BRITISH SEA-WEEDS.

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A

MANUAL

OF THE

BRITISH MARINE ALGÆ:

CONTAINING

GENERIC AND SPECIFIC DESCRIPTIONS OF ALL THE KNOWN
BRITISH SPECIES OF SEA-WEEDS.

WITH PLATES TO ILLUSTRATE ALL THE GENERA.

BY

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JOHN VAN VOORST, PATERNOSTER ROW.
M.DCCC.XLIX.

"Vere magna et longe pulcherrima sunt etiam illa, profundissima sapientia hic exstructa opera tua, OH JEHOVAH! quæ non nisi bene armatis nostris oculis patent! Qualia autem erunt denique illa, quæ sublato hoc speculo, remota mortalitatis caligni, daturus es tuis, Te vere sincero pectore colentibus! Eheu qualia!"—*Hedwig.*

TO

MRS. GRIFFITHS,

OF

TORQUAY, DEVON,

A LADY WHOSE LONG-CONTINUED RESEARCHES HAVE, MORE THAN THOSE OF ANY OTHER OBSERVER IN BRITAIN, CONTRIBUTED TO THE PRESENT ADVANCED STATE OF

MARINE BOTANY,

AND WHOSE NUMEROUS DISCOVERIES, COMMEMORATED IN THE GENUS

GRIFFITHSIA,

ENTITLE HER TO THE LASTING GRATITUDE OF HER FELLOW-STUDENTS,

THIS VOLUME,

WHICH OWES MUCH OF WHATEVER VALUE IT MAY POSSESS TO HER LIBERAL DONATIONS OF RARE SPECIMENS, AND HER ACCURATE OBSERVATIONS UPON THEM,

IS RESPECTFULLY INSCRIBED,
BY HER FAITHFUL AND OBLIGED FRIEND,

THE AUTHOR.

Trinity College, Dublin,
June 30, 1849.

ADVERTISEMENT TO THE SECOND EDITION.

Eight years have now elapsed since the publication of the first edition of this work, and during this period much has been done, both in this country and on the Continent of Europe, to further our acquaintance with the Algæ. Many new species have been discovered,—the natural result of a greater attention to the subject; and much has been done to advance our knowledge of the structure and fructification of these plants. From both circumstances have resulted many improvements in classification; and if we admit that much still remains to be done before our classification can be considered perfect, we may also congratulate the numerous company of British Algologists on the progress that has been made in illustrating their favourite branch of study, and on the flourishing condition to which it has arrived.

In the present edition an improved distribution of the marine species, particularly of the *Red sea-weeds* (Rhodospermeæ) has been, it is hoped, introduced. I have been forced, however, to omit the fresh-water Algæ, which were included in the first edition, for two reasons: first, because they have recently been treated at large in a separate work, by a cotemporary; and secondly, because my attention has been so exclusively turned to the marine Algæ, whilst engaged on the Phycologia Britannica, now in course of publication, that I have not had sufficient leisure to study the fresh-water species with the care that their intricacy demands.

No great changes have been made in the descriptive portions of the work, with the exception of improved generic and specific characters where such improvement seemed needed; and the introduction, at the commencement of each *Order*, of short descriptions and remarks in illustration of the variations in habit observed among the species, their geographical range, and anything peculiar connected with their history.

The general Introduction has been, with some small corrections, for the greater part, retained; very little has been added, but several passages have been struck out, the substance of which will be found embodied in the introductory observations prefixed to the orders. The most important improvement in this new edition consists in the plates to illustrate the genera. These, it is hoped, will be found sufficiently full to enable the student, with the help of the descriptions, to ascertain the genus to which any sea-weed he may find belongs. It is not intended, in a work like the present, to give full analytical or anatomical details in such figures, but sufficient analysis is given for practical purposes.

Trinity College, Dublin,

June 30, 1849.

PORTRAIT OF PROFESSOR HARVEY.

It was the intention of the Publisher to have prefaced this volume with a portrait of the Author. The Author's absence in the New World prevents this until his return, which is not expected before Midsummer, 1850. As soon after this time as the engraving can be finished, the Publisher will deliver the print, free of charge, in exchange for this notice, which purchasers of the work are solicited to sign and present, either direct, or through their respective Booksellers.

John Van Voorst.

Paternoster Row, London,

December 20, 1849.

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INTRODUCTION.

Whoever has paid the slightest attention to the classification of natural objects, whether plants or animals, must be aware, that if we desire to follow natural principles in forming our groups,—that is, to bring together such species as resemble each other in habit, properties and structure,—it is a vain task to attempt to define, with absolute strictness, the classes into which we are forced to combine them. At least, no effort to effect this desirable object has yet been successful. Natural groups are so interwoven into each other, and often exhibit such an exaltation and degradation of characters within the limits of an Order or a Genus, that the distinctive marks, as they approach each other, gradually disappear, and two tribes, which in the more highly developed species scarcely resemble each other, are found, in the lower, to be either undistinguishable or with difficulty distinguished. Thus, to a common observer, the *Poppy* and the *Fumitory* would scarcely be supposed to be closely related; yet there is so much gradation between them, through allied genera, that some botanists have placed them in the same Natural Order. Still more unlike in appearance are the *Rose* and the *Shamrock*, yet they belong to Orders so closely connected, that the only invariable mark by which they can be distinguished is, that in one, what is called the *odd* segment of the calyx is posterior, while in the other it is anterior; and till this was pointed out by Mr. R. Brown, botanists were at a loss to *define* the respective orders, though very seldom indeed puzzled as to whether a genus were Rosaceous or Leguminous. If it be thus difficult to *define* groups among highly organized plants, it can be no matter of wonder that when we come to the Cryptogamia, whose structure is so much more simple and uniform, and whose forms are still more sportive, the difficulties become vastly increased. But it fortunately happens that these difficulties are much more formidable on paper than in the field. Thus, while the system-maker, in his study, may puzzle his brains with the fruitless task of attempting to express in words a diagnostic which shall include every species of the class Algæ, and, at the same time, exclude every denizen of the allied groups, Fungi and Lichenes; the student, roaming through the fields or along the sea-shore, finds no difficulty whatever in recognising a *sea-weed*, as distinct from a *mushroom* or a *Lichen*. The search into structure and affinities among the works of creation is something like that after first principles. We can distinguish and analyse up to a certain point: there we are stopped by that invisible and intangible, but impassable veil, behind which the Creator hides his operations. At this point we must rest satisfied with differences which we can *see*, but which we cannot *know* or *define*. Dismissing, therefore, speculations on the exact limits between Algæ and all other tribes, let us proceed to consider the subject more immediately before us, namely, the *habit*, *structure*, *geographical distribution* and *uses* of these plants.

The name Algæ, under which the Lichens were formerly included, is now limited by botanists to that large group or *Natural Class* of Cryptogamic or flowerless plants, which forms the principal and characteristic vegetation of the *waters*. The sea, in no climate from the polar circle to the equator, is altogether free from Algæ, though they abound on some shores much more than on others, a subject which will come particularly under notice when we speak of the distribution of their several tribes. Species abound likewise in fresh water, whether running or stagnant, and in mineral springs. The strongly impregnated sulphureous streams of Italy, — the eternal snows of the Alps and arctic regions, — and the boiling springs of Iceland, have each their peculiar species; and even chemical solutions, if long kept, produce Algæ. Very few, comparatively, inhabit stations which are not submerged or exposed to the constant dripping of water; and, in all situations where they are found, great dampness, at least, is necessary to their production.

