to say how far wrong inferences based on published reports may be. For one thing, it is fairly certain that many outbreaks of "red water" are so sharply limited in time and space that they fail to reach or to attract the attention of interested observers. For another thing, many occurrences of large abundances of organisms deserving to be listed as "red water" lack the strong and striking depth of discoloration which stimulates an observer to make the record.

Even an experienced observer may sail through an expanse of water showing a dingy chocolate or other inconspicuous color and think nothing of it, although the microscopic organisms causing the color may be present in numbers of a half million to a full million per liter of sea water at or near the surface. Yet the difference between that color and one of distinct redness may rest only on the presence of another million or two, a mere doubling or trebling of the less conspicuous density of population.

Within a period of three weeks I have had the unusual experience of seeing three separate and distinct occurrences of "red water" in or near sandy beaches of the East Pacific, facts which seem to be worth recording without delaying for extended discussion.

On May 14, 1938, I made a brief visit to Copalis Beach, located a little to the north of Gray's Harbor, Washington. There I found the water in and near the breakers colored a dingy, reddish brown by the presence in great numbers of the discoid diatom *Aulacodiscus kittoni* Arn. which has made the beach especially interesting to petroleum geologists[2] and to certain marine biologists for a decade or more. On account of a strong breeze and rough sea, I could not tell how far to seaward the discoloration extended, but it was at least far enough to warrant the application of the term "red water" to the appearance of the immediate vicinity.

On May 15, at Seaside, Washington, on the "long beach" a few miles north of the Columbia River, I found a discoloration essentially similar to that at Copalis except that foam developed in the breakers and gave a much lighter shade of color. In this case, also, a strong breeze and rough sea prevented a view to seaward. The organism responsible for the color in that place was a plankton diatom, *Asterionella kariana* Grun, which had been observed in northern collections made for the Scripps Institution of Oceanography but never before in striking abundance.

Some time in the latter part of May the water in La Jolla Bay near the pier of the Scripps Institution began to show patches of discoloration. This condition attracted some comment but little other attention from members of the scientific staff of the institution until June 3, when certain patches became notably prominent. On that date I found in the densest patch an abundance of about 500,000 individuals per liter of *Gonyaulax polyedra* Stein, the dinoflagellate which had been held responsible for wholesale destruction of inshore animal life in the Southern California region in 1901.[3] The color was much like that observed at the two northern beaches, a dingy or muddy chocolate. About twenty species of other phytoplankton organisms were also present.

On June 6 an area distinctly red in color drifted into La Jolla Bay from the northwest at about noon. With the exception of a few thinner streaks, it covered an expanse of several square miles. On June 7 I was told by a pleasure fisherman that the "red water" had interfered with sport fishing near the Coronado Islands (off San Diego). If so, the region affected must have been at least twenty-five or thirty miles long and five to ten miles wide. At the point of strongest discoloration on June 6 near the institution pier, where the red was much like that of nearly fresh blood, the numbers of *Gonyaulax* specimens were about 3,000,000 per liter. This color was so conspicuous that it attracted the attention of nearly every one about the institution, yet its biologic and oceanographic significance may have been no greater than that of the less striking discoloration of June 3 or of a week earlier.

The experiences of an individual observer with these three occurrences is fairly indicative of the oppor-

[1] Contributions from the Scripps Institution of Oceanography. New Series, No. 21.

[2] P. D. Trask, "Origin and Environment of Source Sediments of Petroleum," Gulf Publishing Company, 1932.

[3] H. B. Torrey, *Amer. Nat.*, 36: 187–192, 1902.

tunities for drawing unsoundly extensive conclusions from non-extensive observations or from sporadic records of observations. For example, even though daily observations in La Jolla Bay for nearly twenty years have failed to reveal so many as ten occurrences of "red water," it is not scientifically safe, or permissible, to conclude that the number of occurrences in the Gulf of Catalina in that time have been restricted to that limit or anywhere near it. Even a question so simple as that of frequency of occurrence of a natural phenomenon like "red water" in a geographic region requires an indefinite number of positive records for a reliable answer.

