

Essay

on

The Botanical and Geographical  
Distribution of Algae. 1883.

(accompanied by a collection of  
"seaweeds"  
from the Firth of Forth.)



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1.  
The class Algae, constitutes one of the divisions of the lower cryptogams, or Thallophyta. In all the structure is essentially cellular, and a distinct gradation can be traced, from the higher forms in which there is a branched thallus with leaf-like appendages & root-like organs, down to free unicellular organisms. In many respects Algae are closely allied to Fungi, but in the latter class, there is a total absence of chlorophyll. The algal cell frequently contains starch, & chlorophyll is constantly present though often obscured by other pigments. Many of the lower forms are enveloped in a gelatinous substance, produced by a degenerative process in the cell wall, which fixes the plant in its position; while others again owing to the deposit of silica or calcium carbonate in the cell wall, are thus provided with a valuable protective covering.

The more highly constituted Algae often attain colossal dimensions, and form huge submarine forests while many

of the lower forms, on the other hand require for their proper examination, high powers of the microscope.

Reproduction is effected, by both sexual & asexual means. The sexual method consists essentially in the formation of zoospores, and is most concerned in the distribution of the species, inasmuch as some possess the power of remaining dormant for long periods, and even bear desiccation, after which on exposure to favourable circumstances, they germinate and form new plants. Many of the more minute Algae living in water, in common with the zoospores of the higher forms, possess the power of spontaneous movement, which is effected in many cases by means of very delicate cilia. These along with some Infusoria, constitute the disputed borderland between the animal & vegetable Kingdoms; and a separation can only be made by a proper appreciation of the physiological characters of each species.

As in Algae a very great diversity in form and size is observable, in colour also there are many modifications met with throughout the various genera; but it is generally found that the colour is typical of each subdivision, and that it is greatly modified by the habitat of the various species. Among the members of the class, three principal shades of colour are met with. Thus green in its various shades is typical of fresh water algae, and most of the shallow water marine forms, where there is greatest exposure to sunlight; and nearly all the more minute forms are characterized by this colour. Red is also characteristic of many algae, & these are almost exclusively marine, and confined to deep water, or to the shaded sides of rock pools, where there is greatest protection from the sun's rays. The olive-brown algae are chiefly marine, and flourish best between tide marks; and to these chiefly the characteristic appearance of

our rock bound coasts is due. Some possessing this last colour, however are found in deep water, and they then become much darker, - in some cases nearly black. - Most Algae are referable to one of these three colours, but there are numerous intermediate shades notably in the large suborder of the Diatomeae, in which the colour is a greenish brown. There are also many exceptions in regard to the habitat of species, of any certain colour. Thus many green algae, as the familiar Desmarestiae, Sporochne, etc. of our own shores, are usually found beyond the tidal limit; while a few red, as Catenella opuntia, are found near high water mark.

The growth of Algae is remarkably rapid, and cases are recorded in this country, of marine species as Alariae, Laminariae, etc. having attained their full size in the course of a few months. A still more wonderful instance

is seen in the case of *Nereocystis lutea*, a native of the northern part of the Pacific Ocean, which is said to reach its enormous length of three hundred fathoms, in the course of a single summer; as it is an annual, and never seen in spring. This rapid cell growth often leads to the production of vast numbers of the less highly organized forms, in the course of a single night; thus giving rise to the appearances known as "red snow", and "rain of blood."

Algae require for their proper growth and development, the conditions of moisture, and light. By far the greater number inhabit water, or moist places; and are exposed to the influence of light.

The circumstance of their living in a fluid medium, greatly modifies their distribution, and the distributing agencies are therefore totally unlike those obtained in the case of land plants. The latter are continually impeded in their progress, by intervening seas, rivers, or mountains;

marine plants rarely by land barriers, and the vast extent of ocean, greatly facilitates a general dispersion. Thus some species of algae possess a more general distribution, than any other members of the vegetable kingdom. Some are almost cosmopolitan in range; and as examples we may cite *Ulva latissima* and *Enteromorpha compressa*, which extend from the icy shores of the Arctic Ocean, throughout the tropics, and southwards as far as Cape Horn.

The nature of the soil, and climate, seem to be the principal causes which govern the distribution of land plants, over the surface of the earth. It is generally believed however that the first of these, has but little influence in the distribution of marine forms; as the root-like processes with which many are provided, appear to act merely as a means of attachment or support. This is corroborated by the fact that many algae are found growing on iron-work.

stones, shells, etc. from which they could not possibly derive any nourishment through the roots. On the other hand there is no doubt that many forms are influenced by the soil on which they grow; for different kinds of rock, afford different species in greater perfection than others. The selection of habitat would thus seem to prove that the root is not altogether so sluggish an organ, as has been supposed. It does not however present much modification, and the increase in size is not proportional to that of the individual, thus differing from most land plants. A curious state of matters exists in the fucoids found in the vast Sargasso sea. These plants though never fixed, and always living in a floating state, on the surface of the Atlantic, are yet provided with root-like processes which must act in some beneficial way to their bearers.

It is also well known that many algae live a semiparasitical life, attaching

themselves to others; and some have even  
as in the case of Laminariae, been known  
to fix themselves to plants belonging  
to their own species. Some seem to  
flourish equally well either on rocks,  
or on other algae, while others are found  
only to adopt the one situation. In these  
cases of parasitism, the choice of a  
host plant is not indiscriminate, and  
certain species alone are selected; and  
of these there are usually a few on  
which the plant is more commonly found  
than on others, and on which it also  
seems to thrive best. Mr. G. W. Traill  
who has paid much attention to this  
point, has shown that the parasite  
apparently by a process of natural  
selection, invariably chooses as its host  
plant, one which has a sufficiently  
long period of duration, to allow of the  
development of its fruit and escape of  
its spores; and also that the life period  
of the parasite, is in the great majority  
of cases, considerably shorter than that

of the host plant. Many examples of this localized habitat of species, could be cited. On our own coasts for example, *Polysiphonia fastigiata* nearly always selects as its host plant, *Fucus nodosus*, though other *Fuci* are equally abundant around; and *Phylota plumosa* is almost invariably found on *Laminaria digitata*. From the abundant fructification in these higher forms, it is evident that a far greater number of fertile spores is produced, than can be accounted for by increase of individuals, or is necessary to maintain the existence of the species. These are readily transported through the water, and deposited in various situations, some finally reaching the ultimate host plant on which they are to develop. We must suppose that in the latter they find a fit soil or at least one which is conducive to their development; while the others not meeting with favourable conditions, have their development arrested.

There is also no doubt that the

general surroundings of many algae have an influence on their distribution. For instance many marine species reach their greatest perfection, half buried in the soft estuary mud at the mouth of rivers. In these cases the mud or sand must have some direct action on the plant, in addition to its action in a certain degree, as a protective agent.

The growth of marine algae is also greatly dependent on the quality of the water in the locality, especially as regards the amount of sodium chloride present. Thus many species are found only in brackish water; others again can only exist where the water is pure and no fresh water stream in the vicinity.

Many species attain the greatest luxuriance where a fresh water stream enters the sea. Landlocked seas as the Baltic into which many great river systems flow, and consequently the water of which is rendered almost brackish, are characterized by a peculiar marine

flora distinct from that of the open sea near, of which the inlet is a part.

The second great cause governing the distribution of land plants viz. Climate, also very materially affects the distribution of Algae. The term "Climate" as applied to the latter must chiefly resolve itself into the temperature of the medium in which they exist. This may be very well exemplified by the distribution of many British seaweeds. Thus many species also common to the Mediterranean find their northern limit on the south coast, such as *Padina pavonia* and others. Other species again inhabiting the south of England, and the Channel Islands, extend their range all along the west coast, as far as the Orkney Islands. This is doubtless due to the fact that these coasts, are more or less exposed to the genial influence of the Gulf Stream. The same plants are either unknown on the east coast, or if present do not reach anything like the same

state of luxuriance in growth. Many of the south coast plants, owe their presence there, to the southern latitude but in the case of those which find their way as far north as the Orkneys, - keeping in view the difference in latitude we must assume that this last habit is due chiefly, to the influence of the sea and its temperature. On the other hand some species attain their greatest development in the Northern parts of Britain and become both smaller and scarcer as we proceed southwards, such as, - *Odonthalia dentata*, *Ptilota plumosa*, and *Alaria esculenta*, which are seldom found on the south coast, and then only fruiting imperfectly.

There are however many curious anomalies in the distribution of marine algae, not easily explained; as in the case of those species which are confined to certain localities, and even there perhaps limited to a few rock pools, though many similar situations

seemingly quite as favourable to their growth, exist around. It may even be noticed in the case of some common species, that growth is more luxuriant in special pools in a certain locality, apart from other influences such as shelter, exposure to light, + depth of water. In the Firth of Forth, a locality by no means noted for the luxuriant growth of its algae, two species at least viz. - *Bryopsis plumosa*, and *Chaetopterus plumosa*, reach a state of perfection, unexcelled by their brethren of the sunnier south; even though these species may be equally common in the other localities.

In Algae as in other plants there are limits in temperature, which when exceeded arrest the distribution of the species. From the nature of the medium in which they grow, aided by powerful distributing agencies such as ocean currents, it is evident that marine species must tend to spread from the original centre, to a greater extent

than is the case with land plants. Hence the spores of Algae will often be carried to places, beyond the temperature necessary for healthy growth. Thus the Gulf Stream occasionally brings to our shores, specimens of exotic algae as Sargassa, even in fructification, and doubtless the spores of many others; yet no instances are known of their having developed in this country. As might be anticipated we find that those species which have a limited range, reach their greatest perfection in a certain area, and as we recede from it become scarcer, and less luxuriant, till they finally disappear.

In all seas despite the temperature, Algae are met with; from the icy shores round the poles, to the waters of tropical oceans. Even on land, hot springs are not without their forms, such as *Anabaena thermalis*, lately found in Fontaine Chaud

de Dax, at a temperature of 54° C.

There is another influence viz. shelter, which acting along with temperature, greatly affects the growth and distribution of marine algae. Thus rocky uneven coasts, are characterized by the presence of many species, quite unknown on low flat shores. This is mainly due to the fact that many plants, especially those belonging to the red series, are peculiarly susceptible to the action of light; and growth is arrested, unless complete immunity from the sun's rays, is conferred on them by the presence of some overhanging rock, or thick fringe of other seaweeds. Many will not even bear exposure to the atmosphere for a short time, so are either found beyond tidal influences, or in deep rock pools. Thus many British species as the Griffithsiac, Delesseriace, etc. are found sheltered beneath friendly rocks, hidden from the eyes of all, save those of the

prying collector. On the other hand some seem to affect open and exposed situations on rocky coasts, and these are usually robust, & well fitted for such a habitat. As examples of the latter we may take *Alaria esculenta*, and *Himanthalia lorea*, which flourish at low water mark, on rock exposed to the full violence of the ocean. Contrary to what we should expect, some also of the more delicate red weeds, seem to prefer tidal pools into which the water rushes with great violence.

Having now seen how the distribution of Algae is affected by soil, and climate; we must next consider how it is influenced vertically by light. The vast majority, require for their proper growth and development, the access of light. Thus the green forms, or those containing most chlorophyll, are as a rule directly exposed to the influence of sunlight.