Thus extensively scattered through all climates, and existing under so many varieties of situation, the species are, as one would naturally suppose, exceedingly numerous, and present a greater variety in form and size than is observable in any other tribe of plants whose structure is so similar. Some are so exceedingly minute as to be wholly invisible, except in masses, to the naked eye, and require the highest powers of our microscopes to ascertain their form or structure. Others, growing in the depths of the great Pacific Ocean, have stems which exceed in length (though not in diameter) the trunks of the tallest forest trees; and others have leaves that rival in expansion those of the Palm. Some are simple globules or spheres, consisting of a single *cell* or little bag of tissue filled with a colouring matter; some are mere strings of such cells cohering by the ends; others, a little more complex, exhibit the appearance of branched threads; in others, again, the branches and stems are compound, consisting of several such threads joined together; and, in others, the tissue expands into broad flat fronds. Only the higher tribes show any distinction into stems and leaves, and even in these, what appears a stem in the old plant, has already served, at an earlier period of growth, either as a leaf, as in *Sargassum* and *Cystoseira*, or as the midrib of a leaf, as in *Delesseria.* A few exhibit leaves or flat fronds formed of a delicate, perforated net-work, resembling fine lace or the skeletons of leaves, a structure which is also found among zoophytes. Of those so constructed, the most remarkable are the New-Holland genus *Thuretia,* the East-Indian *Dictyurus* (*Callidictyon*, Grev.), and *Martensia,* a genus lately discovered at Port Natal, in South Africa, by Dr. Krauss, which produces fan-shaped fronds, the lower half of which has the structure and colour of *Nitophyllum,* the upper that of the delicate net-work of *Thuretia.* *Claudea,* one of the most singular of all the Algæ, has a reticulated frond of somewhat different structure. In this plant the phyllodia are not formed by the simple interlacement of fibres, or the perforations of a membrane, but by the anastomosing of minute, ribbed leaflets, which are at first free, and gradually connect their points with the rib of the leaflet next above them. The new originate all at the upper side of the older leaflets, and stand at right angles with them; thus a net-work is soon formed, and as the distances between the leaves are small, the structure is delicately lacy.

Among British Algæ, the only structure analogous to these exists in *Hydrodictyon*, a fresh water Alga, which grows in the form of a perfect net, with regular meshes.

The *substance* of which the frond consists is as variable as the form. Some are mere masses of slime or jelly, so loose that they fall to pieces on being removed from the water; others resemble, in feel and appearance, threads of silk; some are stiff and horny; others are cartilaginous, or with the aspect and elasticity of gristle; others tough and coriaceous, or resembling leather; while the stems of some of the larger kinds are almost woody. The leaves of some are delicately membranaceous, glossy and transparent; of others, coarse and thick, and either wholly destitute of nerves, or furnished with more or less defined ribs, or beautifully veined. Several have the power of withdrawing carbonate of lime from the water in which they grow, and laying it up, in an organized state, in their tissues. Among fresh-water species, particularly of the *Rivulariæ*, we find the first imperfect exhibitions of this remarkable power, but in some of these the lime occurs in such lumpy masses, that it may perhaps rather be regarded as an incrustation, through which the plant continually grows. In the marine *Corallines*, and in several of the orders *Siphonaceæ* and *Batrachospermaceæ*, the secreting process is too perfect for the lime to be considered as an incrustation. It is obviously necessary to the perfect development of the vegetable. Some of the least perfect of the *Corallines*, the *Melobesiæ* or *Nullipores*, resemble masses of calcareous matter, not at all unlike the incrustations formed in water strongly impregnated with carbonate of lime; but when we place these apparent rocks into acid for a short time, until the lime is partly dissolved, there remains a delicately cellular structure, of the full form and size of the original mass, and built in a perfectly regular manner. In the cells of this body, and the interstices between them, the particles of lime had been arranged. Among the most minute kinds, many (comprising the family *Diatomaceæ*) are cased with organized *silex*, and these cases, which resist the action of fire, are found in countless myriads in a fossil state, in many countries, covering miles of ground, or forming mountains, and presenting to the naked eye a whitish, powdery substance, known by the name of "mountain meal."

In *colour*, the Algæ exhibit three principal varieties, with, of course, numerous intermediate shades, namely, *grass-green*, *olivaceous*, *red*. The *grass-green* is characteristic of those found in fresh water, or in very shallow parts of the sea, along the shores, and generally above half-tide level; and is rarely seen in those which grow at any great depth. But to this rule there are exceptions, sufficiently numerous to forbid our assigning the prevalence of this colour altogether to shallowness of water. Several of the more perfect *Confervеæ* and *Siphoneæ* grow beyond the reach of ordinary tides; and others, as the beautiful *Anadyomene*, are sometimes dredged from very considerable depths. The great mass, however, of the green-coloured species, are inconsiderably submerged. The *olivaceous-brown* or *olive-green* is almost entirely confined to marine species, and is, in the main, characteristic of those that grow at half-tide level, Algæ of this colour becoming less frequent towards low-water mark; but an olivaceous vegetation frequently occurs also at greater depths, in which case it is very dark, and passes into brown or almost black. The *red* also, is almost exclusively marine, and reaches its maximum in deep water. When red sea-weeds grow above half-tide level, they assume either purple, or orange, or yellow tints, and sometimes even a cast of green, but in these cases their colour is sometimes brightened by placing the specimens, for a short time, in fresh water. The red is rarely very pure much within the range of extreme low-water mark, higher than which many of the more delicate species will not vegetate; and those that do exist degenerate in form as well as in colour. How far below low-water mark the red species extend has not been ascertained, but those from the extreme depths of the sea are of the olive series in its darkest form. For the colours of these last it has puzzled botanists not a little to account. It is well known that *light* is absolutely necessary to the growth of land-plants, and that the green colour of their foliage altogether depends upon its supply: if placed in even partial darkness they quickly acquire a sickly yellowish hue, and finally become white. But with Algæ it is different. At depths to which the luminous rays, it is known, do not penetrate, species exist as fully coloured as those along the shore. They therefore, in this respect, either differ from all other plants (Fungi included), or perhaps, what are called the *chemical* rays, in which seem to reside the most active principles of solar light, may be those which cause colour among these vegetables, and *may* penetrate to depths to which luminous rays do not reach. But this is mere supposition. However this may be, it is worth remarking that this property among Algæ, of producing vigorous growth and strong colour without the agency of light, affords another link between them and the animal kingdom, among the lower tribes of which light is by no means essential to growth and the most brilliant colour.

There is this difference also in the distribution of colours among Algæ to what obtains among other plants. Among plants in general, nothing is so variable or uncertain as colour: far from serving as a mark to distinguish groups or genera, colour does not even aspire to the rank of a specific character, and the utmost to which it can pretend is to separate one variety of a species from another. Among Algæ, on the contrary, it has been ascertained that the classes of colour enumerated above, are, to a great extent, indicative of structure, and consequently of natural affinity. Thus, the *green* species are of the simplest structure, and differ remarkably in their mode of propagation from either of the other tribes, their spores being endowed at the period of germination with a sort of motion, which some have called voluntary, but which does not really possess that animal property. The *olivaceous* are the most perfect and compound in the structure of their organs of vegetation, and reach the largest size; and the *red* form a group distinguished not less by the beauty and delicacy of their tissue, than by producing spores under two forms, thus possessing what is called a double fructification. Hence, modern botanists, since the publication of Lamouroux's system, have, whatever their particular views of arrangement may be, almost invariably used *colour* as one of the principal characters on which their systematic arrangement is based; and to a great extent it may be safely trusted.

But the young student must be careful not to place too absolute dependance on colour alone, in referring plants which he may gather to their place in the system; for some species, which in their healthy state are red, or of that class of colour, become, when growing under unfavourable circumstances, of an orange, yellowish, whitish, or greenish shade. *Laurencia pinnatifida* is particularly variable in this respect. When this species grows near low-water mark, it is of a fine, deep, purple-red; a little higher up it is dull purple-brown; higher still a pale brownish red, and, at last, near high-water mark, it is often yellowish or greenish. The other species of *Laurencia* vary in similar but less striking degrees. *Chondrus crispus* too, when found in shallow water, exposed to strong sunlight, is often of a bright herbaceous green; and *Ceramium rubrum* passes through every shade of red and yellow, and at last degenerates into a dirty white, before it ceases to grow. All these species vary in form and size, as they do in colour, and the various anomalous shapes that they assume are almost sure to deceive a young botanist into the belief that the varieties are so many different species.

Many Algæ, whilst growing under the surface of the water, reflect colours which perish almost immediately after they are removed to the air. Of this class are several species of *Cystoseira*, especially *C. ericoides*, which, though really of a greenish olive, appears, when growing under water, to be clothed with the richest phosphoric greens and blues, changing momently, as the branches move to and fro in the water. Similar colours have been observed, though in a less striking degree, on some species of the *red* series. The genus *Iridæa* derives its name from this character, though our *I. edulis* is not remarkable in this respect. *Miss Ball* and *Mr. W. Thompson* have observed *Chondrus crispus* to be occasionally iridescent. At the Cape of Good Hope, *Champia compressa* and *Chylocladia capensis* present very brilliant rainbow colours. *Miss Hutchins* observed that *Conferva Hutchinsiæ* has changeable glaucous tints when fresh, and looks almost white when seen through the water. The cause of these brilliant colours has not been particularly sought after.

