when vaccines consisting of inactive virus are used, they must contain a sufficient amount of immunizing antigen if they are to be successful. Fortunately, viruses can be concentrated and it is possible that the concentration of viruses for use in the preparation of vaccines containing inactive virus will provide a new epoch in the conquest of certain virus diseases. One of these is influenza, a virus disease that was responsible for one of the three most destructive outbreaks of disease within the knowledge of man. During the influenza epidemic of 1918–19, approximately five hundred million people suffered from this disease, and of these approximately fifteen million died. At the height of the epidemic, one out of every fifty people in the world died each month, a death rate that is unsurpassed in history. During World War I no means of protection against influenza existed. Even the cause of the disease was unknown. Since then the virus of influenza has been discovered, and it has been grown in chick embryos.

Events of major significance appear to be taking place in connection with the control of influenza, for an Army Commission reported in a recent number of the *Journal* of the American Medical Association that through the use of a concentrated vaccine prepared from the allantoic fluid of infected chick embryos the attack rate during an influenza epidemic was drastically reduced. It seems likely that progress will continue and that the concentration and purification of viruses by modern methods, such as differential centrifugation, will provide vaccines that will result in the elimination of influenza and certain other virus diseases as major health problems. Thus, this type of biological engineering and vigorous, aggressive research on the viruses themselves should provide the means for the future conquest of virus diseases. The American pharmaceutical manufacturers can contribute greatly to this conquest by sponsoring research work on viruses in their own laboratories and in the laboratories of our universities. There is also a need for an awakening, on the part of the public, to the possibilities of medical research. Mankind's complacent and resigned acceptance of a world-wide catastrophe, such as the 1918 influenza epidemic, has been a source of wonderment to me. Here is a disease that in four months killed a half a million people in the United States alone, yet even the nature of the responsible infectious agent was unknown. Despite the tremendous destruction of human life by influenza, a destruction which in four months was far greater than that which resulted in years of combat activities in World War I, the annual monetary expenditure for searches for the true cause of the disease has probably been far less than the cost of a single bomber. The public should insist that the attack on these invisible agents of disease be pursued with the same vigor with which the attack on our visible enemies is now being made. Research is the foundation of this attack and with increased emphasis on research we will eventually realize the true conquest of virus diseases.

THE MARINE ALGAE OF CALIFORNIA[1]

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INSTEAD of speaking to you about the marine algae of California I would prefer to substitute a field trip where we could actually pull the algae from the rocks and talk them over one by one as we found them. This being impossible, I propose to take you on a hypothetical field trip and discuss some of the marine algae found along the coast of California. Since this is a hypothetical excursion we could ignore distances and cover a thousand miles of the coast in a single field trip. However, to make it more realistic, this discussion will be restricted to what one could see during a single favorable low tide at a suitable locality.

Before deciding upon the particular locality we intend to visit it might be pointed out that the algal flora is much the same throughout the entire 1,200-mile stretch between Puget Sound and Santa Barbara, California. This is in marked contrast with the algal flora along the corresponding portion of the east coast of North America: the stretch from Newfoundland to North Carolina. There one would find marked differences when comparisons were made between collections made in Maine, at Woods Hole and at Beaufort, North Carolina. The uniformity of the algal flora along the western shore of this continent is in large part due to the California current flowing south along the coast. This current has two marked effects upon the temperature of shore waters. Firstly, there is only a slight gradient in water temperatures from northern Washington to central California. Secondly, the annual variation of water temperature from winter minimum to summer maximum is usually less than five degrees Centigrade. It might even be said that the uniformity of the western flora is due to the thermostatic control exerted by the California current.

On the Pacific coast, as elsewhere throughout the world, there are marked differences between the algae

[1] Address of the retiring vice-president of Section G—Botanical Sciences, American Association for the Advancement of Science, Cleveland, Ohio, September, 1944.

found on exposed rocky headlands, on partly sheltered rocks and in quiet land-locked coves. The Monterey Peninsula, some 150 miles south of San Francisco, is selected for our hypothetical excursion because all these habitats are found within a short distance of one another at Monterey. This region epitomizes conditions from Washington to central California and more than 80 per cent. of the algae known from this range have been found in the Monterey area.