Nearly all the land and fresh water forms, and most of the shallow water marine forms, come under this division. The red weeds are also in all cases exposed to light; but as already mentioned, they are exceedingly susceptible to the direct influence of sunlight. They are found in greatest perfection beyond tide marks, but also underneath shelving rocks, and on the shaded side of rock pools. The olive brown weeds, seem least of all to be affected by sunlight. They are found abundantly between tide marks, but also reach a considerable depth; and then become much darker in colour. Hence the presence or absence of sheltering rocks, accounts partly for the occurrence or not, of certain forms in any special locality. It can be shown that neither the temperature, nor the chemical composition, nor the movement of the water, will account satisfactorily for the vertical limit of algae; so light must be the most important factor. It was formerly

thought that the fringe of algae, <sup>which surround</sup> the sea coasts everywhere, became thinner and thinner, till it reached a depth of forty or fifty fathoms; beneath which light can not penetrate, and then finally disappeared, along with all other forms of life; the only exceptions being some of these huge marine plants, with fronds two or three hundred fathoms in length. The dark abyssal region beyond was thought to be wholly devoid of life, only containing the remains of pelagic forms which had slowly settled down to their last resting place. Recent investigations however especially those of the "Challenger Expedition," have shown the existence at least of a deep water fauna, in the abysses of the ocean. Whether any of even the lowest forms of algae live there, is at least doubtful, and it is probable that the animals present, are ultimately dependent on the surface pelagic algae which

abound in most parts of the ocean, for their vegetable supply.

Touching on the relationship between plant and animal, we are led to refer briefly to a curious condition of mutual relationship between certain animals, and algae, which has been recently investigated, - termed symbiosis. It was first pointed out in 1841 by Cienkowski, that the so called "yellow cells" of Radiolarians, concerning the functions of which there has been so much variety of opinion, were in reality forms of parasitical algae. It was afterwards shown chiefly by chemical reagents, that some of these bodies continued to live even after the death of their hosts, growing and developing till their total evolution proved them to be forms of unicellular algae, such as *Palmella*, and *Gloeocystis*. (Enty 1846). Thus it was maintained that they were "independent organisms, that had forced their way into, and temporarily

enjoyed the hospitality of their hosts. In 1844 Dr. Perceval Wright of Dublin published an account of a green alga living in the fronds of other algae, (*Ceramia*, and *Polysiphoniae*), and also described its spores entering into and growing within, the structures of *Epistylis*, and *Vaginicola*; and he even figured some adult forms, within the lorica of *Vaginicola crystallina*, and throughout the frond of *Polysiphonia urceolata*. Mr. Patrick Geddes in 1881, at the Naples Zoological Station, pointed out the parasitism of algae in *Coelenterata*, (especially in forms of *Actiniae*), and in some *Radiolarian*. He also made important observations on their physiological relations. He communicated his results in a paper read before the Royal Society of Edinburgh, in January 1882. In November 1881, Dr. Brandt of Berlin asserted that the minute algae forming the "yellow cells" of *Radiolarian*.

were of service in supplying food to the host. "So long as the animals contain few or no yellow cells, they are nourished like true animals, by the absorption of solid organic substances; but as soon as they contain a sufficient quantity of these algae, they are nourished like true plants by assimilation of inorganic substances." So these algae have precisely similar functions to the chlorophyll bodies of plants, and are nourished by the waste products of the animal, while the latter lives on the compounds elaborated by them, and the oxygen they set free. Dr. Brandt has termed the animals containing these algae and depending on them for their nutritive supply, - *Phytozoa*; and he compares their mode of life with that of lichens. There is however this peculiarity in the *Phytozoa*, that morphologically it is the alga, physiologically the animal, which is the parasite. It was also shown by Lyedde, that

pure oxygen is evolved by animals containing abundance of these beneficial "parasites".

As all animals are ultimately dependent for their existence, on that of plants, the distribution of the latter must naturally have a marked effect on the distribution of animals. In many seas, especially in the tropics, forms of animal life swarm in the surface water, thus constituting a distinct pelagic fauna. These myriads of animals, are almost entirely dependent for food supply, on surface vegetable forms as Diatoms, Oscillatoriae, etc.

Professor Moseley in his address on "Pelagic Life," at the Southampton meeting of the British Association, August 1882; suggested that in many parts of the ocean where vegetable organisms are not markedly abundant, and yet the vast extent of the pelagic fauna would imply a more plentiful food supply, that the condition of symbiosis

may help to make up for the deficiency.

It is thus probable that the presence of these minute algae in Radiolarians etc is of great importance in the economy of pelagic life. Mr. Moseley also suggests that symbiosis may possibly have been more common amongst pelagic faunas of earlier geological epochs, when diatoms were either very scarce, or did not exist. Hence it is seen that the distribution of pelagic plants, has a direct influence on that of a pelagic fauna, and through the latter indirectly, on the distribution of the deep water fauna, in the same part; as this last, at any great distance from the coast, depends on the pelagic fauna overhead.

A good example of the close relationship between pelagic animals and plants, is seen in the Sargasso Sea. The mighty Gulf Stream, flowing from America to Europe, when it reaches the Azores, in part turns southward toward the coast of Africa, and is then driven

back to the shores of America, by the north east trade winds. Within this limit is enclosed, from  $22^{\circ}$  to  $36^{\circ}$  north latitude, and from  $25^{\circ}$  to  $65^{\circ}$  west latitude, a calm sea with very few currents, and these depending on the wind blowing at the time. This tranquil part of the Atlantic, with a surface of more than forty thousand square miles, or an area about three times as large as Europe, may be compared to a vast marine meadow and is covered by innumerable beds of the floating "gulf weed" or *Sargassum bacciferum*. This floating mass of seaweed, has an historical interest having impeded the progress of the vessel, which contained the discoverer of America. Many animals find their residence and food in these floating islands. Multitudes of small Serpularians, cover the weeds, and myriads of minute Pleurobrachs, Crustaceans, etc. swarm in and out among the branches.

serving as food to the countless fishes, and swimming crabs, which have here taken up their abode. All the higher forms are specially adapted for their strange life in this pelagic forest. Thus we have here in the centre of the Atlantic, a strange little isolated world, inhabited by distinct vegetable and animal forms, peculiarly fitted for this floating existence, and mutually dependent on one another. It may be mentioned as an interesting fact, that these banks of fucoids afford us the most remarkable instance, of gregarious plants of a single species. Nowhere else is such ~~such~~ uniformity of vegetation to be found, neither on the grassy prairies of America, nor in the vast pine forests of northern Europe. It is a strange fact and difficult to explain, why this Sargasso sea occupying so great an area, has not extended its range, with so many powerful distributing agencies in its close vicinity. The Gulf Stream however,

seems instead of aiding the distribution of *Sargassum bacciferum*, to have had an opposite effect, hemming it in on all sides; and if spores do happen to be carried away by it, these must be deposited in regions, where the temperature and other conditions, are not at all favourable to its growth.

In addition to this mutual relationship between plant and animal termed symbiosis, some algae live a parasitical life in the interior of other plants. Dr Wright published a few years ago, an account of a microscopical alga living within the frond of *Ceramium acanthonotum*, and since then many other examples have been noted. The endophytic algae chiefly belong to the group of Nostochineae, (*Anabaena* or *Nostoc*). In 1880 N. Wille described under the name of *Entocladia Withrockii*, a new alga living in the cell wall of *Ectocarpus siliculosus*, and *Ect. firmus*, near Christiania. It consists of slightly bran-

rows of cells, containing large starch grains and parietal chlorophyll. Professor Wright at one time asserted that the structure known to algologists, as the granular frond of *Ectocarpus granulosus*, was nothing more than an endophytic alga.

As we have now considered the general conditions under which algae live, and the various causes which promote or retard their growth, and distribution, a glance may be made at the situations in which they are found. As far the most important members of the group are marine, we may consider them first.

If we examine the vegetation characteristic of the space left uncovered by the ebb of the tide, on any coast, we notice two important points; - first that the plants, as a rule increase in size and number, as we reach low water mark, and secondly that certain species affect certain zones more than others, and are characteristic of them.

Here again we meet with an analogous

state of matters in marine and land plants. In the latter it is seen that certain species do not exist above a certain altitude, becoming scarcer as we ascend till they finally disappear. Thus on the tops of the highest mountains, all the more highly organized forms have disappeared. In regard to marine plants the reverse obtains, the greatest number being found near low water mark and decreasing as we descend, till they finally disappear in the abysses of the ocean. There is however a marked difference noticable for in land plants assuming the base of a mountain to be the point of maximum intensity, a broad line gradually narrowing would mark the distribution in altitude; whereas in the case of marine plants, assuming the starting point to be near low water mark, we should have to draw a narrowing line proceeding in one direction for the bathymetrical distribution, and another line gradually narrowing as we

approach high water mark, in the other direction. Although this slight analogy exists as to mere vertical distribution, the modifying causes are of course quite distinct in each case.

In the British seas naturalists speak of littoral, laminarian, coralline, and deep sea coral zones, each characterized by the presence of certain vegetable and animal species. The first includes the space between high and low water marks, or that coming under the tidal influence.

We may divide this intertidal, or littoral zone, into three rough and not sharply defined areas. (1.) An upper extending from extreme high water mark, to a point somewhere between this and half tide. (2.) A middle area extending from the last, to a point near low water (3.) A lower area from the last, to the low water mark of spring tides. Each of these is characterized by certain species. Thus in the upper, we have chiefly those forms which can bear much exposure to

light, and do not require a lengthened immersion. Some plants are even found above high water mark, where a slight dashing with spray twice daily, seems to meet their requirements. This area is characterized by the presence of such plants as *Fucus canaliculatus*, *Catenella opuntia*, *Enteromorphae*, *Ulvae*, *Confervae* etc. In the middle area the *Fuci* proper reach their maximum intensity, and the finer red forms begin to appear. In the third area, many red weeds are found and at low water the broad fronds of *Laminariae* are seen waving in the water and only uncovered by low tides.

We now enter the second or *Laminarian* zone, extending from low water to a depth of fifteen fathoms. It is of course chiefly characterized by the plants giving it its name, but many other species also occur chiefly belonging to the Red, and Brown, series, but also a few green forms. It affords shelter and food to a large and important

littoral fauna.

Naturalists next speak of a coralline zone, extending from fifteen to fifty fathoms, and in it the higher forms of algae become scarcer, and the majority disappear. Everything beyond this depth may be termed "abyssal," as far as marine plants are concerned; with the exception of a few gigantic weeds in a few localities, diatoms alone existing.

Horizontally the ocean has been divided into ten separate geographical provinces, each containing certain genera and species of algae.

I. The North Circumpolar region extending from the pole to latitude 60 north, including the seas forming the northern boundary of the Russian empire and North America, and those washing the shores of Norway, and Greenland, including the islands of Iceland, Nova Zembla, and Spitzbergen. The marine flora of this land of ice and snow, as is the case with most of its other

productions, has been little investigated. The lower forms such as Diatoms, abound in the surface waters, forming the food of various pelagic animals, and these again constituting the staple supply of the whales occurring in this region. The results obtained in NordenSKIÖLD's recent expedition, show that an algal flora appears at various points, at a distance from the Siberian sea coast, as well as in the sublittoral areas. Fucaeeae are not present in the littoral zone, and only one (*Fucus evanesens*), was met with in the eastern part of the Arctic Ocean, this plant also having a wide distribution in the western part. In the algae obtained on the expedition, Fucoideae were represented by sixteen species, Florideae by twelve, and only a few Chlorosperma were procured.

II. The North Atlantic province, extends from latitude 40 north, to latitude 60 north. This corresponds to the upper part of the North Atlantic Ocean.