There are other species which really change colour shortly after their removal from the water, as the various kinds of *Sporochnoideæ*, which pass rapidly from a clear olive to a verdigris-green. But this is the effect of death and incipient decomposition, for with the colour they lose their crispness, become flaccid, and emit an offensive odour, and, as has been observed by botanists, possess the remarkable property of changing the colour of other small filiform Algæ with which they may come in contact. No doubt this is owing to the development of some active chemical agent. *Professor Mertens*, in describing the circumstance as occurring with *Desmarestia ligulata* and

D. aculeata, says, that these species remain unaltered while they cause decay around them. But this I have not found to be the case. The *Desmarestia* always loses its rigidity, and its original olive is changed to verdigris before it possesses any destructive power. The *Fucoideæ* become black on exposure to the air. The *Laminariæ*, on the contrary, first become green and finally white, under similar circumstances. Many of the *Florideæ* are much brightened in colour after having been cast upon the beach, especially if exposed to rain and sunshine. Amongst those of our own shores, *Plocamium coccineum* and *Dasya coccinea* are conspicuous in this respect. Both are, originally, of a dull, deep pink, but when thrown up and a short time exposed, become of a very rich scarlet-crimson. But *Gelidium cartilagineum*, so common at the Cape of Good Hope, often presents the most splendid gradation of colour in a single specimen, from dull purplish pink (its original dye) through scarlet, orange, yellow, and verdigris-green to white; to which colour all the red and green species may be bleached after long exposure.

Among the more delicate tribes several are instantly altered by being plunged into fresh water. *Nitophyllum versicolor*, as *Mrs. Griffiths* has observed, is remarkable in this respect; its full pink being instantly changed to a bright orange. *Delesseria hypoglossum* and *ruscifolia* have the same peculiarity, as have many of the *Callithamnia* and *Griffithsia*, and other delicate Rhodosperms. All these changes are accompanied by decomposition. In the case of *Griffithsiæ** especially, shortly after the change, the colouring matter of the joints is abundantly discharged with a crackling noise through the ruptured membrane, staining with a beautiful carmine colour the water or the paper to

* See an excellent description of this in a paper by Dr. Drummond, of Belfast, in 'Mag. Nat. Hist.' vol. ii. p. 121.

which the specimen has been removed. No doubt a fine lake could be prepared either from *G. setacea* or *multifida*, could they be procured in sufficient quantity. Paper stained by them retains its colour after many years in the herbarium. At the Cape of Good Hope there is a species of *Callithamnion* (*C. purpuriferum*), which, when growing, is of a dull, deep, grayish brown, with but a slightly reddish hue; but the moment it is placed in fresh water it discharges an abundance of fine, brilliant, purple powder, and almost immediately becomes flaccid and putrid. The beautiful *Thorea ramosissima*, lately discovered by Mr. Mc'Ivor in such abundance in the Thames, at Walton Bridge, is at first of a dark olive, but gradually acquires, after it has been dried, a purple tint. Many of the *Polysiphoniæ* also, which are, when growing, of a brown colour, become, in fresh water, purple or pink; while some of the same group, as *Rytiphlæa complanata*, &c., which are at first red, give out, in fresh water, quantities of blackish brown juice, and would become wholly black if dried without long previous steeping. Heat converts the colour of most species to green. If any of the *Fucaceæ* be plunged in boiling water they rapidly assume a bright green, but, on removal, revert to their original olive, and finally to black. The colours of the Rhodosperms may be more permanently changed, and also to green, by similar treatment. *Dictyotaceæ* perhaps are less affected by fresh water, either cold or hot, than any others. Some of them are nearly unchanged; others assume more or less of a green shade.

Most Algæ are, at some period of their growth, found attached to other substances by means of a *root*, or at least a hold-fast. It has been doubted whether, as no distinct vessels of absorption have been discovered, they receive any nourishment through this organ, but the question is by no means settled. Thus much is at least certain: some

Algæ appear to be as much influenced by the soil in which they grow as other plants are, and a large number of those that are parasitical confine themselves to particular species. This selection of habitat would seem to prove that the root is not so sluggish an organ as it has been supposed to be. It does not, however, present much modification, and rarely attains a large size. The usual form is that of a hard, callous disk; sometimes this is accompanied by fleshy fibres; and occasionally, but rarely, the root consists of an extensive creeping mass of fibres. This latter form is most remarkable in the genus *Caulerpa*, the species of which grow on sand, and consequently require the support of an extensively ramified, penetrating and compact root. Some species, which, under ordinary circumstances, are attached by roots, occasionally dispense with them, and continue to flourish independently of them. Of these the most remarkable are *Sargassum bacciferum* and *vulgare* (?), which, under the Spanish name "Sargasso," or the English "Gulf-weed," have forced themselves on the notice of all voyagers who have crossed the Atlantic since the time of Columbus. The vast fields of sea-weed which were met with by "the adventurous Genoese" and his early followers, which made the ocean appear like a meadow, and sensibly impeded the course of their small vessels, consisted of these species. According to Humboldt there are two principal banks; one, the largest, extending from the 25th to the 36th degree of north latitude, and a little west of the meridian of Fayal, one of the Azores; the other, which is much smaller, a short way west of the Bahamas, and between the 22nd and 26th degrees of latitude. These localities of the banks, however, can but be considered as approximations, for with plants that float about wherever the winds and currents drive them no very certain station can obtain. Vessels returning from the Cape of Good

Hope, sometimes, in these latitudes, pass through immense fields of sea-weed; and others, though steering exactly the same course, and at the same season, meet with scarcely any. I have made the voyage four times, and only once met with sea-weed in sufficient quantity to claim any attention. It did not then occur in strata resembling fields, but rather in ridges, from ten to twenty yards broad and of great length, stretched across the sea. The species invariably found in these was *S. bacciferum.* Of a large quantity that we dredged up for several successive days not a particle belonged to *S. vulgare,* and I am much inclined to suspect that most, if not all, of the stories related by voyagers as of that species, belong to *S. bacciferum,* a plant which has never been found in any other situation than floating about in the deep sea, whereas *S. vulgare* (the *Fucus natans* of Turner) is well known in many tropical countries to grow on the rocks, within the reach of the tide, like others of the genus. It is therefore much to be regretted that the name of *natans* was not retained for *S. bacciferum,* to which it is chiefly, if not only, applicable. Authors who have written on this *Fucus* have much disputed, both respecting its origin and whether it continues to grow whilst floating about. Nothing at all bearing on the former question has yet been discovered, for though species of *Sargassum* abound along the shores of tropical countries, none exactly corresponds with *S. bacciferum.* That the *Ancestors* of the present banks have originally migrated from some fixed station is probable, but farther than probability we can say nothing. That it continues to flourish and grow in its present situation is most certain. Whoever has picked it up at sea, and examined it with any common attention, must have perceived not only that the plants were in vigorous life, but that new fronds were continually pushing out from the old, the limit being most clearly defined by the *colour,* which in the old frond is foxy-brown; in the young shoots pale, transparent olive. But how is it propagated?—for it rarely produces fructification. It seems to me that the old frond, which is exceedingly brittle, is broken by accident, and the branches, continuing to live, push out young shoots from all sides. Many minute pieces that I examined were as vigorous as those of larger size, but they were certainly not seedlings, and appeared to me to be broken branches, all having a piece of *old frond* from which the young shoots sprung. As the plant increases in size it takes something of a globular figure, from the branches issuing in all directions, as from a centre. On our own shores we have two species analogous to *S. bacciferum* in their mode of growth, namely, *Fucus Mackaii*, and the variety β. *sub-ecostatus* of *Fucus vesiculosus*, (*F. balticus*, Ag.) Neither of these has ever yet been found *attached*, though they often occur in immense strata; the one on the muddy sea-shore, the other in salt marshes; in which situations, respectively, they continue to grow and flourish. And if it be hereafter shown that *F. Mackaii* is merely *F. nodosus*, altered by growing under peculiar circumstances, may it not be inferred that *S. bacciferum*—which differs about as much from *S. vulgare* as *F. Mackaii* does from *F. nodosus*—is merely a pelagic variety of that variable plant?