Excluding the blue-greens, the number of species known from the twenty-mile coastline of the Monterey Peninsula is slightly more than 400, a number approximately the same as that given by Taylor for the Atlantic coast from Hudson Bay to Virginia. The number of genera is, respectively, 178 and 165. However, other than indicating the comparative richness of the two floras, these statistics are meaningless because there are only 55 genera common to the two and among these genera less than 25 species are found on both coasts.

Monterey has long been known to phycologists because of the many species described from this area. The reason for this becomes evident when one recalls the historical importance of Monterey. It was the civil and the ecclesiastical capital during the years California belonged to Spain and to Mexico. It was the largest settlement and chief port of call between Lower California and San Francisco. Almost all the early exploring expeditions visited Monterey, and the naturalists of these expeditions did more or less collecting here. Algae were of secondary interest to botanists of these expeditions and they only collected a few scraps cast ashore on the beach. Menzies, the first botanist known to have collected algae at Monterey, was here in 1786 and again in 1793. The only alga definitely known to have been collected at Monterey by Menzies is one of the kelps (*Egregia Menziesii*). Collie and Lay, the naturalists of the Beechey Expedition, collected a few algae here in 1827. In November, 1832, the botanists Douglas coming down from the north and Coulter working overland from the south met at Monterey. Finding the season unfavorable for flowering plants the two men made extensive collections of algae. It would be interesting to know whether they were content to pick up what they found cast ashore or whether they scrambled over the slippery rocks as do their present-day successors.

The bare listing of names and dates gives no inkling of the significance of these early records. At this time California was a remote, vaguely known country more than a year's journey from Europe. Yet, the algae of Menzies were the first to be described from any part of North America, and Harvey's short article of 1833 listing the algae of collectors named above is the first enumeration of algae from any part of North America. Thus the botanical world knew about marine algae from a distant almost uninhabited portion of this continent before there was any corresponding record from the readily accessible, inhabited, eastern seaboard. In addition to Harvey the list of those who have described one or more species from the Monterey area is an imposing one and includes C. A. Agardh, Farlow, J. G. Agardh, C. L. Anderson, Saunders, Setchell, Gardner and Kylin.

Our hypothetical trip should be made during a low tide and of these the spring tides of the full moon are by far the best because the variety of available algae is fourfold that exposed during ordinary low tides. Low tides during the full moon may be suitable, but they can hardly be called convenient since they occur at sunrise during the summer months. This means that if we are to take full advantage of the tide we should be ready to begin collecting as soon as it is light enough to see the algae.

Those in the party who have seen algae growing along the Atlantic coast will be impressed by a number of differences. Perhaps the first thing noted will be the profusion with which algae grow upon every available rock. Another feature immediately attracting attention will be the large number of algae wholly different from anything along the eastern coast, and most members of the party will be in doubt as to whether many of the algae belong to the red algae (Rhodophyceae) or to the brown algae (Phaeophyceae). This uncertainty is due to the fact that Rhodophyceae growing in the upper half of the intertidal zone are brown or black instead of red or reddish purple. Still another feature impressing the visitor will be the fact that fully two thirds of the species are of macroscopic size and large enough to be determined in the field by one familiar with the algal flora. Another obvious difference is the larger size of macroscopic algae of the Pacific coast as compared with macroscopic algae of the eastern seaboard. All botanists have heard about the giant kelps of the Pacific Ocean. Comparatively few botanists know that in the case of genera common to the two coasts (as *Porphyra, Gigartina* and *Gymnogongrus*) the Pacific coast species are usually larger than Atlantic coast species.

Marine algae of the Monterey Peninsula fall into the four well-known classes of blue-green, green, brown and red algae. The blue-greens will not be discussed because all of them are of microscopic size and can not be determined in the field. The visitor from the east will feel most at home among the green algae. Here he will find such familiar cosmopolitan genera as *Ulva, Enteromorpha, Cladophora* and *Bryopsis.* In the case of such an easily recognized genus as *Ulva* certain of the species, as *U. taeniata,* are quite different in appearance from those of the east coast.

Others, as *U. lobata,* look like familiar species from the Atlantic, but the shape and dimensions of the cells are different. *Bryopsis corticulans* can be cited to prove the boastful contention of Californians that plants grow bigger and better out west. This west-coast plant grows to double the size of species of *Bryopsis* along the Atlantic coast. The question as to whether it is a better plant is more difficult to answer. The Monterey flora contains two siphonaceous green algae (*Codium* and *Halicystis*) not found north of the Carolinas on the eastern shore of this continent. The presence of these two genera at Monterey is difficult to explain because the two ordinarily are found only in warm seas; yet the ocean temperature at Monterey is distinctly cold, ranging from 12° C in midwinter to 15° C in midsummer.