It includes on the new world side, Cape Farewell, and the coasts of Labrador, Newfoundland, and Nova Scotia; and in the old world, the shores of the British Isles, the North Sea, the atlantic coast of France, and part of that of Spain, and Portugal. This is the region of Fuci proper, and the Delesseriae. The Gulf Stream the most powerful of all known currents, has its source in the Gulf of Mexico, where in summer the temperature is  $86^{\circ} 7$  or  $8^{\circ}$  above that of the Atlantic (Renell). From this reservoir it crosses the ocean in a north easterly direction, as far as the Azores then dividing, one part flowing to the north as far as the Arctic Ocean, impinging in its course against the western coasts of Europe, the other curving south wards, towards the equator. This great thermal ocean river, as it has been termed has a remarkable effect on the climate, and also on the distribution of marine plants in the places mentioned; as we have already referred to in the distribution

of British seaweeds.

III. The region of the Mediterranean. As might be expected from the land-locked nature of this sea, the marine flora is fairly distinct, but there are many species inhabiting it, which are also common to the North Atlantic, and warmer temperate zone of the Atlantic. Some think it is only a sub-region of the latter.

IV. The Temperate zone of the Atlantic between latitude 23 north, and latitude 40 north, constitutes a fairly well marked region.

V. The Tropical Atlantic is characterized by the vast Sargasso sea, especially. In it *Sargassum bacciferum* abounds.

VI. The South Atlantic forms a region in which Fuci again appear. The descending part of the Gulf Stream (South Atlantic current of Rennell), traverses it.

VII. The Antarctic American region extends from Chili to Cape Horn, and includes

the Falkland Islands, and the whole Circumpolar ocean south of  $50^{\circ}$  south latitude, we have in this area some of the giants of the vegetable Kingdom appearing. In the numerous channels and bays of Tierra del Fuego, the rocks are covered with the huge *Macrocystis pyrifera*, which in some cases reaches a length of four hundred feet (Darwin). On the shores of the Falkland Islands, gigantic seaweeds are also met with as *Lessoniaceae*, *D'Urvilleae*, and *Macrocystes*, which form submarine forests, and give shelter to multitudes of marine animals.

VIII. The seas surrounding Australia and New Zealand, constitute a well marked marine province, equally as distinct as the terrestrial flora of these countries.

IX. The Indian Ocean, and Red Sea, forms a large area with a well marked marine flora. It is worthy of remark that the Red Sea flora, is perfectly distinct from that of the Mediterranean

and plants such as Sargassa, abound in it which are quite unknown in the latter.

V. The Chinese and Japanese seas, also constitute a large area. In addition to many peculiar forms we have here also a localized group of Sargassa, consisting of several species which differ in form from the other members of the family.

In addition to these regions, there are also a few, especially in the Pacific, not well defined. The North Pacific, for instance is characterized by many peculiar forms as *Nereocystis*, *Costaria*, *Agarum*, and others.

As a rule every sea surrounded by land on nearly all sides, as the Mediterranean, Baltic, Red Sea, Gulf of Mexico, etc possess a flora distinct from that of the ocean of which it is a branch. This is mainly due to the fact that such seas are of less depth, often of higher temperature, and are more directly

influenced by the countries which nearly enclose them. When these also are the recipients of large river systems, there is no doubt that the admixture of fresh water, has a decided influence on the growth of their algae. As regards inland seas it is found that the algal flora generally includes species found in brackish waters on the nearest coasts. It is a curious fact that two, out of three species of algae lately found in Utah Salt Lake, are common also to the Atlantic.

The vast expanse of ocean has thus been divided by botanists, into these distinct provinces each with its peculiar growth of algae. We must however bear in mind that in marine as in terrestrial plants, distinction between provinces relates strictly to species, and not to forms. It is also to be noted in regard to the numerical preponderance of certain forms, and peculiarities of internal structure, that a marked agreement is generally perceptible, in the marine flora of certain

provinces placed in corresponding latitudes, and under similar physical conditions, however remote their position. Thus seaweeds on the shores of Brazil, Africa, and India, in nearly corresponding latitudes, present many points of analogy. Few species of marine algae however, are common to the shores of Tasmania, New Zealand, and Cape Horn, but a great number of genera, and among these a few occurring in these regions of the southern hemisphere, are each represented in distant seas as those of Britain, by a single species. It is also further to be noted, that plants found in southern temperate regions, and the antarctic ocean, belong to genera which are represented by other species in analogous climates in the northern hemisphere; but yet very few of the species are identical, unless belonging to families universally diffused.

We may in the next place glance at the distribution of some of the more

important forms of marine algae.

The Fuci flourish between latitudes 55° and 44°, and are rarely seen nearer the equator than 36°. *Fucus nodosus*, and *F. serratus*, were traced by Hooker on the northern edge of the Gulf Stream from latitude 36° to England. Most of the British fuci are common to the Atlantic shores of North America, and Europe, within certain latitudes; but *F. serratus* appears to be confined to Europe.

The genus *Sargassum*, the most extensive of the *Fucoideae*, is nearly confined to the two tropics; and never extends beyond latitude 42°. Specimens are found on the shores of the East Indies, China, Japan, Australia, Tasmania, the Red Sea, the Cape of Good Hope, and in the tropical Atlantic.

The *Laminariae* have a fairly well marked distribution, being most frequently met with from latitude 40° to 65°, while the *Macrocystes* exist from the equator to about 45° south latitude.

The genus *Cystoseira* exists between the 50<sup>th</sup> and 25<sup>th</sup> degrees of latitude, gradually superseding the *Fuci*. This family reaches its maximum in Britain on the southern shores of England, and most of the species are quite unknown in Scotland. In Australia also a distinct group of *Cystoseirae* predominates, in character quite distinct from their allies on the other side of the world.

The *Florideae* are as a rule found in the temperate zones. In this very large group, however, many exceptions to the rule occur, as there are some genera exclusively tropical. It is also to be noted that the southern temperate zone, contains much fewer red algae, than the northern, a fact accounted for according to Lamouroux, by the inferior extent of the temperate zone in this hemisphere.

In addition to the fairly well localized distribution of these families, there are however many species which do not affect particular temperatures, or zones

of latitude, and these we may term cosmopolitan. The algae enjoying this extended range chiefly belong to the Chlorospermeae. The genus *Codium*, and the Ulvaceae, are scattered over nearly the whole world. *Codium tomENTOSUM*, is found in the Atlantic, from the shores of Britain, to the Cape of Good Hope, and in the Mediterranean also, in the Pacific, on the shores of North and South America, and as far as Australia. The common British *Enteromorpha compressa*, has been found in high latitudes of the Arctic Ocean. Among species strictly antarctic Dr Hooker in his voyage to these regions recognised not less than a fifth of the total number of species then found in the British seas.

In regard to the distribution of the fresh water and terrestrial forms of algae little can be said. The higher forms as we have already remarked, belong almost entirely to the Chlorospermeae; and are found exposed to light and other influences throughout the globe, wherever collections

of fresh water, or suitable localities, are to be met with. To a certain extent they seem to follow the same general rules in regard to their geographical distribution, as the higher algae; so that well marked areas have certain definite species peculiar to them. As a rule however the various genera are ubiquitous, and no definite provinces can be assigned to them.

As many of the lower forms of algae multiply with great rapidity, vast accumulations often take place in a very short time, and we may have certain species appearing suddenly in a locality where they were before unknown. In this way the various phenomena known as "rain of blood", "red snow", "water turned to blood", etc. are accounted for. Another distributing agency we have not yet mentioned viz. the wind, is here occasionally brought into requisition. In some parts of Morocco, where the appearance known as "rain of blood" has been

observed, myriads of a young undeveloped condition of a form of Protococcus, are conveyed by strong south west winds from the Sahara.

We have already noticed the fact that the surface waters in many parts of the globe, swarm with minute vegetable organisms. As the "Challenger" passed between Australia and New Guinea, the sea on all sides for several days voyage, was discoloured by minute forms of algae (Oscillatoriae etc.), and in some parts of the Atlantic also, a similar appearance was met with. The important part that these play in the bathymetrical distribution of marine animals has been already alluded to.

As there are many special features of interest in the distribution of the Diatomaceae, we may briefly state a few of the leading points. The members of this large class, are nearly all free aquatic organisms. A great number possess the power of spontaneous movement. The

great majority are found, either in salt, fresh, or brackish waters; but some as the Desmidiaceae, are exclusively confined to fresh water. Diatoms being provided with a siliceous envelope, are practically indestructible; hence in some cases they form geological deposits, and these, with obscure markings of furoids etc., constitute the only evidences of the existence of algae, in former epochs of the earth's history. Such an accumulation is even now going on in the depths of the sea, by the slow subsidence of diatoms, along with foraminifera, and other organic particles. In size they are all microscopic, so this fact combined with their free habit, greatly facilitates their dispersion throughout the waters of the globe. Thus ocean currents, rivers, and other distributing agencies, act readily on them. It has also been asserted that they can bear desiccation successfully for long periods of time, hence other agencies as winds might

come into action. It appears highly probable also that in some cases they are dispersed by sea fowl, and other animals, even after having remained for some time in the alimentary canal of their bearers. Hence we find that Diatoms are almost universally distributed, and almost every pool of water in the globe, will be found to contain certain species. Many are cosmopolitan, while others are apparently confined to certain areas. They are exceedingly abundant in Polar seas, often rendering the water quite turbid. and they were observed by Hooker and others, washed up on the ice and colouring it brown, in the Antarctic regions. In the temperate and warmer seas, diatoms though still present become scarcer, and their place is taken up by other simple minute algae. In mere vertical distribution they reach far greater depths than their more highly organized brethren, and in the greatest depths sounded by the "Challenger", and other recent deep

sea expeditions, diatoms were regularly brought up from the dark abysses of the ocean.

We now bring our essay to a close with a few final remarks. It may be stated in short, that nearly every collection of water, or part of the sea throughout the globe, is tenanted by some forms of algae. These play as important a part in the great economy of nature, as the better known and more easily reached land plants. From a botanical point of view they are not less interesting, and the singular beauty of many of the forms, would alone commend them to notice. In these modern times of improvement many useful products are derived from algae; and the chemist, and agriculturist, have found that money may spring from the formerly despised seaweed. To the sea side stroller a new world of beautiful forms is opened up by the examination of marine plants, and the microscopist

has found in many a tiny diatom, the  
study of an object "frail but a work divine".

All the seaweeds in this book were collected by myself, in the Firth of Forth, during the years 1882-83, & mounted also in every case by me. For the naming of many of the rarer plants, especially those more recently added to the marine flora of Britain; I am greatly indebted to Mr. G. W. Frazer, Portobello. Mr. G. M. Holmes F. L. S. also kindly examined & named some of my rarer plants for me.

In all the collection comprises between 140 and 150 species and varieties, & of these a number are new to the Firth of Forth.

Two species at least, are here recorded for the first time in Britain; viz. *Fucus distichus*, of which a single specimen was found by me in *reputamenta* at Portseton; & a small *Ceto carpus*, of which I found several specimens (all growing on *Porphyra laciniata* at Goppa). This latter plant is quite distinct from any other British species, and the fruit consists of short blunt silicles. I have been unable to get it identified.

In many cases more than one specimen has been mounted of the same species, in order to show some difference in form, or fructification. All the plants of which there is any doubt, I have marked "questionable," and those I cannot get named, are left blank. The calcareous forms, & these encrusting rock, are kept apart in a small box, owing to the impossibility of fixing them in a book.

John R. Henderson.  
1 George Square, Edinburgh.  
30th June, 1883.





*Calothrix semiplena* Harv.  
(*Symploca Harveyi* Le Jolis)

Kincraig, Carlsferry  
4/8/82.