In *structure*, whilst there is a great variety among the different tribes of Algæ, we find, in material points, a perfect similarity among all. All consist of simple cellular tissue, or of its elements, *gelatine* (or organic *mucus*), *membrane*, and *endochrome* (or *chlorophyll*), variously elaborated and perfected. No vessels or ducts have been discovered in any, nor does woody fibre, though of common occurrence among the *Fungi*, exist in the *Algæ*. The *gelatine* (or *mucus*) is perfectly transparent in all, but differs greatly in consistency in different species, but without much regard, seemingly, to the comparative perfection of the structure of which it forms a part. It is often as lax and as slimy in some plants of the higher tribes as in those of lower organization, and some of the latter have it as firm and consistent as any of the former. Thus the frond of *Champia* and *Chylocladia* among Laurenciaceæ is filled with a watery gelatine; that of *Splachnidium* among Fucaceæ with a loose, slimy matter; whilst *Rivularia* among Oscillatoriaceæ has a singularly firm and consistent jelly. In *Mesogloia* it is very loose, investing the threads of which the frond is composed with a lubricous sheath. In *Gigartina*, *Chondrus*, &c., it is so firm as to give those plants the consistence of cartilage, and in these it is immediately dissolved in hot water, opening to us a curious and unexpected affinity between them and *Mesogloia;* for if a branch of any *Gigartina* be plunged into hot water it will be converted, by the dissolving of its gelatine, into one having all the characters of the frond of the former genus. Thus we find that there is no fundamental difference in the structure of the frond of these two apparently dissimilar genera, but that one has a firmer gelatine than the other.

The *cellular* tissue of Algæ presents some varieties. The most common form of the cell is cylindrical, often of very small diameter in proportion to its length; and, in such cases, the cells always cohere by the ends into threads or *filaments*, bundles of which, either branched or simple, form the *frond* by lateral cohesion. The fronds of many of the simple kinds, *Confervеæ*, *Ceramieæ*, &c., consist of a single thread, or string of cells or *joints*. Those which are more compound may generally be resolved into such threads by macerating small portions, either in hot water, or, if that prove ineffectual, in diluted muriatic acid. If a branch of a *Fucus* (say *F. tuberculatus*), be so treated, and a thin longitudinal slice be then examined with the microscope, it will be found to consist of four distinct portions concentrically arranged, which Lamouroux, who first observed minutely the anatomy of these plants, compares, perhaps too fancifully, to the epidermis, bark, wood, and medullary sheath of exogenous plants. The central portion, corresponding to the medulla, occupies fully a third of the diameter of the branch, and is composed of densely packed, longitudinal, parallel fibres, or strings of cells, firmly cohering into one compact mass. Outside this is a much less dense layer, of a paler colour, composed of branched, anastomosing fibres, partly horizontal and partly vertical, inextricably laced together; and surrounding these, which represent the wood, is a third and much denser and darker coloured layer (bark), which is altogether composed of horizontal, radiating, simple fibres, very densely packed together. Outside this portion, and forming the outer coat of the frond, is a very thin layer of cells, which is frequently but loosely attached, and separates much in the manner of an epidermis. Something similar to this, which we may call the *analogy* of the Exogenous type among Algæ, is the structure of many of the larger kinds, both of the red and olive series, but minor variations occur in the comparative substance of the different layers. Thus, in some the centre is very loose and gelatinous, with merely a few scattered fibres, while the outer coat is very dense. The second circle (that representing wood) is never, I believe, so dense as the others, and very generally consists of branched, interlacing and colourless fibres, and from it fructification generally, if not always, proceeds. Another common form of the cell is that of an irregular, very rarely regular, polygonal solid, resulting from the lateral and vertical pressure of a mass of spherical cells. This form is found generally in the *Ulvæ*, and in most species having large expanded leaves, especially among the

Rhodospermeæ, where both stems and leaves are often composed of a homogeneous mass of such cells packed together.

In *fructification* we find many modifications of structure, without much real difference either in the manner in which the fruit is perfected or in the spore that is produced. The spore that is finally formed in all the Algæ appears pretty nearly to agree in structure, and to consist of a single cell or bag of membrane, filled with a very dense and dark coloured granular or semifluid mass, called the *endochrome*. This spore, on germination, produces a perfect plant, resembling that from which it sprung. Nothing at all resembling floral organs has been noticed in any, and all that we know of the fructification is, that it takes place with regularity, arising from the same parts of the frond, and having the same appearance in plants of the same kind. Its growth may be watched from the commencement, when the germ of the future spore begins to swell. But little has been ascertained that throws light on the process of fecundation. In some instances, it is true, as for example in *Zygnema*, the spore is formed from the union of the matter contained in a cell of one filament with that in a cell of another, and it has been observed that the cells of one filament uniformly give out, and that those of another uniformly receive; but before conjugation no difference whatever can be perceived between the two filaments. This, which occurs in a tribe of very low organization, affords the nearest analogy that has yet been noticed with what takes place in higher plants. If it have any real affinity with that process, we may fairly expect the discovery of sexes in the more perfect tribes; and the seeming analogues of male flowers have indeed been noticed in some of these. Old authors invested the air-vessels of *Fucus*, or the tufts of hairs that clothe the surface of some species with this character; but both opinions have been long since given up as untenable. The recent observations of Messrs. Decaisne and Thuret* have shown the existence, in the *Fuci*, of organs similar in many of their characters to what are supposed to be the male organs of *Mosses*, *Charæ*, *Hepaticæ*, &c. The little bodies called by these authors *antheridia* (a name now adopted) had been previously observed, and referred, under the name *acrospores*, to the female system of the plant. They are found in the spherical conceptacles of the *Fucus*, either in those which also contain spores or in others, which they exclusively occupy, and which do not differ from female conceptacles in any other character than by their contents. The *antheridia* are little transparent cases, each formed of a cell, borne on branching threads, that form little tufts springing from the sides of the conceptacle. At maturity the *antheridia* fall off from their stalks, and then appear more or less filled with orange-coloured granules of very minute size. After a time these granules escape, and immediately commence most lively movements, strikingly similar to those observed in the spores of the Chlorosperms. Under very high powers of the microscope each corpuscle is found to be furnished with two active cilia or hairs, which are its organs of motion. The shape of these little bodies is different from that of the spermatozoa found in the supposed anthers of the *Mosses* and *Hepaticæ*, but their motion by means of cilia is very similar, and there seems no reason to doubt their analogy with those objects. They are best observed in winter, at which season many of the fronds of *Fucus serratus* and *F. vesiculosus* will be found covered with orange-coloured or bright yellow receptacles. If some of the brightest coloured fruits are selected and allowed

* In the 'Annales des Sciences Naturelles.

partially to become dry, drops of an orange, viscid liquid will ooze out of the pores of the conceptacles, and collect on the surface. If a small portion of this fluid, diluted by a drop of sea water, be now placed under the microscope, it will be found to consist of myriads of detached antheridia, in all stages of fullness, among which troops of spermatozoa will be seen performing their strange gyrations. Such is the nature of the supposed male system of the Fuci. Its analogy with the antheridia of the mosses is obvious, but observations are still wanting to show that the spermatozoa in either case have any connexion with the fecundation of the spores. If we limit our assertions by the present state of our actual knowledge on the subject, all that we can state with certainty is, that in those cases where the formation of spores among Algæ has been most closely watched and most successfully observed, the spore has resulted from the union of the contents of two cells. That a transmission of the endochrome from one cell to another, prior to the formation of spore, occurs in all the compound Algæ, seems probable from the fact that the cells immediately surrounding the spores are always colourless and empty, but there is nothing as yet known to prove that one cell is less adapted than another to receive the endochrome, and form the future embryo,—nothing to show that there is any clear distinction into male and female.

