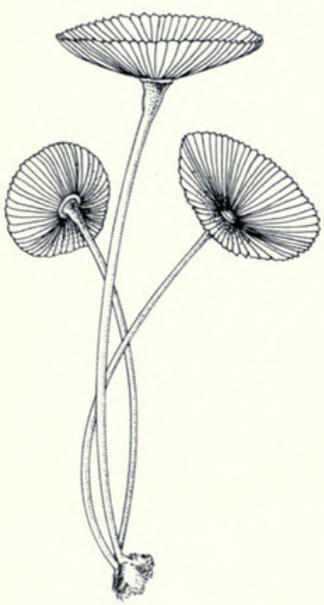
Algae Are Man's Best Friends

Dr. Matthew H. Nitecki



Acetabularia crenulata. One of the most beautiful algae, often referred to as mermaid's wineglass or mermaid's parasol. The disc at the top of the plant indeed looks like a shallow cup or inverted parasol. Because it grows easily in captivity, it is a much-studied alga. The recent studies are particularly concerned with the role and function and interrelation of cell nucleus and the protoplasm.

Illustrations by Richard Roesener

If an extraterrestrial giant could come to the earth and stand over the greater Chicago area, he would notice many unusual things. When the sun first falls upon the earth the biomass begins flowing towards the center of the megalopolis, and when the sun goes down the same biomass leaves the city to disperse itself into the periphery. The giant would postulate his first law—that *the solar energy controls the movements of the biomass.* If he could pick up a car in his colossal fingers the occupant would either jump out, try to hide, scream, panic, freeze, or simply die of fright. If, nevertheless, the giant would succeed in holding up the driver, he no doubt would squeeze all life out of the poor man and he would postulate his second law—that *life is a fragile thing and very difficult to study.* He may further add that life manifests unpredictable behavior and movements. The giant, while examining and testing the physical environment, would formulate his third law—that *the biomass releases great wastes into the atmosphere and into the water* in the complicated process of manufacture of seemingly strange objects, and in production of heat and locomotion.

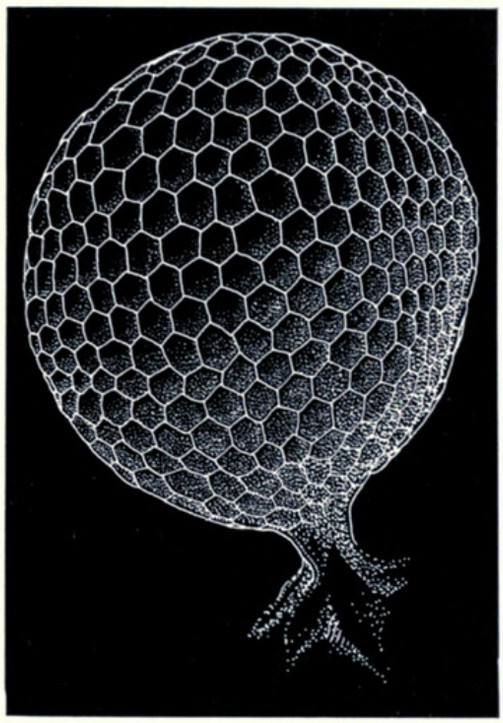
If our giant strides away in his seven-league boots to follow the sun west, he may step over some forest and wonder over its tranquillity and the purity of the air above it. He will notice that oxygen is produced by plants during the day and little waste is manufactured. He may pick up the tree from its bed and meditate over it under the scrutiny of his instruments. He will neither be shot at, nor screamed at, and he will, therefore, modify his second law by adding that plants are more stable and less neurotic than animals. When examining the air around him, and measuring the production of sugar and carbohydrates, he will postulate a fourth law—that *plants provide all the food and all the oxygen,* and that animals simply eat and burn it. He may consider animals

degenerate organisms unable to produce their own foodstuffs and dependent upon plants to do it for them. He may even think of man as a capricious parasite of the earth. He will see plants as benefactors that alter the simple inert matter into the complexity and dynamism of life. Our other-world giant may go further to the great ocean where he will find out that most of this activity of food and oxygen production and cleaning the air of carbon dioxide is conducted in the sea by "simple" organisms called algae. And so he will put forward his fifth law —that *algae, indeed, produce most that is needed for life on the earth.*

Our giant will marvel at the efficiency of algae and will discover that the well-known photosynthetic equation

$$CO_2 + H_2O \xrightarrow[\text{green plants}]{\text{light}} CH_2O + O_2\uparrow$$

means that one molecule of carbon dioxide combines with one molecule of water in the presence of light within the pigment of green plants to produce carbohydrates and oxygen. In a more sophisticated way he can say that in the process of photosynthesis the atoms of hydrogen from water are used to transfer carbon dioxide into carbohydrates and at the same time the free oxygen from the dissociated water is released. Our Gargantuan, just like Professor Eugene I. Rabinowitch of the University of Illinois, will calculate that each year plants of the earth combine about 150 billion tons of carbon with 25 billion tons of hydrogen, and set free 400 billion tons of oxygen! Throughout the last three billion years, plants have been continuously dying and organic matter has been continuously decomposing. The only process known that steadily reverses the results of decomposition and provides for the continuity of life on earth is photosynthesis. In the process of photosynthesis, plants harness solar energy and produce organic matter which, after being used by animals, is dissipated and is mostly lost as heat into the interplanetary space. Our colossus will be astonished to realize that when photosynthesis ceases, life stops and the atmosphere will lose all its free oxygen.