*Rivularia atra*  
on *Clad. rupestris*.

Carlsferry.  
5/8/82.



*Ulva linza.*

Caroline Park.  
19/6/82.



*Ulva latissima*

Joppa.  
19/6/83.



*Enteromorpha intestinalis*

Joppa.  
15/8/82.



*Enteromorpha compressa.*

Joppa.  
6/83.



*Enteromorpha erecta.*

Joppa.  
16/6/83.



*Prasiola marina*

Joppa.  
3/20/82.



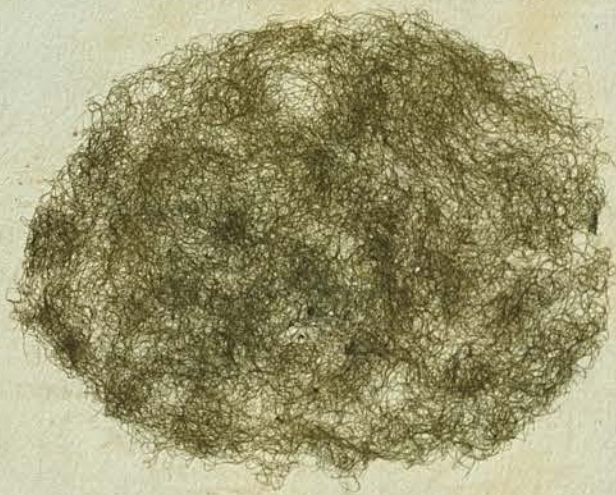
*Ulothrix flacca.*

Caroline Park.  
25/5/82.



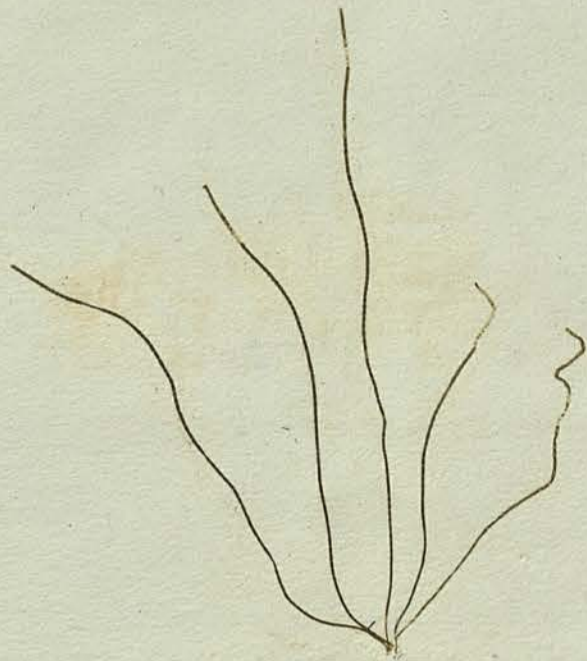
*Urospora penicilliformis*  
with *Ulothrix flacca*.

Caroline Park.  
19/6/82.



*Chaetomorpha tortuosa*

Joppa.  
15/8/82.



*Chaetomorpha melagonium.*

Dunbar.  
9/6/83.



*Chaetomorpha implexa?*  
growing on *Callithamnion*  
*polyspermum.* Caroline Park.  
25/5/82.



In brackish water pool. at h.w.  
Longmiddy 24/5/83.



*Rhizoclonium riparium.*

Craigroyston.  
15/4/82.



*Cladophora lactevirens.*

Joppa.  
27/4/82.



*Cladophora lactevirens*  
growing on.  
*Cladophora rupestris.*

Caroline Park.  
25/5/82.



*Cladophora rupestris.*

Ladies' Tower. Chic.  
3/8/82.



*Cladophora uncialis.*

Dunbar.  
9/6/83.



*Cladophora lanosa.*

Dunbar.  
19/6/83.



*Cladophora arcta.* Inckelth  
2/6/83.



*Cladophora centralis* Lyng. ? Joppa.  
29/4/82.



*Bryopsis plumosa.*

Joppa.  
15/8/82.



*Chorda lomentaria.*

Joppa.  
16/6/82.



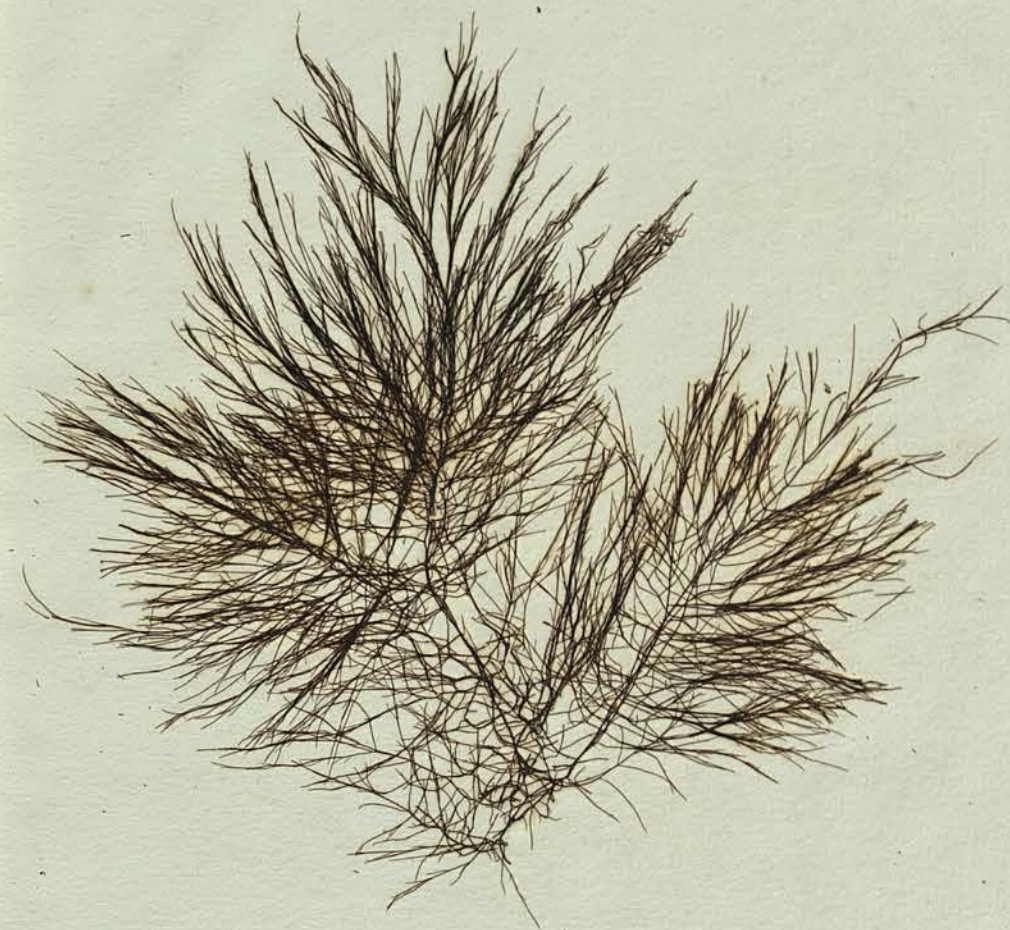
*Litosiphon laminariae*  
on *Alaria esculenta*.

Carl ferry.  
1/8/82.



*Punctaria plantaginea*  
(fruit)

Dunbar.  
10/6/82.



*Desmarestia viridis*

Cocks Tail Rocks.  
Carlisle  
2/8/82.



*Desmarestia viridis*  
(very young.)

Portseton  
18/4/82.



*Desmarestia aculeata.*

Earlsferry.  
1/8/82.



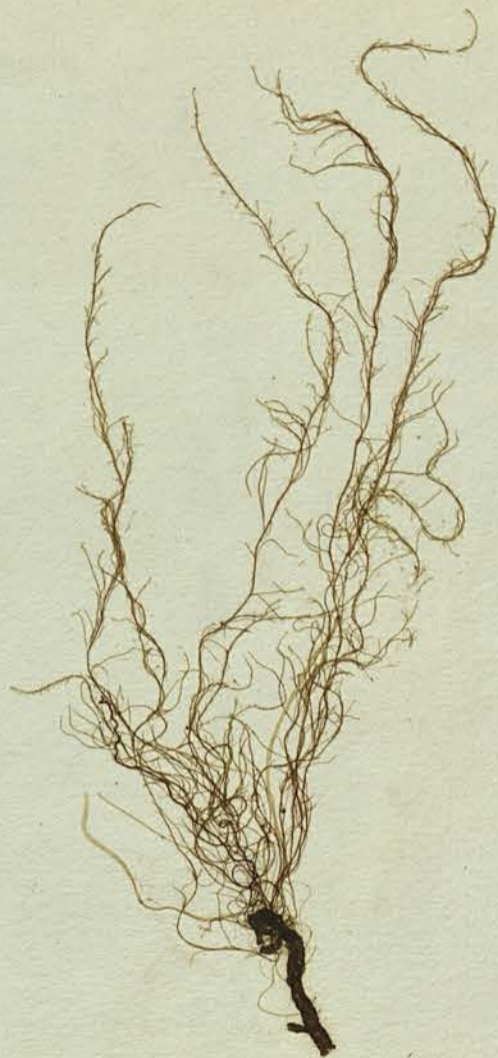
*Desmarestia aculeata.*  
winter form.

Newhaven.  
Cast ashore. 1/82.



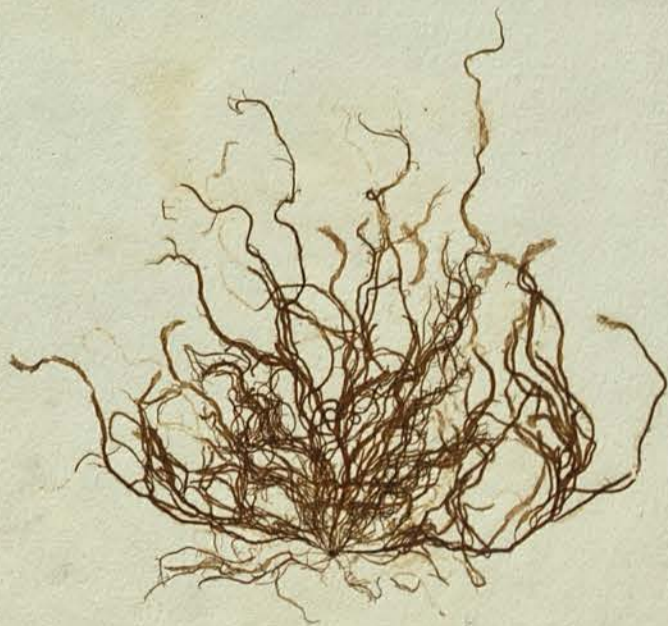
*Dictyosiphon foeniculaceus.*

Dunbar.  
10/6/82.



*Dictyosiphon foeniculaceus*  
sub-species *hispidus* of Kjellman.

Joppa.  
12/7/82.



*Dictyosiphon mesoglia* Ag.

Longuidry.  
19/6/83.



*Myriotrichia filiformis*  
on *Asperococcus echinatus*.

Carlsferry.  
5/8/82.



*Ectocarpus siliculosus*.  
(young.)

Joppa.  
16/6/82.



*Gelidium siliculosus.*  
(fruit.)

Joppa.  
15/6/82.



*Gelidium siliculosus*  
(young.)

Longquiddy.  
6/83.



*Ectocarpus littoralis*  
(fruit)

Joppa.  
16/6/82.