Experiments on the propagation of Algæ from their spores have not yet been so frequently made as the interest of the subject deserves. In our own country, I am not aware that any one since *Mr. Stackhouse*, in 1796, has attempted it. This gentleman attempted to grow some of the *Fuci*, and so far succeeded with *F. canaliculatus* as to witness the germination. The following account of his experiment, which I extract from his '*Nereis Britannica*,' though already more than once published, may prove interesting to those who have not seen it, and perhaps tempt botanists whose residence near the sea gives them an opportunity, to repeat the trial. "Having procured a number of wide-mouthed jars, together with a siphon to draw off the water without shaking or disturbing it, on Sept. 7, 1796, I placed my plants (*F. serratus*, *canaliculatus* and *tuberculatus*) carefully in the jar, with their bases downwards, as in their natural state; on the following morning I decanted off the sea water, and, letting it subside in the basin, I found a few particles at the bottom, which on being viewed with the microscope appeared to be little fragments detached from the surface by friction in carriage. I then poured a fresh quantity of sea water on the plants, and placed them in a window facing south: on the following morning the jar containing the plants of *F. canaliculatus* discharged into the basin a few yellowish grains, which, on examining them, I found to be the actual seeds of the plant; they were rather oval than pear-shaped, but the most curious circumstance attending the observation was, that each individual seed was not in contact with the water, but enveloped with a bright mucilaginous substance. It was easy to guess the wise economy of nature in this disposition, which, as hinted above, serves a double purpose; each equally necessary towards continuing the species. On the following morning a greater quantity of seeds were discharged by this plant, and at this time a few seeds were procured from *F. serratus*; but this latter plant discharged such a quantity of mucous fluid that the sea water in which the plant was immersed was of the consistence of syrup, and consequently, the seeds being kept suspended, it was difficult to separate them. The seeds of *F. canaliculatus*, however, were numerous, and visible to the naked eye, and after letting the water rest for a few minutes it was no difficult matter, by gently inclining the basin, to pour off the water and let the seeds remain. In performing this operation I was witness to an explosion or bursting of one of these seeds or pericarps, which agitated the water considerably under the microscope, and brought to my recollection the circumstance mentioned by *Major Velley* during his investigation of *F. vesiculosus*. I at last obtained a discharge of seeds likewise from *F. bifurcatus* (*tuberculatus*); these perfectly resembling the others. Having established this point, viz., *that marine plants scatter their seeds in their native element without violence when ripe, and without awaiting the decay of the frond*, I next procured some sea pebbles and small fragments of rock, taken from the beach, and having drained off the greater part of the water in the jar, I poured the remainder on them, and left them dry for some time that the seeds might affix themselves. I then fastened strings to the pebbles, and alternately sunk them in sea water in a wide-mouthed jar and left them exposed to the air, in order to imitate as nearly as possible their peculiar situation between high and low-water mark, and when the weather was rainy I took care to expose them to it. In less than a week a thin membrane was discoverable on the surface of the pebble where the seeds had lodged, with a naked eye; this gradually extended itself, and turned to a darkish olive colour. It continued increasing in size, till at last there appeared numerous papillæ or buds coming up from the membrane: these buds, when viewed with a glass, were rather hollow in the centre, from which a shoot pushed forth: in some instances they seemed on a short, thick footstalk, and in this latter case resembled in some measure the pezizæ-formed seedling of *F. loreus*, and the others without stems were like the stemless *Pezizæ*. These plants continued to put forth the central shoots for some time, but their growth was not rapid after the first efforts; most probably owing to their confined situation; and as I was six or eight miles from the sea, and had not the opportunity of placing the pebbles in some of those pools which are left by the sea at low water, I discontinued the experiment." It is much to be regretted that *Mr. Stackhouse*, in conducting the above experiment, did not make more use of the microscope. We are not told how the membrane proceeded from the spores, nor whether the sprouts arose from each single spore, or from several associated.

More recently, on the continent, *M. J. G. Agardh*, son of the celebrated Swedish algologist and worthy successor to his chair, has made more minute observations on the germination both of spores and of tetraspores, of several species, and has published magnified figures of the young plants in various stages of development. His memoir on this subject will be found in the '*Annales des Sciences Naturelles*,' for October, 1836; and I shall here extract some of its more interesting matter. According to him, whatever may have been the shape of the *spore* before it issued from the capsule, it soon acquires a spherical form, and is then undistinguishable from the *tetraspores* of the same species, which likewise germinates in the same manner. In his figures, for I regret to say he has not detailed the whole process, nor given an account of his method of proceeding with the plants, he has represented the first effort of germination as showing itself by the spore acquiring an oval form; a minute papilla then issues from one end, which elongates and becomes the root; the upper end likewise pushes in an opposite direction, gradually elongating, and increasing in diameter by the production of new cells, till at length it acquires the character of the species. He has figured the germination of the spores and tetraspores of *Ceramium rubrum* and *Laurencia pinnatifida*, and of the spores of *Fucus vesiculosus;* to all which the above applies. But the most interesting part of the memoir is, the account given of some curious circumstances attending the germination of some of the lower Algæ, those belonging to the *grass-green* series, (*Chlorospermeæ*, Nob., *Zoospermeæ*, Ag. fil.) I allude to the peculiar *motion* observed in the spores of several plants of this group, which has given rise, on the Continent, to some very startling theories, which have again produced much warm, not to say angry, discussion. Without entering into all that has been written on the subject, which would occupy too much space for our limits, I shall here transcribe *M. Agardh's* account of *Conferva ærea*, translating from his memoir above noticed.

"The filaments of *C. ærea* are, as is well known, articulated or divided at equal distances into little compartments (joints), which have no communication among themselves other than what results from the permeability of the dissepiments. The green matter contained in these joints appears at first altogether homogeneous, as if it were fluid; but in a more advanced state it becomes more and more granular. The granules are, at their formation, found adhering to the inner surface of the membrane, but they soon detach themselves, and the irregular figure which they present at first passes to that of a sphere. These granules congregate by degrees in the middle of the joint, into a mass, at first elliptical, but which at length becomes perfectly spherical. All these changes are conformable to phenomena known in vegetable life; those which are to follow have more analogy with the phenomena of animal life. At this stage an important metamorphosis exhibits itself, by a motion of swarming (un mouvement de fourmillement) in the green matter. The granules of which it is composed detach themselves from the mass, one after another, and having thus become free, they move about in the vacant space of the joint with an extreme rapidity. At the same time the exterior membrane of the joint is observed to swell in one point, till it there forms a little mamilla, which is to become the point from which the moving granules finally issue. By the extension of the membrane for the formation of the mamilla, the tender fibres of which it is composed separating, cause an opening at the end of the mamilla, and it is by this passage that the granules escape. At first they issue in a body, but soon those which remain, swimming in a much larger space, have much more difficulty in escaping, and it is only after innumerable knockings (titubations) against the walls of their prison, that they succeed in finding an exit. From the first instant of the motion one observes that the granules or *sporules* are furnished with a little beak, a kind of anterior process, always distinguishable from the body of the sporule by its paler colour. It is on the vibrations of this beak that the motion, as I conceive, depends; at least I have never been able to discover any cilia. However, I will not venture to deny the existence of these, for with a very high power of a compound microscope one sees the granules surrounded with a hyaline border, as we find among the ciliated Infusoria on applying a glass of insufficient power. The sporules, during their motion, always present this *beak* in front of their body, as if it served to show them the way; but when they cease to move, by bending it back along the side of their body, they resume the spherical form, so that before and after the motion one sees no trace of this beak. The motion of the sporules before their exit from the joint consists principally in quick dartings along the walls of the articulation, knocking themselves against them by innumerable shocks; and in some cases we are almost forced to believe that it is by this motion of the sporules that the mamilla is formed. Escaped from their prison they continue their motion for one or two hours, and, retiring always towards the darker edge of the vessel, sometimes they prolong their wandering courses, sometimes they remain in the same place, causing their beak to vibrate in rapid circles. Finally they collect in dense masses, containing innumerable grains, and attach themselves to some extraneous body at the bottom or on the surface of the water, where they hasten to develope filaments like those of the mother plant. The spherical sporules elongate at first into egg-shaped bags, attached to the strange body by the narrowest end. Their development only consists in a continual expansion, without emitting any root. The green internal matter divides in the middle by a partition, which appears at first sight as a hyaline mucilage, but which gradually changes into a complete diaphragm. It is thus, by successive divisions of the joint first formed, that the young plant increases. The position of the mamilla in each joint is uncertain, at least I have seen it very different in neighbouring joints. The exit of the sporules does not take place at the same time in the different joints. One often sees those of one of the articulations already escaped, while in the neighbouring one they are not yet completely formed. Commonly the uppermost joints empty themselves first, so that it is not rare to see all the upper part of a filament entirely transparent, whilst the lower part continues still to develope. In this manner the formation and dissemination of the sporules continues during the whole summer, and thus a single filament suffices for the formation of an infinite quantity of sporules. If one remembers that each joint contains perhaps many hundreds of spores, it is not astonishing that the water becomes perfectly coloured with them; so that we might readily take for a *Protococcus*, or other simple Alga, what are only the spores of a *Conferva*. I suspect that from such a mistake have arisen the theories of metamorphosis proposed by many modern algologists."