The botanist familiar with Atlantic coast algae meets an unfamiliar flora when he turns to the brown algae. However, he will find that a well-known generalization still applies, the rockweeds grow high in intertidal zone and the kelps low in it. In the rockweed zone he will find *Fucus,* that alga so familiar to students in elementary courses. Determination of the species found on the Monterey Peninsula presents no difficulty because there is but one, *F. furcatus.* The easterner will look in vain for *Ascophyllum;* in its place he will find *Pelvetia* and find that it grows more abundantly than *Fucus.*

Eleven genera of kelps are present on the Monterey Peninsula, and two of them, *Laminaria* and *Alaria,* are well known to students of Atlantic coast algae. Most of the kelps at Monterey are endemic to the North Pacific Ocean and several will be recognized from their portraits published in botanical texts. The sea palm, *Postelsia,* is one of the kelps that every visitor wants to see. It has been likened to a miniature palm, but the accent should be on the miniature because it rarely attains a height of more than three feet. *Postelsia* is exceptional among the kelps in that it grows high in the intertidal zone. However, it is found only on rocks exposed to the full force of the surf, a habitat so rigorous that there are but few competitors for the available rock surfaces. Certain of the kelps found locally are true giant kelps. One candidate for this honor is *Egregia,* sometimes called the feather boa kelp because of its resemblance to the feather boa worn by ladies during the gay nineties. This kelp grows in the midlittoral, and the stems may be 25 to 30 feet long. The real giants are the long bladder kelp (*Macrocystis*) and the bull kelp (*Nereocystis*) which grow in dense stands on submerged reefs where the water is 30 to 60 feet deep. *Macrocystis* has a repeatedly forked stem with large leaves at regular intervals and each leaf has an elongate air-filled bladder at the base. The upper part of the alga floats horizontally at the water's surface and the total length of a plant may be as much as 125 feet. *Nereocystis* has an unbranched stem, 35 to 75 feet long, that terminates in a spherical airfilled bladder about 6 inches in diameter. Above the bladder are 25 to 40 strap-shaped leaves, each 15 to 20 feet long. To one especially interested in the algae there is a great temptation to name and describe the remaining kelps of the Monterey area. This temptation will be resisted.

In addition to the kelps there are two other brown algae much larger than brown algae along the eastern shores of this country. One is *Cystoseira,* the oak leaf seaweed. This alga, a relative of *Sargassum,* is repeatedly branched and with a row of several, small, bead-like air bladders at each branch tip. Plants 25 feet tall are by no means unusual. The other large brown alga is *Desmarestia.* As found on the Atlantic coast, *Desmarestia* is rarely over five feet tall. The same is true of four of the species at Monterey, but a fifth, *D. munda,* may be 25 feet tall and the leaves up to 10 feet long.

The foregoing emphasis on large size of brown algae in the Monterey area may have left the impression that the flora lacks species of moderate or of microscopic size. This is far from the case, and there are numerous species of *Ectocarpus* and other microscopic genera. The most striking difference as compared with the east coast is the absence of these filamentous genera from the upper two thirds of the intertidal zone. There is also a good representation of small foliaceous browns: some belonging to genera found on the east coast and others to genera found only in the Pacific. Most of the latter are epiphytic and with each species restricted to a particular host.

The red algae, with some 225 species distributed through 111 genera, outnumber all other algae combined. In general, they are larger than red algae growing along the American or European shores of the Atlantic Ocean. The number of species in the upper half of the intertidal zone is approximately 35, but all of them grow in abundance everywhere. As already mentioned, these high-growing Rhodophyceae often baffle the stranger because their color is not red. *Iridophycus* (*Iridaea*) is a good example of a red alga that is not red. Its blades are so green that the tyro frequently mistakes it for *Ulva.* Dried herbarium specimens give no hint of the character upon which the generic name is based—the iridescent many-colored sheen of blades submerged in water. Two species of *Porphyra* are also abundant in the midlittoral, and both of them have brownish to steel-gray blades. At one time the Chinese residents of Monterey gathered and dried large quantities of *Porphyra* for shipment to China. To-day, it is only occasionally that one sees a lone old Chinaman trudging homeward with two sacks of *Porphyra* balanced on a bamboo pole across his shoulders. *Gigartina* is an upper littoral rhodophycean genus that is even more abundant than *Porphyra* or *Iridophycus*. Whenever one finds an unfamiliar brownish or blackish macroscopic alga above the mid-tide level the best thing to do is to assume that it is a species of *Gigartina*. Several species of this genus grow above the mid-tide level and they differ so markedly that the novice is amazed to find they all belong to a single genus.