*Ectocarpus tomentosus.*

Earle Ferry.  
3/8/82.



*Ectocarpus crinitus*?  
(grows hanging down from  
ledges of muddy rock)

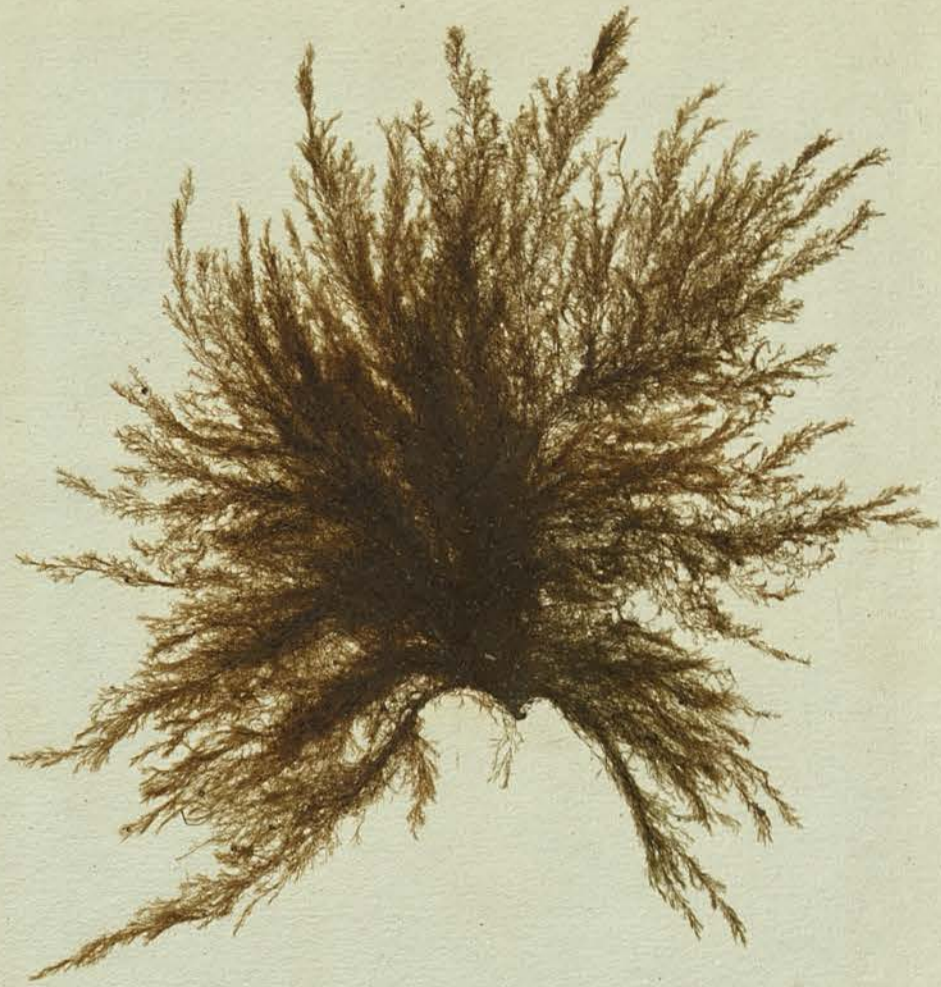
Joppa.  
24/4/82.

*Phloeospora brachiata*, likely.



*Ectocarpus* —? (in fruit.)  
on *Porphyra laciniata*.  
New to Britain.

Joppa.  
15/8/82.



*Ectocarpus granulosus.*  
(fruit)

Joppa.  
12/4/82.



*Ectocarpus sphaerophorus*  
(fruit)

Dunbar.  
10/6/82.



*Ectocarpus fasciculatus*  
on a *Laminaria* frond.

Dunbar.  
Castashore 9/6/83.



*Ectocarpus* — ?  
growing on *Laminaria*  
stem.

Dunbar.  
Castashore. 9/6/83.



*Ectocarpus brachiatus.*  
(fruit)  
on *Rhodomenia palmata.*

Carlsferry  
4/8/82.



*Ectocarpus Cronani.*  
*Myristichia filiformis*  
(unilocular sporangia)  
and *Melobesia?* x

Carlsferry  
5/8/82.



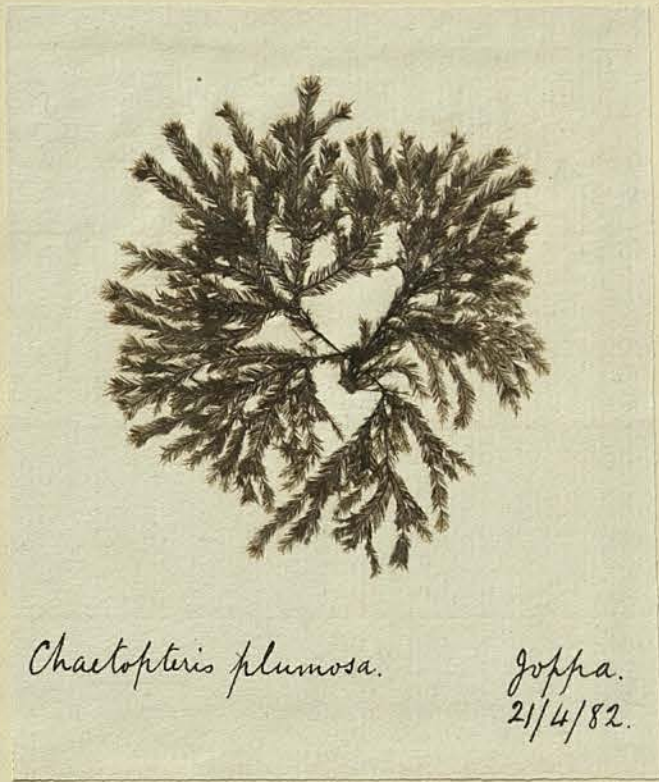
*Sphaclaria radicans.*

Joppa.  
20/3/82.



*Sphaclaria cirrhosa.*

Kincraig, Carlisle.  
4/8/82.



*Chaetopteris plumosa.*

Joppa.  
21/4/82.



*Chaetopteris plumosa.*  
(unilocular sporangia)

Joppa.  
9/3/83.



*Cladostephus spongiosus*  
(fruit)

Craigropton  
2/82.



*Elachistea fucicola.*

Dunbar.  
10/6/82.



*Elachistea flaccida*  
(plurilocular sporangia)

Carlson  
4/8/82.



*Leathesia tuberiformis*

Dunbar.  
10/6/82.



*Endesme virescens*

Longmiddy.  
19/6/83.



*Chordaria flagelliformis*  
(with young *C. hippocoides*)

Dunbar.  
10/6/82.



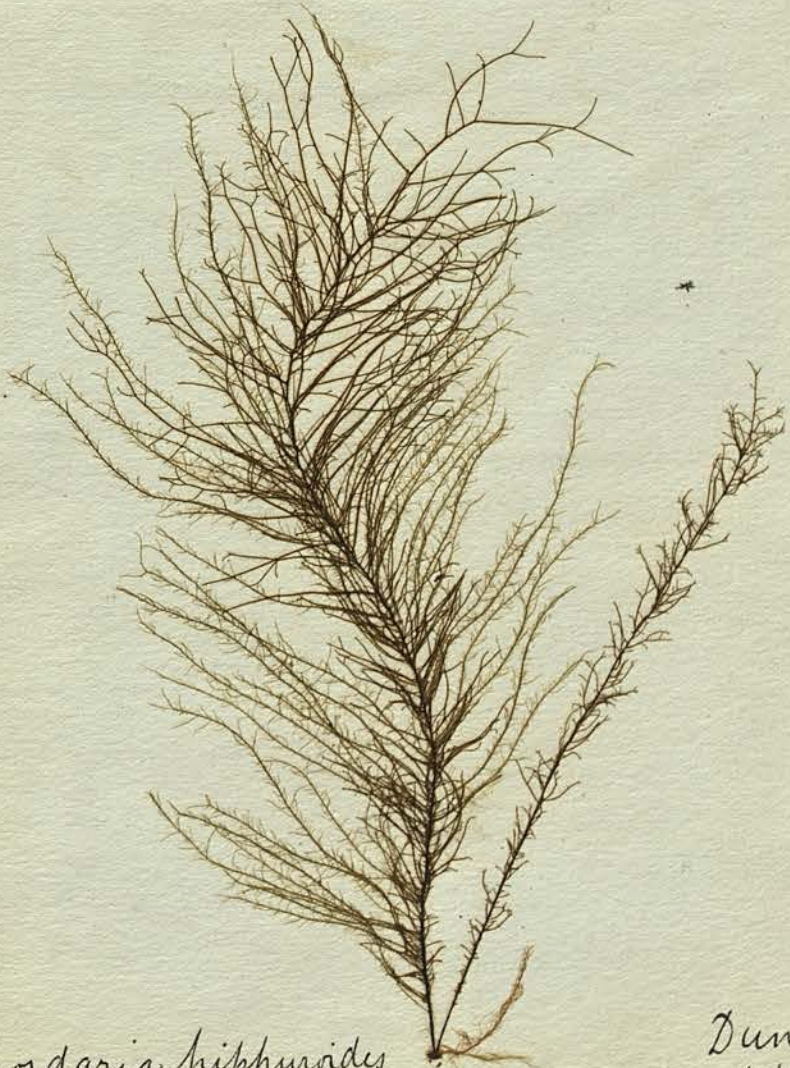
*Chordaria flagelliformis*  
var. *y. minor* Ag.

Joppa.  
15/6/82.



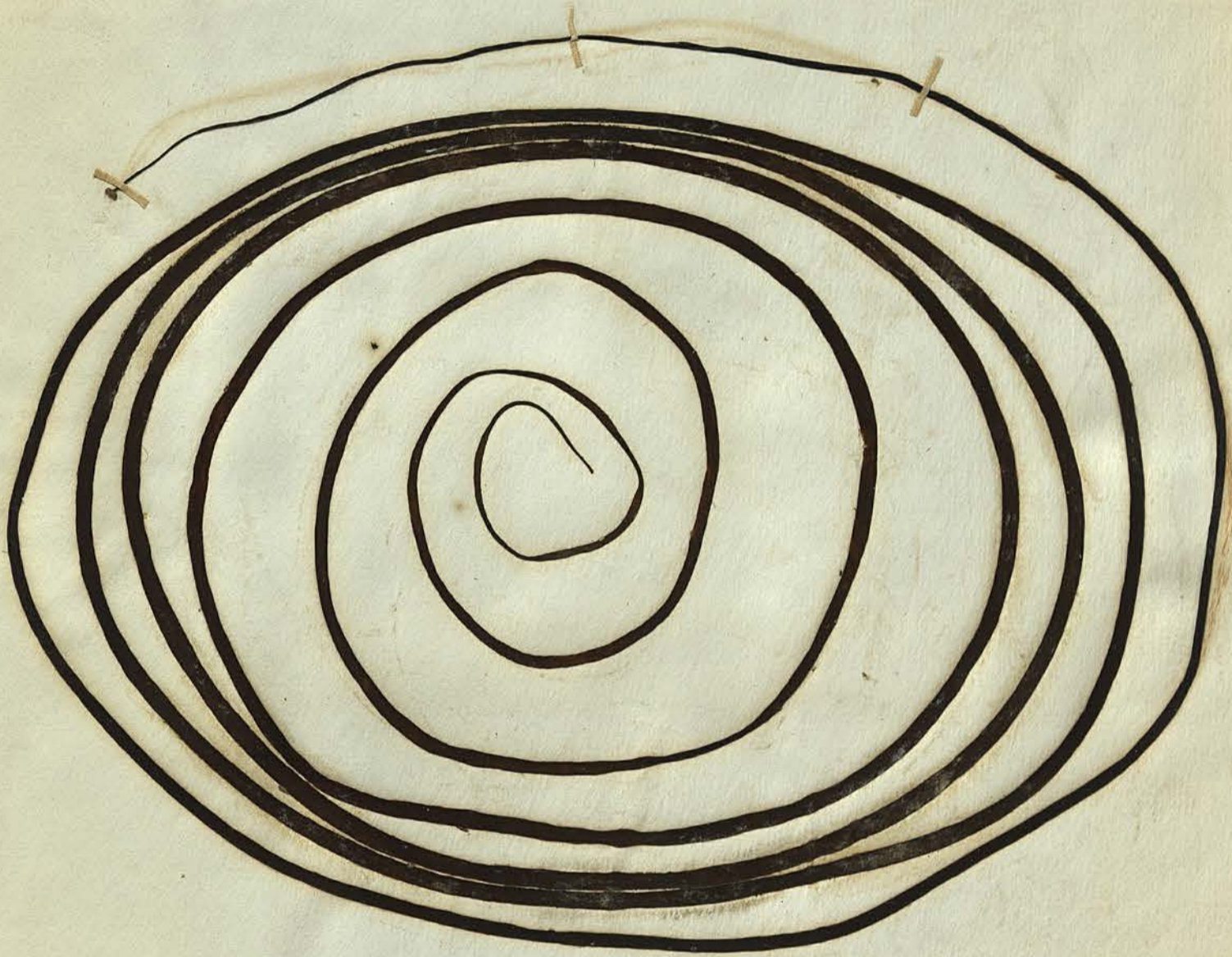
*Chordaria hippuroides* Ag.  
*Dietyosiphon hippuroides* Aresch.  
(epiphytic on *Chordaria flagelliformis*)