W. E. ALLEN
SCRIPPS INSTITUTION OF OCEANOGRAPHY,
UNIVERSITY OF CALIFORNIA

PARADICHLORBENZENE AS A CONTROL FOR BLUE MOLD DISEASE OF TOBACCO

BLUE mold (downy mildew) *Peronospora tabacina* Adam., has in recent years become a serious problem for tobacco growers in the United States. In 1935, a gas treatment for this disease was reported.[1] Extensive tests with the benzol-gas method in this country have shown that it is highly effective but probably too cumbersome and expensive to be generally practical under our conditions. Evaporating pans are scattered through the bed to be treated and must be filled nightly. These are inconvenient and likely to be overturned. Seeking a material that would be simpler to use, tests were initiated with paradichlorbenzene. Under greenhouse conditions, paradichlorbenzene vapors gave effective blue mold control and 1 ounce by weight of the crystals was equal in effectiveness to 5 fluid ounces of benzol. Plant bed studies were begun this spring, and experiments have now been completed by J. G. Gaines at the Coastal Plain Experiment Station, Tifton, Georgia, and W. M. Lunn at the Pee Dee Experiment Station, Florence, South Carolina. Paradichlorbenzene was used at the rate of 1 ounce to 4 or 5 square yards of bed area. Adequate control of blue mold was obtained, the results being fully equal to those secured in adjoining plots with standard benzol treatments. In these tests the full amount of paradichlorbenzene required for the area to be treated was weighed out and scattered on boards to evaporate. In one experiment a narrow shelf running inside and near the top of the sidewalls of a bed 9 feet wide gave adequate blue mold protection throughout the bed. Treated beds were enclosed nightly with the usual muslin sheeting to hold in the fumes. Obviously, more extensive tests under a wide variety of conditions must be conducted before final conclusions can be drawn. It does appear, however, that paradichlorbenzene as a substitute for liquid benzol may be a distinct advance toward making the gas treatment for blue mold disease simpler to use and hence more practical.

[1] H. R. Angell, A. V. Hill and J. M. Allen, *Jour. Coun. Sci. and Indust. Research, Aust.*, 8: 203–213, 1935.

E. E. CLAYTON
BUREAU OF PLANT INDUSTRY,
U. S. DEPARTMENT OF AGRICULTURE

TRANSMISSIBLE LYSINS IN WATER EXTRACTS OF SEEDS

LYSINS transmissible in series are generally recognized to be wide-spread in nature. They are found in decaying organic matter, such as manure, septic tanks, decaying vegetables, infected plants, degenerating nodules of legumes, sewage disposal beds, runoff water in creeks and rivers, and various other sources. So far as we are aware, however, water extracts of viable seeds have never been reported as a source of such substances.

The presence of a lytic factor for *Aplanobacter stewartii* (E. F. Smith) McCulloch was first detected in an investigation of the nature of the resistance of field corn to the bacterial wilt disease. Water extracts of the grain tested against the bacterial wilt organism revealed that there was a close correlation between the resistance of the variety to the wilt and the presence of a lytic factor in the seed. Resistant varieties of field and sweet corn generally contained the lytic factor; whereas susceptible varieties of sweet, flint and pop corn did not.

The investigation was further extended to include seeds of cereals and grasses. Tests were made of the seed of nineteen different species. Two strains of *Apl. stewartii* were used as test organisms, and very strong transmissible lytic factors were found to be present in water extracts of rye, oats, foxtail, winter wheat, redtop and timothy. Weaker lysins with respect to the test organisms were detected in alfalfa, red and alsike clover, but none in soybeans.

In order to determine the probable identity of the lysins in seeds with a bacteriophage isolated from a fire blight canker, the following points of comparison were considered: (1) transmission in series with increase in titer; (2) formation of plaques; (3) loss of pigment of the test organism in the secondary growth following initial lysis and inhibition; (4) thermoinactivation temperature; (5) effect of dilution; (6) effect of certain organic reagents, such as acetone, ether, chloroform and alcohol; (7) adaptation of the seed lysin to organisms upon which at first the lytic factor had little or no effect.

Basing our conclusions upon these seven points of comparison, we can entertain little doubt but that the lysin of seed extracts is the same as the lytic factor found in fire blight canker. The slight variations noted were considered of little importance. The lysin in