Many Rhodophyceae grow only in the lowermost portion of the intertidal zone and are only available when the tide falls below mean low tide level. Here the number of species is quadruple that found elsewhere in the intertidal zone. Almost all of them are reddish to purplish red in color. Some of the species are abundant wherever the habitat is suitable; others are found only in small numbers. Many of the latter, as is evidenced by their abundance in drift cast ashore on beaches, are undoubtedly stray individuals from the sublittoral.

The first thing attracting the attention of one seeing the low water zone for the first time is its brilliant pink color, a color produced by the coralline algae covering all rocky surfaces below mean low tide level. Crustose corallines predominate in this zone, but erect jointed corallines are present in sufficient abundance to contribute to the mass effect. The two most abundant crustose genera are *Lithothamnion* and *Lithophyllum,* but, as on the Atlantic coast, fruiting specimens must be available and they must be decalcified and sectioned before the two genera can be distinguished from each other. To the eastern botanist, mention of erect jointed corallines is synonymous with mention of *Corallina officinalis.* At Monterey there are three genera of jointed corallines in addition to *Corallina.* These four genera of jointed corallines are readily distinguishable from one another by the shape of the joints and position of conceptacles upon them.

Most of the non-calcareous red algae in the lower littoral are foliaceous and of sufficient size to be determined in the field. Curiously enough the largest of the lower littoral reds are those growing on rocks subject to the strongest wave action. These algae, as in certain species of *Gigartina,* may have large undivided blades two or more feet tall. Contrary to what one would expect, the red algae growing on the sides of somewhat sheltered rocks usually have much-divided blades. Here one finds a much richer representation of Delesseriaceae than on the Atlantic coast, and several of the species grow in dense stands completely covering the underlying rock. On other rocks one finds dense stands of *Rhodymenia.* The names of the two commonest species, *californica* and *pacifica,* immediately show that they are distinct from species in the Atlantic Ocean.

Several of the species in the lower littoral superficially resemble species found in the Atlantic. This has led to considerable confusion in the past and has resulted in many errors in identification of algae from the Monterey and other Pacific coast areas. To cite one example, the so-called *Callymenia reniformis* reported from the Monterey Peninsula is now known to be a species of *Pugetia,* a Pacific coast genus very distantly related to *Callymenia.*

The botanist accustomed to the abundance of delicate filamentous red algae along the Atlantic coast will be impressed by the relative scarcity of them on the Monterey Peninsula. One must make a special search for the filamentous red algae, and the number of specimens one accumulates during a day's collecting is disappointing. If the easterner is looking for unfamiliar genera he will also be disappointed because he will find such well-known genera as *Antithamnion, Callithamnion, Spermothamnion* and *Polysiphonia.*

Parasitic red algae are present in abundance at Monterey but are apt to be overlooked unless the collector makes a special search for them and knows where to search. There are ten genera in the local flora, all of them minute and gall-like. Some are colorless, others are pinkish and of a much lighter color than the host. The completely colorless species show that a distinction between algae and fungi can not be made solely on the basis of presence or absence of photosynthetic pigments. The host is always a member of the Rhodophyceae and in most cases the parasite is restricted to a particular species. Reproductive structures of the parasite show that host and parasite are closely related genera. It has been argued that the parasites are merely fertile gall-like outgrowths of the host, but such an interpretation is untenable because of the repeated demonstration that cystocarpic thalli of parasites may grow on tetrasporic thalli of hosts or *vice versa.*

Our time on this hypothetical field trip has been devoted to a description and a naming of the algae we have found. The finding of many algae and a naming of them is but a beginning and leaves many questions unsettled. One group of unanswered questions centers around the algae whose reproduction and life cycle are incompletely known. We can make guesses concerning the relationships of these algae to other algae (that is, their position in a system of classification), but we can not answer the questions with assurance until we know more about development of their reproductive structures.