Dunbar.  
10/6/82.



*Chordaria hippuroides*  
(young)  
on *C. flagelliformis* var. minor.

Dunbar.  
10/6/82.



*Chorda filum.*  
8 feet 9 inches long.

Earlsferry.  
4/8/82.



*Asperococcus echinatus*.  
(fruit.)

Dunbar.  
10/6/82.



*Asperococcus echinatus*  
narrow variety

Carlisle  
5/8/82.



*Laminaria digitata*  
(young undivided frond)

Dunbar.  
9/6/83.



*Laminaria digitata*

Joppa.  
Summer 82.



*Laminaria saccharina*  
(young)

Joppa.  
24/5/82.



*Laminaria saccharina*. Gony  
(formal *heiroglyphica*.)

Dunbar.  
9/6/83.



*Laminaria fasciata* Harv.  
*Phyllitis caespitosa* Ag.

Joppa.  
1/5/82.



*Laminaria fasciata* Harv.  
*Phyllitis caespitosa* Ag.

Joppa.  
12/4/82.



*Laminaria debilis*

Joppa.  
1/5/82.



*Laminaria debilis*  
(curved form)

Joppa.  
27/5/82.



*Laminaria debilis*  
acuminate form.

Joppa.  
27/5/82.



*Phyllitis fascia* Ag.  
*Laminaria fascia* Harw.

Joppa.  
24/5/82.



*Alaria esculenta*  
(young)

Dunbar.  
19/6/83.



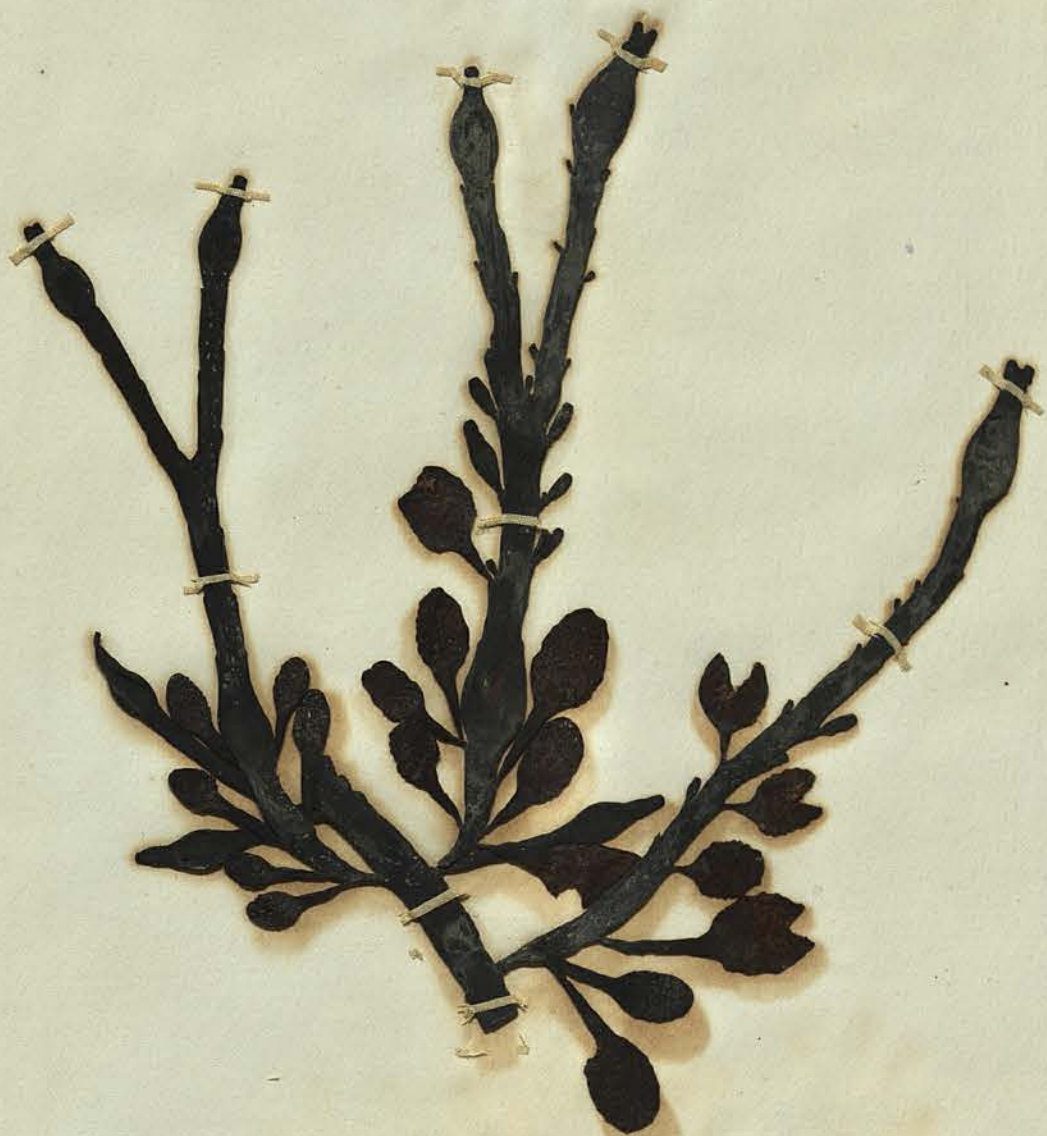
*Himanthalia lorea.*

Dunbar.  
10/6/82.



*Fucodium canaliculatum.*  
(fruit.)

Longquiddy.  
6/83.



*Fucodium nodosum.*  
(fruit)

Joppa.  
6/83.



*Fucus vesiculosus.*  
(fruit.)

Joppa.  
6/83.



*Fucus vesiculosus.*  
(fruit)

Joppa.  
6/83.



*Fucus platycarpus.*  
(fruit)

Joppa.  
6/83.



*Fucus distichus* Ag.  
The first recorded British specimen.  
(Identified by E. M. Holmes F.L.S.)

Portleton  
Castashov. 18/4/82



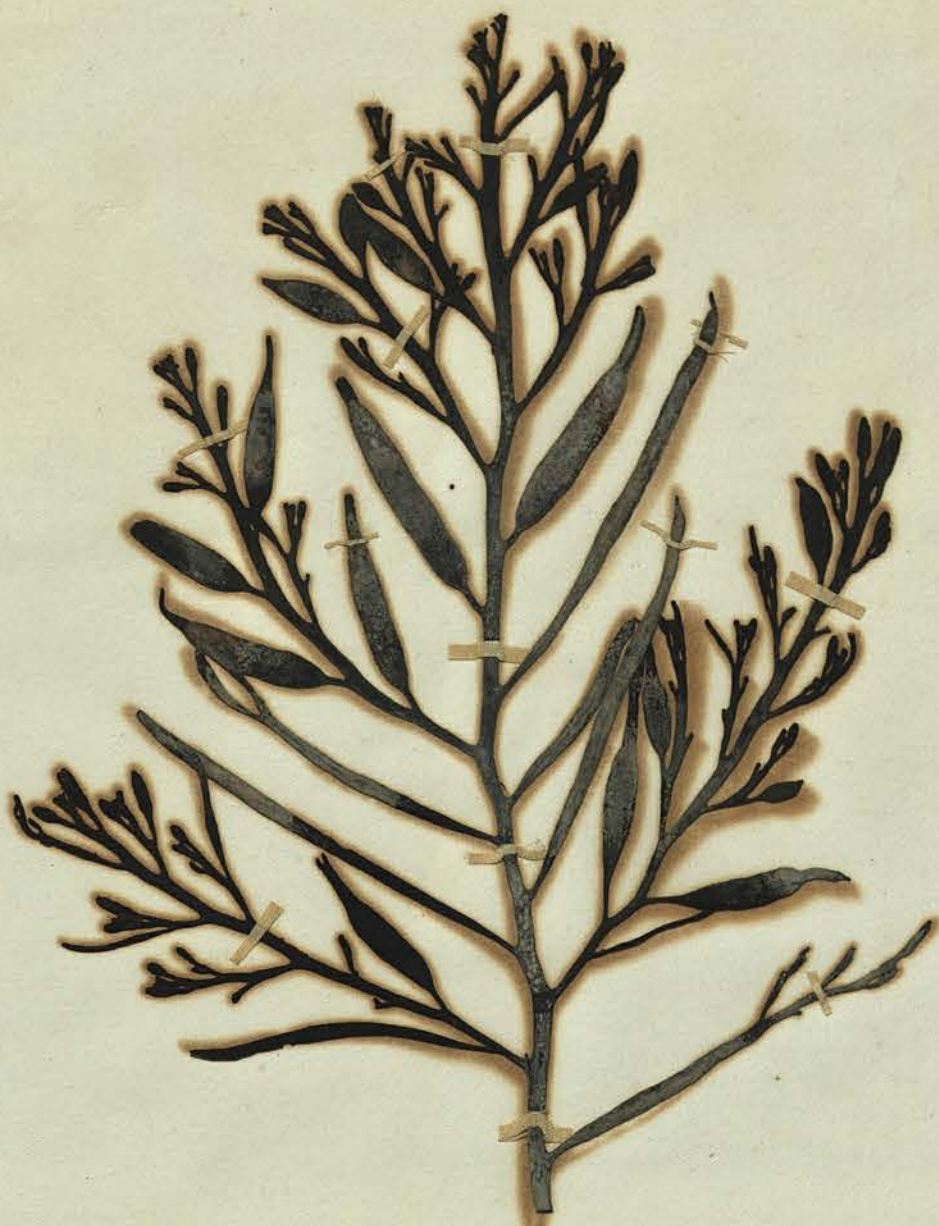
*Fucus ceranoides.*  
(fruit)

Broxmouth  
10/6/82.