Mr. Agardh then proceeds to detail the results of his examination of *Zygnemata*, *Ulva clathrata*, *Bryopsis Arbuscula*, and other Algæ, in all which he has noticed a motion, apparently spontaneous, among the spores at the period of germination. Similar observations on other Confervoid Algæ have been made by many continental botanists, particularly by *Unger*, an abstract of whose account of *Vaucheria clavata* will be found in '*Loudon's Mag. Nat. Hist.*' *vol.* i. *p.* 305; by *Meyen*, *Bory St. Vincent*, *Guillon*, *Treviranus*, *Milne Edwards*, and others who have communicated their discoveries in several memoirs inserted in the '*Annales des Sciences Naturelles*,' '*Encycl. Méthodique*,' &c.; in fact experiments have been so multiplied by independent observers, and the result is so invariably the same, that however difficult it may be to account for these anomalous motions, and however little they may accord with our preconceived notions of the powers of vegetable life, it is not possible to doubt the fact of their existence; for we cannot suppose that all these respectable witnesses have been themselves deceived, or have wished to impose on our credulity. The *fact* of the existence of motion being granted, it will naturally be asked, how we are to account for it? Here we have vegetables producing spores which exhibit a feature that we have been accustomed to regard as one of the distinguishing characters of animal life. Are these spores then *animalcules?* This strange opinion is not without its zealous supporters, who contend that an actual metamorphosis takes place; that the spore *becomes* (*how* is not said) a perfect animalcule, which after enjoying an animal existence for a time ceases to live *animally*, and, reverting to its original nature, gives birth to a vegetable. Thus, this seed was first vegetable, then animal, and then again vegetable, and finally giving birth to animals to be again transformed into vegetables, and so on. This opinion has found many advocates among continental writers, among which we must number the elder Agardh, who speaks of the disengaged spores of *Tetraspora lubrica* as "having become animalcules;" whilst others have strongly combated it, and in England it has never been received. *Mr. Berkeley* ('Hook. Journ. Bot.' i. p. 233), in combating such notions, suggests that this motion may arise from the endosmose or exosmose caused by the spores being of a different density with the water into which they are discharged; but, as *Mr. Agardh* remarks, this cannot be the reason, for the motion equally exists in *Conf. ærea* before the spores are separated from the frond. He likewise denies the *animal* nature of the spores, observing, "the sporules have never any opening analogous to the mouth of infusorial animals, and we never perceive them to swallow any food. Their motion, however irregular and capricious it may appear, however like it may be to spontaneous motion, is easily distinguishable from motion truly animal, although this distinction may be difficult to establish by decided characters. And besides, why refuse a locomotive faculty to vegetable life, when each day we discover new indications of it? The researches of *M. Unger* on the anther of *Sphagnum* show analogous motions among the mosses; and the spermadic granules offer an example of it among phænogamous plants." It is scarcely necessary to add that I fully unite in the view taken by this ingenious writer; that we are neither to regard the phenomenon in question as caused by external agency, or as resulting from an animal existence, but receive it as a strictly vegetable peculiarity, which we are to expect will be observed in many more instances, when our insight into the very imperfectly explored regions of vegetable anatomy shall be clearer than it is. A few years ago the circulation of the juices in *Chara* was considered extraordinary; a similar

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circulation is now found in so many other plants as to lead to the inference that it is universal in the vegetable kingdom. It must be remarked, however, that as yet the motion of the sporules has only been observed in certain families, and *Mr. Agardh*, in the memoir before us, denies its existence in any but those of the series *Chlorospermeæ*, and, with doubt, in *Ectocarpus;* whence he proposes to divide the class into two great groups,—*Zoospermeæ*, having *moving* spores, and *Fucoideæ*, having *motionless* spores. But to me it appears that our knowledge of this subject is too much in its infancy to render any such division safe or expedient. Indeed, since the publication of Mr. Agardh's paper, minute bodies, endowed with analogous motion, have been discovered (as stated in a former page) in the *antheridia* of the *Fuci*, and may be expected to occur in many other Algæ. *Zoospermeæ*, as I have before observed, corresponds to our *Chlorospermeæ*, so that, without having recourse to this dubious character, the result of our arrangement is the same.

The relative distribution of plants on the surface of the globe offers a wide and interesting field of inquiry, which has of late years attracted considerable attention from botanists; and though, as we approach lower and less complicated organizations, we find the influence of climate to be less powerful in causing a difference of character among the groups, or even a dissimilarity of species, still among Cryptogamia we may discover evident traces of distinct regions of vegetation, analogous to what obtain among phænogamous plants. With respect to the *Algæ*, little has been done in this department to follow out and correct the views of *Lamouroux*, whose excellent essay, published some time after his death in the seventh volume of the 'Annales des Sciences Naturelles,' I shall take as the ground-work of the observations I am about to offer; but so little comparatively is yet known of the vegetation of extra-europæan seas, that we cannot speak with much minuteness concerning it, but must rest satisfied with a few general and hasty remarks. It appears well established among Algæ, as among more perfect plants, that the species of distant seas are, with a few exceptions, different, and this without reference to difference of latitude; thus it would seem probable that certain species had their centres of growth, from which they are disseminated within a limited range. But *Lamouroux* observes that they do not *radiate* from a centre as land plants commonly do, but rather extend in lineal series, following the lines of coast, and influenced by a common depth of water: this is, however, merely a modification of the principle that influences the former. There are, however, exceptions to this limitation of species to particular places among Algæ, as among phænogamous plants; and these are chiefly to be found among the lower tribes, which seem either to have been originally created over the whole surface of the earth, or to possess an unlimited power of dispersion. Of this kind are the species of *Ulva* and *Enteromorpha*, which are equally abundant in high northern and southern latitudes, as they are under the equator and in temperate regions; nor is there any specific difference observable between plants of these genera from such different localities; they appear to reach an equal degree of perfection in all climates. These have a very low organization, but among those a degree higher up in the scale we find *Codium tomentosum* having a range nearly equally wide; being found along all the shores washed by the Atlantic and Pacific oceans, from a high northern to a high southern latitude, as well as in the Mediterranean and Baltic seas; having thus a place in the Flora of every country in Europe, of Africa, of both sides of the American continent, and of Australia. Several of the *Conferræ*, which may be regarded as on a level in organization with *Codium*, have as wide a range. Among the *Rhodospermeæ* and *Melanospermeæ* it is more rare to find species so indifferent to climate or country, and which we may term *cosmopolitan* or *pelagic* races; but in the former we observe *Plocamium coccineum* and *Gelidium corneum* common to the Atlantic and Pacific, and even Indian oceans; *Rhodymenia palmata* found at the Falkland Islands and Tasmania; while *Ceramium rubrum* and *diaphanum* are as widely scattered as the *Ulvæ:* and in the latter, *Fucus tuberculatus* is found from the shores of Connaught (perhaps its northern limit), to the Cape of Good Hope; *F. vesiculosus* as well on the north-west coast of America as on the shores of Europe; and *Desmarestia ligulata* in the northern Atlantic and Pacific oceans, as well as at the Cape of Good Hope and Cape Horn; while *Sargassum bacciferum* and *vulgare* are proverbial wanderers, and some species of *Ectocarpus* usually accompany the *Ceramia* and *Ulvæ*. These exceptions sink into insignificance, however, when we consider the whole series of Algæ, the vast majority of which are strictly limited in dispersion; and in the following observations *Lamouroux* is substantially correct. "I have observed," says he, "that the Atlantic basin from the polar circle to the 40° of north latitude, offers a peculiar vegetation; that the same is true of the West Indian sea, comprising the Gulf of Mexico; of the east coast of South America; of the Indian ocean and its gulfs; and of the seas of New Holland. The Mediterranean * has a system