The questions become even more numerous when we turn to the local distribution of marine algae on the Monterey Peninsula. Why do certain algae grow high in the intertidal zone? Why are certain algae restricted to the midlittoral? Why are so many of them found only at low water level? Such questions may be called ecological questions, but it is obvious that they are fundamentally physiological. The questions become more perplexing when we seek an explanation for the discontinuous horizontal distribution of algae restricted to specific tidal levels. Two striking examples of this problem may be cited. *Gymnogongrus linearis,* which only grows between the 0.5 foot and mean low tide levels, is a perennial restricted to rocks within 100 feet of the ends of long sandy beaches. *Nemalion lubricum* is an annual which appears late in May and disappears early in October. Every year for the past 20 years it has reappeared on the same rocks but not on adjacent rocks where conditions seem to be identical. Why do not these algae spread laterally to what seem to be equally favorable habitats? The questions are obvious, the answers are not. All that can be done is to invite you to take another trip 25 years from now and hope some of these questions will have been answered by that time.

OBITUARY

WILLIAM TRELEASE
1857–1945

WILLIAM TRELEASE, professor emeritus of botany of the University of Illinois, died after a brief illness in his eighty-eighth year on January 1, 1945. He had remained active during the summer and early autumn, to the extent permitted by rapidly failing eyesight, and though hospitalized for several days in October, he had rallied and returned to his home. Until the middle of October he was engaged in the taxonomy of recent collections of Central and South American peppers. It is interesting to note that his active botanical career spanned a period of more than sixty-five years; his first botanical publication appeared in the *Torrey Bulletin* in September, 1879.

Trelease's interests were broad, including all plants from bacteria to angiosperms. His earliest studies included insects in relation to cross pollination in plants. His doctor's thesis at Harvard was in cryptogamic botany, at that time a new division of botany, under the direction of Professor Farlow, but he had already published a score of botanical contributions. Earlier he had received, from Asa Gray, instruction from which stemmed his interest in the taxonomy of seed plants.

William Trelease was born in Mount Vernon, N. Y., on February 22, 1857, a son of Samuel Ritter and Mary Elizabeth (Gandall) Trelease. After attending high school at Branford, Conn., and the Brooklyn (evening) high school, he entered Cornell University, graduating with the B.S. degree in 1880. He had come under the instruction of Professor J. H. Comstock and was appointed by the U. S. Department of Agriculture as a special agent on cotton insects. In his leisure time connected with this duty he made many observations on pollination by humming birds and insects, and on nectar secretion, which may partly account for his early activities in this field of biology. In 1881–1883 he was instructor in botany at the University of Wisconsin; in 1883–1885 he was professor of botany there. In the summers of 1883–1884 he was in charge of botany at the summer school of Harvard, and in 1884 was lecturer at the Johns Hopkins University. He received his D.Sc. degree from Harvard University in 1884.

At the University of Wisconsin, Trelease gave much of his attention to bacteria and fungi. He conducted the first comprehensive survey of the parasitic fungi of Wisconsin and taught the first course in bacteriology given in the university. He was at this time one of the leading mycologists in this section of the United States.

It was largely through the influence of Asa Gray that he was appointed to the Englemann professorship in Washington University, St. Louis, where he opened the Shaw School of Botany in 1885. He served as director of the Missouri Botanical Garden from 1889 to 1912. Under his leadership this institution prospered and became famous as a botanical center, to which many American botanists owe their training in research.

In 1913, Professor Trelease came to the University of Illinois, where he served as professor and head of the department of botany, retiring from active teaching in 1926 as professor emeritus. Trelease enjoyed the following long period of freedom, alternating intervals of travel to various parts of the United States and Mexico, to Europe and New Zealand, with much longer periods at his home. Most of the time he remained in Urbana, almost daily at his desk, engaged in taxonomic work on the groups of plants in which he was the most distinguished authority.

The plants which Trelease named and described number more than 2,500 species and varieties—they may exceed 2,700—and include plants from bacteria to angiosperms. Treleasia and Neotreleasea, the latter a Mexican genus of Commelinaceae, as well as the specific names of many other plants have been dedicated to him by botanists in various parts of the world. He is also commemorated in Mount Trelease, a 12,500-foot summit in Colorado, about fifty air-line miles west of Denver in the Clear Creek country near Loveland Pass, where he had botanized in 1886. In this area mountains named for other famous American