*Fucus serratus*  
(fruit)

Joppa.  
6/83.



*Halidrys siliquosa.*

Longquidry.  
6/83.



*Phlaospora tortilis* Aresch.

Joppa.  
24/5/82.



*Bangia fusca-purpurea.* Caroline Park.  
25/5/82.



*Porphyra laciniata.*

Joppa.  
Summer 82.



*Porphyra vulgaris.*

Morrison's Haven.  
5/5/83.



*Callithamnion Turneri*      *Elie.*  
Cast ashore 3/8/82.



*Callithamnion arbuscula.*

*Elie.*  
3/8/82.



*Callithamnion arbuscula.*  
(tetraspores)

Caroline Park.  
25/5/82.



*Callithamnion arbuscula*  
(favellae)

Joppa.  
1/6/82.



*Callithamnion Hookeri.*

*Elic.*  
*Castashore. 3/8/82.*



*Callithamnion Hookeri*  
*(favellae)*

*Elic.*  
*Castashore. 3/8/82.*



*Callithamnion polyspermum*. Craigroyston  
(growing on *Fucus nodosus*) 20/4/82.



*Callithamnion polyspermum*  
(tetraspores) Joppa.  
25/6/82.



*Callithamnion polyspermum?* Dunbar.  
(tetraspores) 10/6/82.



*Callithamnion polyspermum*  
on *Polysiphonia fastigiata*. Caroline Park  
25/5/82.



*Callithamnion Borreri?*

Woskeru. G.M.T

Joppa.  
20/3/82.



*Call. Borreri?*  
Craigroyston 15/4/82.



*Callithamnion floridulum.* Joppa.  
18/8/82.



*strictum*, Cl  
*Callithamnion mesocarpum*. Joppa.  
 9/3/83.



*Callithamnion polyspermum*? Joppa.  
 (very young)  
 on *Porphyra laciniata*. 15/9/82.



*Callithamnion* ? Dunbar.  
 on *Polysiphonia nigrescens*. 9/6/83.

*Callithamnion*  
*sparsum*.  
 On *Lam. saccharina*.  
 east shore  
 Carlisle 2/8/82.





*Chantramsia secundata*  
on *Rhodymenia palmata*.

Elie.  
3/8/82.



*Chantramsia secundata* Joppa.  
on *Call. polyspermum*? 25/6/82.



*Ceramium rubrum* var. decurrens Joppa.  
(Capsules) 15/8/82.  
G.W.S.



*Ceramium rubrum*  
(capsules)

Dunbar.  
9/6/83.



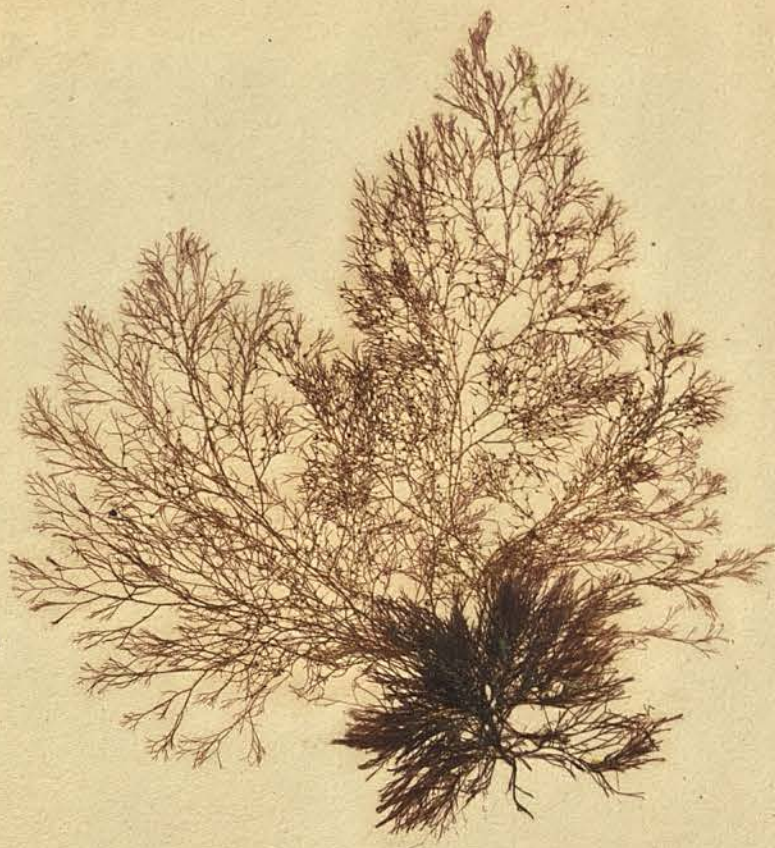
*Ceramium rubrum*?  
(young)

off Inchtuth  
Dredged in 5 fms.  
2/6/83.



*Ceramium Deslongchampsii*

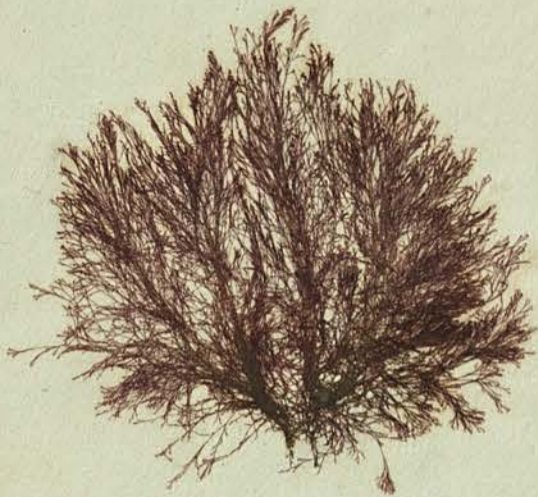
Joppa.  
2/82.



*rubrum*, var. *decurrens*. G.M.T.  
*Ceramium diaphanum*.  
(capsules) Joppa.  
12/7/82.



*Ceramium strictum*.  
Carlsferry.  
4/6/82.



*Ceramium acanthotum.* Caroline Park.  
25/5/82.



*Phylota elegans.*

Ladies Town. Elic.  
3/8/82.



*Ptilota plumosa.*  
(capsules)

Dunbar.  
Castashoe 10/6/82.



*Polyides lumbricalis*  
(fruit)

Dunbar.  
10/6/82.



*Lomentaria articulata.*

Portseton.  
18/4/82.



*Laurencia pinnatifida*  
(granules.)

Dunbar.  
Castashore. 10/6/82



*Laurencia hybrida*  
(granules)

Longquidry.  
19/6/83.



*Laurencia hybrida*  
on *Fucus nodosus*.

Joppa.  
25/6/82.



*Ahnfeldtia plicata.*  
(~~fruit~~)

Dunbar.  
10/6/82.



*Callophyllis laciniata*  
(Capsules)

Dunbar.  
Cast ashore. 19/6/83.



*Callophyllis laciniata*. Dunbar.  
(granules) Cast ashore 9/6/83.



*Catenella opuntia.* Ladies' Tower. Elic.  
3/8/82.



*Chondrus crispus*  
(fruit.)

Joppa.  
5/83.



*Chylocladia clavellosa.*  
(tetrasporus)

Carlsferry.  
Cast ashore. 1/8/82.



*Chylocladia clavellosa.*  
(Capsules)

Cock's Tail Rocks.  
Barlesferry.  
1/8/82.



*Chylocladia clavellosa*  
(young)

Dunbar.  
Cast ashore.  
19/6/83.

Cordylecladia ueta.

Goppa. 9/3/83.



*Cyrtoclonium purpurascens.*

Dunbar.  
Castashore. 10/6/82.



*Cystoclonium purpurascens.*  
var. *cirrhosa.*

Longniddry.  
19/6/82.



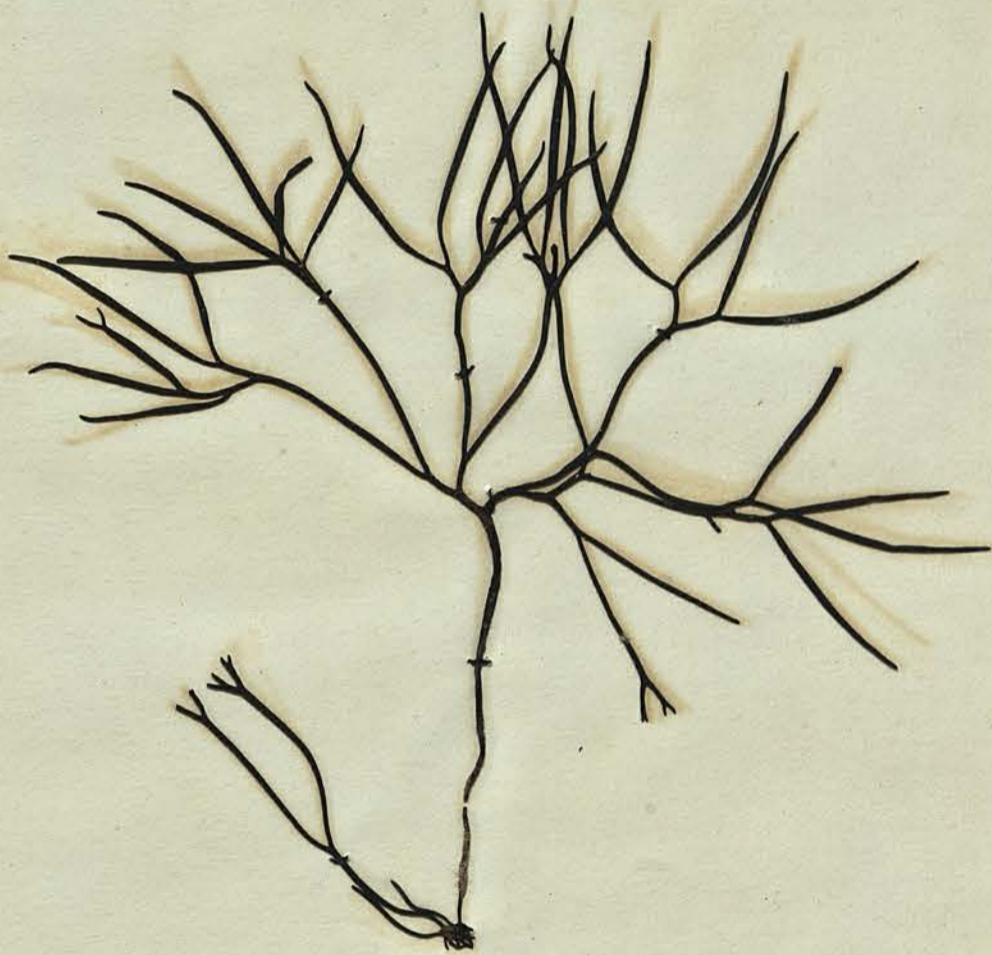
*Dumontia filiformis*

Earlsferry.  
4/8/82.



*Dumontia filiformis*  
var. *crispata*.

Joppa.  
27/4/82.



*Furcellaria fastigiata.*

Earlsferry.  
2/8/82.



*Gigartina mamillosa*  
(fruit)

Inch Keith.  
2/6/83.



*Gigartina mamillosa?*  
(fruit)

Joppa.  
6/83.



*Gyrodia capillaris.*  
(fruit)

Cock's Tail Rocks.  
Earlsferry.  
1/8/82.



*Phyllophora rubens.*

Carlsferry.  
2/8/82.



*Phyllophora rubens.*  
(fruit)

Joppa.  
Cast ashore 20/3/82.