* This observation is true in the main; but many Algæ which were supposed to be peculiar to the Mediterranean when Lamouroux wrote his essay have since been detected in widely distant seas. Some have been found on the shores of Britain; several on the east coast of North America, from New York to Florida; and others sent from the still more distant shores of New Holland.

of vegetation peculiar to itself, which extends to the extremity of the Black Sea; and notwithstanding their geographical proximity, the plants of the port of Alexandria or of the coast of Syria differ almost entirely from those of Suez and the Red Sea." To these regions we may add the Chinese and Japanese seas, which contain many remarkable and peculiar forms. Too little is known of the east coast of Africa, or of the southern ocean, to speak positively of them; and of the vegetation of the Caspian we are completely ignorant. The shores of South Africa, while they possess many species peculiar to themselves, exhibit a vegetation in many respects analogous to that of Australia, with, however, some remarkable deficiencies: thus, among the most curious types of structure, *Splachnidium rugosum* is common to both; a species of *Champia* has lately been brought from Van Dieman's Land; and at Port Natal there is a plant analogous to *Claudea;* and, if we may trust *Von Suhr*, *Gelidium lucidum* and *Rhodymenia Lamberti* occur at Algoa Bay: but with these similarities to the vegetation of Australia, there is a remarkable deficiency at the Cape of the genus *Blosserillea*, a peculiar and extensive group, which gives, as we shall presently see, a prominent feature to the marine vegetation of Australia.

Many powerful causes, independently of climate, undoubtedly tend to limit the distribution of Algæ. The intervention of great depths of the ocean between localities favorable to their growth, has, as *Lamouroux* aptly remarks, a similar and analogous influence on sea plants, as the existence of high mountain ranges exercises on those of the land; the presence of extensive sand banks, which are as much sub-marine deserts as the sandy tracts of continents, are unfavorable to vegetation; strong currents; projecting capes; the fresh waters of great rivers; and a change of soil;—all these interpose to prevent the wide dissemination of species, whose spores cannot exist beyond a certain time floating about at the mercy of the waves, but must perish if they do not soon find a congenial soil and situation in which to fix themselves and vegetate. Corallines, if occurring in abundance, are generally fatal to the growth of other Algæ; and the coral reefs of the Pacific are said to be almost destitute of them. But with due allowance for all these and other modifying causes, we must look to *climate* as the grand regulator of forms among Algæ as among land plants, although it be in a less striking degree, because the temperature of the sea is so much less subject to variation, and ranges within a scale so much shorter than that of the land. It is well known that the majority of the Algæ on our own coasts reach perfection, if not of fruit, at least of foliage, in the summer months; and that warm summers have a perceptible influence in causing an abundant and a luxuriant growth of particular kinds; and there is even a marked difference between the vegetation of the opposite sides of a sub-marine rock, if one have a sunny and the other a cold exposure, precisely as we notice between one side of a hill and another. These observations, of course, apply with the greatest force to plants growing within the influence of the tide, or in shallow parts of the sea. It is possible, says *Lamouroux*, that under the Equator the plants of the bottom of the ocean, where the temperature is 4° or 5° (41° or 44° F.), have a resemblance to those of the Polar seas, and that those that grow at 100—200 fathoms are allied to those of temperate regions; but this is mere conjecture, for we know almost nothing of the deep-sea vegetation, but we do know that, under ordinary circumstances, vegetation ceases at a very moderate depth. "On the shores of the British Islands," remarks *Dr. Greville*, "it is easy to perceive that some species, *Gelidium corneum*, *Phyllophora rubens*, and *Sphærococcus coronopifolius*, for example, become more plentiful and more luxuriant as we travel from north to south; and, on the other hand, that *Ptilota plumosa*, *Rhodomela lycopodioides*, *Rhodymenia sobolifera*, and several others, occur more frequently and in a finer state as we approach the north. *Odonthalia dentata* and *Rhodymenia cristata* are confined to the northern parts of Great Britain," (the former occurs along the north coast of Ireland), "while the *Cystoseiræ*, *Fucus tuberculatus*, *Halyseris polypodioides*, *Rhodymenia jubata*, *R. Teedii*, *Microcladia glandulosa*, *Rhodomela pinastroides*, *Laurencia tenuissima*, *Iridæa reniformis*, and many others, are confined to the southern parts." Several of these, it is worth remarking, which are in England confined to the coasts of Devon and Cornwall, are found in Ireland along the shores of Clare and Galway, where the *Land Flora*, it will be remembered, contains several species otherwise peculiar to the south of Europe. *Rhodymenia cristata*, which in Europe is not known to the south of lat. 56°, and is there of small size and very rare occurrence, abounds on the eastern shores of America, near New York, in lat. 40° 30′, growing most luxuriantly and fruiting abundantly.

If we consider the distribution of the three great series into which we have divided the Algæ, namely, the *olive*, the *red*, and the *green*, we shall find that the first increases as we approach the tropics, where it reaches its maximum of *species*, though perhaps not of *individuals;* that the second chiefly abounds in the temperate zone, being most luxuriant in form and rich in species from the 55th to the 45th degree, and that it rapidly diminishes towards the equator after it has passed the 35th; while the third forms the majority of the vegetation of the Polar seas, is particularly abundant (*Conferveæ*) in the colder temperate zone, but its lowest forms (*Ulvæ*) equally distributed through all. Owing to the large size and strictly social habit of our common *Fuci* and *Laminariæ*, a hasty observer might assume that in the British seas the olive series predominates, and such is undoubtedly the case, if we look to individuals and not species. But he will be surprised to find on examination that our sub-marine meadows are composed, in the main, of not more than ten species of this race; while the 300 or 400 others of which the *marine* Flora consists, are scattered like weeds, and often occur in such small quantities as to escape the notice of any but a botanist. When we speak therefore of different types characterizing different latitudes, we mean merely variety of form, not abundance of production. If we exclude fresh-water species, we shall find that on our coasts the *olive* series amount to $\frac{1}{5}$, the red to $\frac{3}{5}$, and the green to nearly $\frac{1}{4}$ of the whole. Of the olive group only $\frac{1}{5}$ (or $\frac{1}{25}$ of our whole marine Algæ) belongs to *Fucaceæ*, and scarcely $\frac{1}{12}$ (or $\frac{1}{60}$ of the whole) to *Laminariaceæ*.

Thus we perceive that the Creator, while He has scattered the Algæ through the waters of every climate of the globe, has assigned to each country the peculiar kinds best suited to the circumstances under which they are developed; and it would be absurd to suppose that so much bounty and foresight had been wantonly squandered upon objects from which no direct benefit to His other works was to reciprocate. To preserve a harmony through creation, by giving to the depths of the sea a vegetable clothing, as beautiful and varied, yet as linked together, as that of the land, and thus to illustrate His own infinity and indivisibility by works, endless in diversity yet one in plan, may seem, to many minds, a sufficient motive, were there no other, for the exercise of an unlimited creative power; but it will not account for that nice discrimination and foresight with which He has regulated the supply of different kinds to different circumstances. We must therefore look further, and inquire what are the direct *uses* of *Algæ* in the general economy of nature. On land it is only necessary to glance around us to perceive that the animal kingdom could not exist without the vegetable;—"beasts of the forest and fowls of the air," and countless myriads of the insect tribe; man himself;—all depend more or less on vegetables for their food and clothing. The sea too has its hordes, at least as numerous as those of the land, to which the *Algæ* afford food and shelter, and on whose existence, contemptible as many of them seem, depends in a greater or less degree the preservation of every scale of life in the sea. Many of these little animals are so minute, that at first sight it would seem a matter of very little consequence to *us* (for when we speak of "uses," the words "to man" are too generally understood) whether they should starve or not. But when it is remembered that the principal food of the whale consists of a minute jelly-fish, which is scarcely more than an animal sack moving by contraction, and that by far the greater part of the fishes important as articles of food to man depend on minute marine animals for support, a different estimate will be formed of the importance of the lower links in the chain of creation to the whole, and we shall come to the conclusion that there is such a mutual dependance between one living creature and another, that none but the All-wise can dare to determine whether one, the most minute, can be spared without endangering the destruction of all. The *Algæ*, therefore, by supporting the base, support the structure. But besides this, another important function is unquestionably performed by their growth tending to keep pure the waters of the sea, and of lakes, and thus to preserve a healthful atmosphere. Like other plants they discharge a large quantity of oxygen.