Cyclocrinites dactioloides. This marine calcareous green alga of Silurian age was for a long time considered a problematic sponge. Its fossil remains are commonly found among 450-million-year-old coral reefs in Illinois and Iowa.

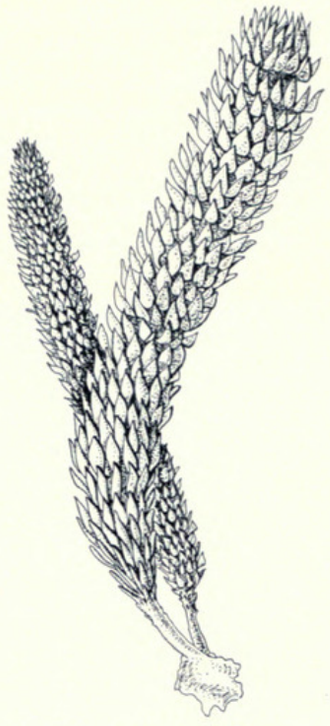
In the past there has been a vigorous discussion in scientific literature of what constitutes the plant kingdom and of what constitutes the animal kingdom. The differences between these two groups disappear when "lower" forms of life are examined. While our Titan can tell the difference between a dog and a rosebush, the placement of certain microscopic flagellate organisms within a kingdom will be more difficult for him. In order to resolve this problem of placing plant-animal-like creatures in classificatory schemes that would indicate their relationship he would expand the two kingdoms into three. In time, this system too would become inadequate, and soon four and even five kingdoms would have to be recognized. The five kingdoms concept of organisms has been suggested by Professor R. H. Whittaker of Cornell University to consist of Monera (for example, blue-green algae and bacteria), Protista, (unicellular forms such as euglenoids, golden algae and protozoans), Plantae ("conventional" plants such as red and green algae and vascular plants), Fungi (absorptive organisms such as fungi and slime molds), and Animalia (the animals).

The system of five kingdoms of living things appears to be gaining some acceptance and seems to serve best our present knowledge of the living world. Within our five kingdom classification algae are assigned to three of these kingdoms: Monera, Protista and Plantae. The word *alga* is subject to change as our understanding of the interrelationship between various groups of algae changes. It is now believed that the algae represent a great variety of organisms of diversified evolutionary

origin and not of a single common lineage. Algologists use the word *alga* to indicate several groups of organisms having similar reproductive mechanisms.

The problem or problems of classification of algae are very technical, particularly since algae constitute a loosely-knit group. The main characters used in their classification are biochemical: algae are separated on the basis of their pigments, the nature of their cell wall, the products of their photosynthesis, and the nature of their flagella.

Algae lack true leaves, stems, or roots, and for this reason have been considered "primitive." This concept is, however, now losing support. Algae represent a great diversity of forms. Some are microscopic; others, as Pacific kelp, may reach a length of 150 feet. Reports of kelp 600 feet long from Brazil need confirmation. Certain algae are single cells that may be filamentous or branching. There are those that are membranous, or some may even be tubular. Although some species are terrestrial, most are aquatic and are found in all waters, seas, lakes, streams and ponds. They can float as plankton or they can exist attached to substrate or to other plants or animals. Some algae inhabit the soil, others live on bark of trees or even on rocks, and recently algae have been collected from the atmospheric currents. There are even those that thrive on snow or within other organisms, or as lichens, the composite organisms consisting of fungi living together with algae. Even two species of sloths in Central America may be distinguished by the different species of algae that grow on their hair.



Halicoryne wrightii, "sea-club alga." A marine green alga from Dutch East Indies and from the Philippines. The genus is known throughout the warm, tropical seas and four species are found in the Caribbean. The body of the plant is covered with a thin layer of carbonates.

Algae that precipitate calcium and carbonate ions from the sea water build hard, limy coverings. These algae are extremely important as rock-building organisms and are responsible for the formations of many limestones throughout geologic history, especially reef deposits. In addition to forming their own masses they also act as the cement that binds together the skeletons of invertebrate animals. It is no surprise, therefore, that these plants have left an extensive fossil record and are extensively studied by paleontologists.