*Phyllophora Brodiaei?* off Inck Keith.  
Dredged in 10 fms.  
2/6/83.



*Phyllophora Brodiaei* Inck Keith  
Dredged 5 fms.  
2/6/83.



*Phyllophora Brodiaei*  
(young)

Joppa.  
9/3/83.



*Phyllophora membranifolia* Morrison's  
(fruit) Haven.



*Phyllophora Traillii*. Holmes.

Joppa.  
9/3/83.



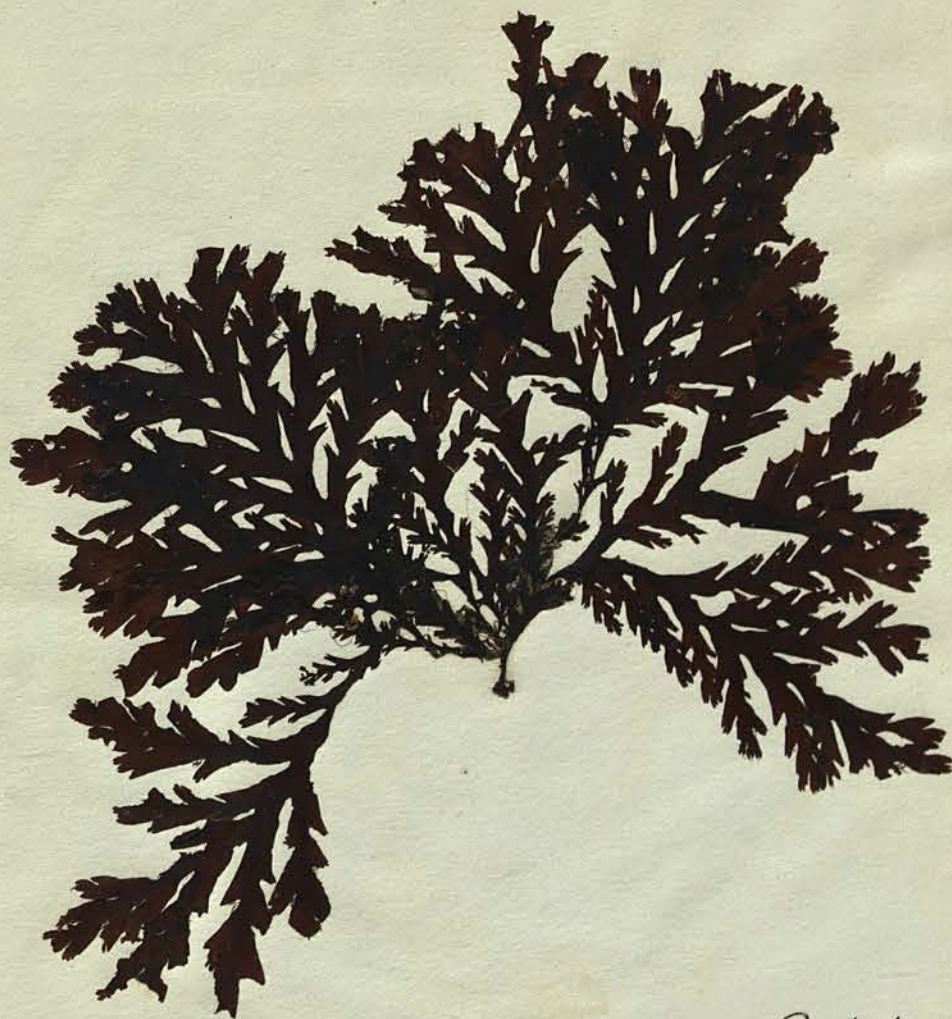
*Schizymenia edulis.*

Inch Keith.



*Schizymenia edulis.*  
(Young)

Carlsferry.  
2/8/82.



*Odonthalia dentata.*  
(stichidia)

Portobello.  
Cast ashore. 1/82.

*Gelidium corneum.*  
*var. clavatum.*

Joppa. 1/4/82.



*Odonthalia dentata.*  
(*stichidia*)

Portobello.  
Cast ashore. 1/82.



*fibrata* I think. PWS.  
*Polysiphonia unceolata?*  
(tetraspores)

Dunbar.  
10/6/82.



*Polysiphonia unceolata.*  
(capsules)

Ladies' Town, E.I.  
Castashou. 3/8/82.



*Polysiphonia formosa.*

Goppa.  
16/6/82.



*Polysiphonia nigrescens.*  
(Capsules)

Portseton.  
18/4/82.



*Polysiphonia fibrata* <sup>Bradiacei, young</sup>

Dunbar.  
9/6/83.



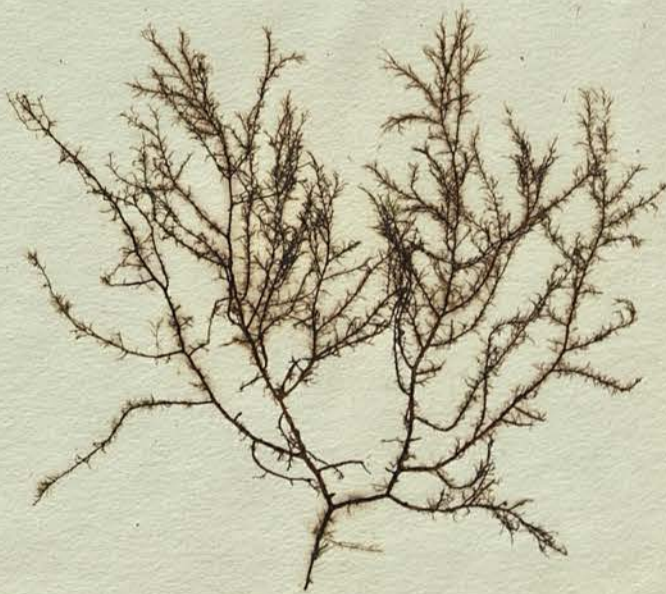
*Polysiphonia fibrata*  
(Capsules)

Longquiddy.  
19/6/83.



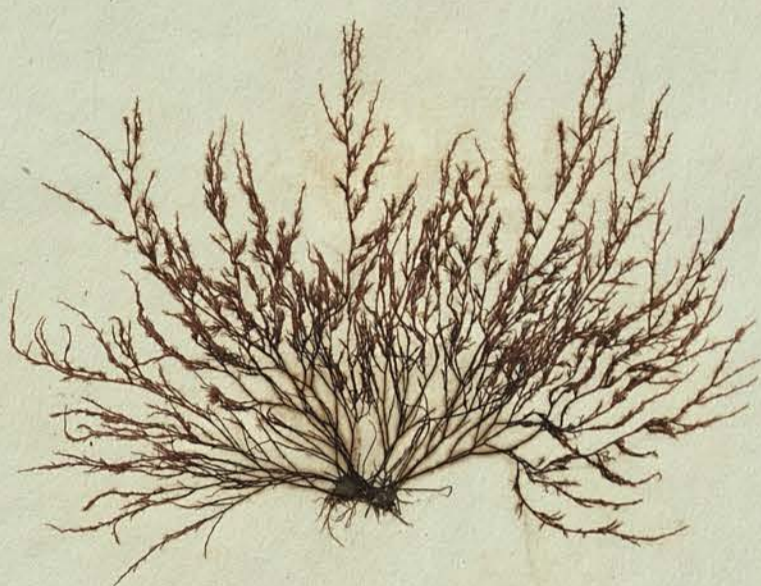
*Polysiphonia fibrillosa*  
a peculiar form.

Portseton.  
18/4/82.



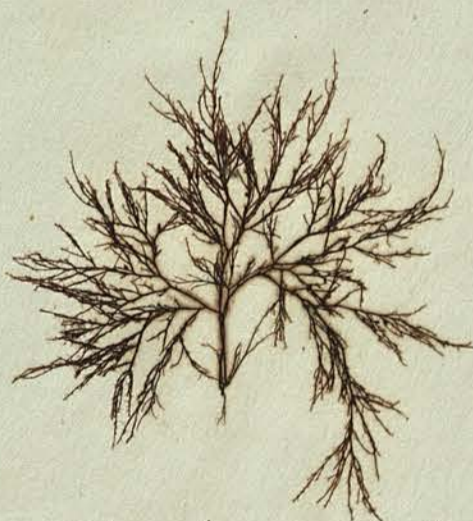
*Polysiphonia fibrillosa*  
(denuded)

Carlisle  
5/8/82.



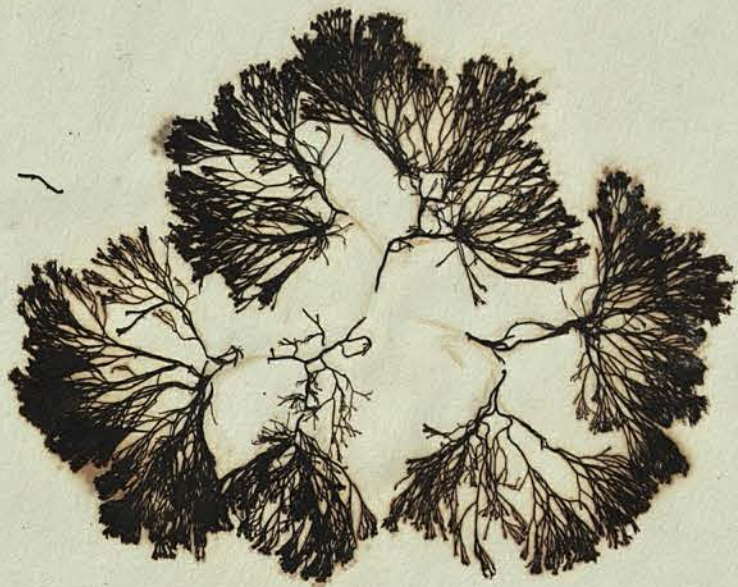
*Polysiphonia atro-rubescens.*

Longquidry.  
19/6/83.



*Polysiphonia atro-rubescens.*  
(capsules)

Longquidry.  
19/6/83.



*Polysiphonia fastigiata*  
(fruit)

Joppa.  
6/83.



*Polysiphonia parasitica*

Carlsferry.  
2/8/82.



*Polysiphonia thuyoides*?  
probably a form of *P. nigrescens* AWK.

Broxmouth  
9/6/83.



*Polysiphonia thuyoides* (?)  
(tetraspores)  
Broxmouth  
nr. Dunbar.  
19/6/83.



*Rhodomela lycopodioides.*

Dunbar.  
Cast ashore. 10/6/62.



*Rhodomela subfusca.*  
(granules)

Joppa.  
3/83.



*Rhodomela subfusca.*  
with *Ptilota elegans.*

Dunbar.  
9/6/83.



*Hydroclathrum sanguineum*

"Crookit Kelly," Carleferry.  
2/8/82.



*Hydrolapathum sanguineum*

Dunbar.  
Cast ashore. 19/6/83.



*Plocamium coccineum.*  
(*Stichidia*)

Dunbar.  
Cast ashore. 9/6/83.



*Plocamium coccineum.*  
(Capsules)

Ladies Tower. Elic.  
Castashore. 3/8/82.





*Delesseria sinuata*

Inchkeith  
Cast. ashore. 2/6/83.



*Delesseria sinuosa.*  
(young)

Joppa.  
27/5/82.



*Delesseria sinuosa*  
(fruit)

Newhaven.  
Castashore 1/82.



*Delesseria alata.*  
(capsules)

Craigropton  
2/82.



*Nitophyllum laceratum.*

Dunbar.  
Cast ashore. 9/6/83.