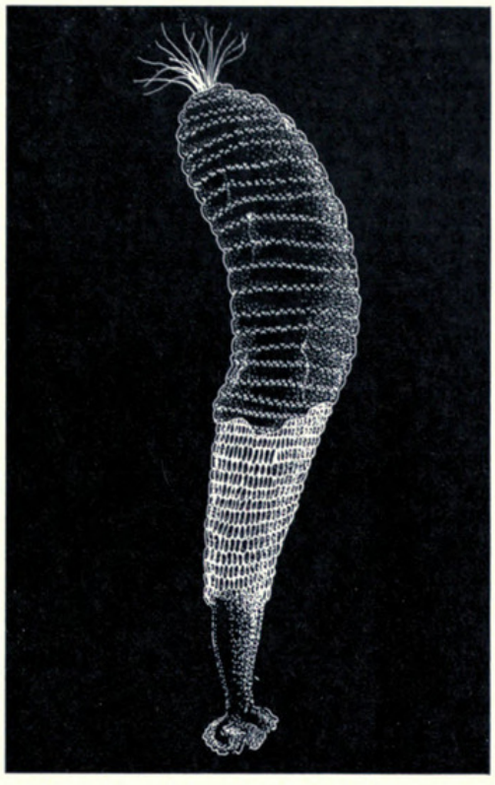
Algae as a group provide the earliest evidence of life on earth, and are the most ancient group of living things known. The oldest algae-like fossils are about three billion years old! Since they represent the first documented life on earth they are from the evolutionary viewpoint extremely important.

If only our giant could search the outcrops of rocks and find the places where remnants of past life are preserved, then he would rejoice in the discovery of the past history of our planet and the life which existed on it. But, by a singular paradox, the processes which gave us the lands also turned the sediments into rocks, changed their composition and made them into marbles and schist, hiding the records from the seeker, and altering the organic remains into their byproducts. Thus, all but scanty evidence was destroyed.

And yet, when we look, when we carefully comb the rocks, we find shapes that are varied, some recognizable, some with strange forms that do not exist any more. Some of these finds are fossils of a common nature, abundant, obtainable by the "bushel," others are rare. Some are so delicate that they require special treatment; some are so preserved that they need the strength of machines and endless hours to prepare for

study. Among many fossils some become more important—because they explain more, they possess some characteristics absent in other specimens—and hence instantly become more interesting and meaningful. The fossil, in brief, reflects the image of life as it once was.

Algae in the 19th century, and among many persons even today, have been considered less vital than most other plants and animals, and are usually deprecated as seaweed, pond scum, and kelp. But algae as a group are important, as we have seen, not only because they represent the first documented life on earth but also because they produce most of the food and oxygen necessary for life on earth. In addition, algae are becoming economically important and great quantities of them are used for human consumption particularly in Japan. They may possibly become a future source of food for the ever-growing and hungry human population. They are already used as a source of potassium and iodine, and for treatment of sewage in certain localities.



Neomeris van-bosseae. When examined in the Museum dry collection, this alga does not look like a plant at all because its attractive white outer calcareous cortex resembles an animal's exterior skeleton. Under this hard covering are whorls of white branches that expand at their ends.

On his long way home, our extraterrestrial visitor will hold in his possession a few vials of small, barely green, calcareous, tubular, whorled algae from the tropical seas of the earth. And he'll wonder over these strange benefactors of apparent simplicity and beauty that together with untold numbers of other algae since time immemorial have endlessly and continuously provided the source of food and oxygen to the inhabitants of the earth.

He will learn now that nature manifests beauty of the highest degree in a multitude of forms—beauty of structure and shape. And he'll pause over this for awhile. Life is a short business when dealing with an individual organism. It is somewhat longer when dealing with taxonomic units like species and genera. Man has existed for time long enough to have a geologic past—but yet, life is still a very fragile thing. Life is difficult to study, because the process of study itself may modify or kill the organism. But life on the geological scale is different; the organisms are gone, but hard skeletal parts remain. Sometimes unaltered, but in most cases replaced, recrystalized—but yet often retaining most of the original details, even the color pattern may be preserved. How many of us have stopped to think that we are dealing with life when studying fossils? Here the wonder is that we have in front of us the record of life, represented by fragments, from which we choose to reconstruct the whole of the evolutionary path of organic history. The past is nebulous and we are penetrating it. What else can give greater joy than to unveil the unkown?

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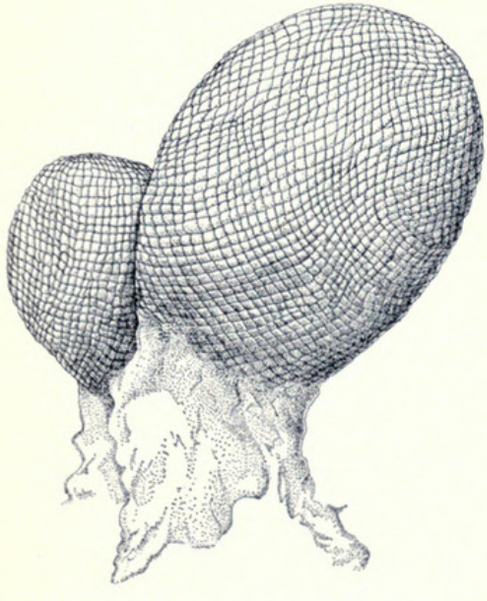

Calathella anstedi. A half-billion-year-old (Lower Ordovician) green calcareous alga from Newfoundland. This fossil is one of the oldest "higher" forms of algae found. Its outer structure is very complicated and advanced, and the alga can be easily placed in a class of well-known living green algae.