If these be some of the direct uses of *Algæ* in the economy of nature, their value to man, whether in agriculture, in the arts, or even as articles of food, must not be overlooked. On many shores the harvest of the deep is anxiously looked after, and as carefully attended to as that of the land, and indeed the last is often dependant on the former for its abundance. The first and most obvious use of sea-weed is for manure, and to this purpose all kinds are applicable. On many of our coasts, as along the west of Ireland, the poorer classes are almost entirely dependant for the cultivation of their potatoes on the manure afforded by their rocky shores and frequent gales of wind. After a storm they may be seen congregating in numbers from the surrounding country, with horses and cars, or with panniers; and the poorest, who cannot afford the assistance of a donkey, are themselves bearers of burdens, eagerly collecting what is thrown up and carrying it beyond the reach of the tide. The kinds preferred for potatoes are the large and succulent *Laminarieæ*, which rapidly melt into the ground, and when these are abundant other kinds are neglected. These are often carried many miles into the interior, and, being mixed with sea-sand, form an excellent manure, which must however be used quickly, as it very soon decomposes, and the gases it gives birth to are consequently lost to the ground if it be suffered to lie open.

But it is for the manufacture of *kelp* that marine plants offer the largest revenue to man. *Kelp* is an impure *carbonate of soda*, mixed with the *sulphate* and *muriate* of the same alkali, and with some combinations of *iodine* and extraneous matter. It is prepared by merely burning the weeds, previously dried, in pits dug along the shore, till they are reduced to hard, dark-coloured cakes, in which state it is sent to market. On our shores the species used for this purpose are *Fucus nodosus*, *vesiculosus* and *serratus*, *Himanthalia lorea*, *Laminaria digitata*, *bulbosa* and *saccharina*, and *Chorda filum*; but all the large *Fucaceæ* are applicable. The crop is gathered in summer, dried and collected like hay, and toward the end of the season burned. *Dr. Greville* has given us (' Introd. to Algæ Britannicæ ') an interesting sketch of the introduction and establishment of this branch of industry into the north of Scotland, where it has been most extensively pursued; and I shall take the liberty of extracting the following passages. " The manufacture of *kelp* was introduced into Scotland, according to *Mr. Neill*, half a century subsequent to its establishment in France and England, and the first cargo was exported from Orkney about the year 1722. The employment, however, being new to the inhabitants of Orkney, the country people opposed it with the utmost vehemence. Their ancestors had never thought of making kelp, and it would appear that they themselves had no wish to render their posterity wiser in this manner. So violent and unanimous was the resistance, that officers of justice were found necessary to protect the individuals employed in the work. Several trials were the consequences of these outrages. It was gravely pleaded in a court of law, on the part of the defendants, 'that the suffocating smoke that issued from the kelp-kilns would sicken or kill every species of fish on the coast, or drive them into the ocean far beyond the reach of the fishermen; blast the corn and grass on their farms; introduce diseases of various kinds; and smite with barrenness their sheep, horses and cattle, and even their own families.' The proceedings exist, as I am informed by *Mr. Peterkin*, in the records of the Sheriff-Court; a striking instance of the prejudices, indolence and superstition, of the simple people of Orkney in those days. The influential individuals who had taken up the matter succeeded in establishing the manufacture; and the benefits which accrued to the community soon wrought a change in the public feeling. The value of estates possessing a sea coast well stocked with sea-weed, rose so much in value, that, where the plants did not grow naturally, attempts were made, and not without success, to cultivate them by covering the sandy bays with large stones. By this method a crop of *Fuci* has been obtained, we are informed by *Mr. Neill*, in about three years, the sea appearing to abound everywhere with the necessary spores. Upon the authority of Dr. Barry, during the years 1790 to 1800, the quantity sometimes made was 3000 tons, and as the price was then from £9 to £10 per ton, the manufacture brought into the place nearly £30,000 sterling, sometimes in one season. During the eighty years subsequent to its introduction (from 1720 to 1800), the total value will rise to £595,000. These, and during the war, when the price of kelp rose to £18 or £20 per ton, were the palmy days of the manufacture, but since the peace the demand has gradually slackened, and the price fallen away. This result, so unfortunate for the owners of northern estates and the numerous population, 'in Orkney alone amounting to 20,000,' who found a profitable employment in the manufacture, 'is to be attributed at first to the superior qualities of Spanish *barilla*, for the purposes of glass-making and soap-boiling, but more recently to the almost entire removal of the duty on common salt,' from the decomposition of which *soda* is now so extensively manufactured as to supersede kelp almost entirely for the above purposes. In this ruinous state of the trade the kelp maker has had recourse to the agriculturist, and experiments have fully succeeded in showing the great value of kelp as a manure, whence an extensive demand may eventually arise; but it is not likely that the price can ever reach its former rate. But here again, soda obtained from rock salt comes into successful competition with it, so that the prospects of the unfortunate kelp grower seem hopelessly sunk; unless the demand, for the purpose of extracting iodine, be sufficiently remunerative to keep the kelp trade alive. The chief source of iodine is still found in the *Fuci*, and so long as this remains the case, the certain demand for kelp, from which that valuable substance may be most easily extracted, will be maintained."

Many of the species that produce kelp are useful in minor ways. *Fucus vesiculosus*, which is one of the richest in the alkaline salts, affords an abundant and wholesome winter provender to the horses and cattle of the people of Norway, who call it kue-tang or cow-weed, and of the north-west of Scotland and west of Ireland. According to *Linnæus* the people of Gothland boil it, and, mixing it with coarse flour, feed their pigs with it, whence they call it *swine-tang*. In the Channel Islands it is used as fuel, and employed in smoke-drying pork and fish. *F. serratus* is also used as winter provender in some northern countries, and in Norway is called *bred-tang*, being given to the cattle sprinkled with meal. Its most common use, however, is to spread over lobsters, shell-fish, &c., in order to keep them fresh when sent into the country. For this purpose it answers better than *F. vesiculosus*, being of a less mucous nature, and consequently less liable to run into fermentation. The very young leaves and stalks of *Laminaria digitata* are eaten in Scotland, under the name of *tangle;* and, according to *Mr. Neill*, the old stems are applied "to rather an unexpected use,—the making of knife-handles. A pretty thick stem is selected, and cut into pieces about four inches long. Into these, when fresh, are stuck blades of knives, such as gardeners use for pruning or grafting. As the stem dries it contracts and hardens, closely and firmly embracing the hilt of the blade. In the course of some months the handles become quite firm, and very hard and shrivelled, so that when tipped with metal they are hardly to be distinguished from hartshorn."

As articles of human food many of the Algæ have, in different countries, been used both as articles of luxury and resources in time of scarcity. Of British species, *Alaria esculenta*, *Rhodymenia palmata*, *Chondrus crispus*, *Gigartina mamillosa*, *Laurencia pinnatifida*, *Iridæa edulis*, *Porphyra vulgaris* and *laciniata*, and *Ulva latissima*, have been more or less used. *Rhodymenia palmata*, the *dulse* of the Lowland Scotch, *duilliosg* of the Highlanders, and *dillisk* of the Irish, is still much eaten in many parts of Ireland and Scotland. It is prepared by being washed and dried, and is eaten raw, chewed like tobacco. It has a sweetish taste. That which grows on rocks or mussel-shells, called "shell-dillisk," is preferred, as it is less tough and coarse than what grows on *Laminariæ*. In Norway it is greedily eaten by sheep and goats, which flock to the shore to seek it, whence *Gunner* once named it *Fucus ovinus*. According to *Lightfoot* it is used in Skye as a remedy in fevers, to promote perspiration, being boiled and mixed with butter. It is sometimes, but seldom, fried, a mode of cooking which answers better with *Iridæa edulis*, which is too tough to be eaten raw. *Chondrus crispus* and *Gigartina mamillosa*, under the name of *Irish moss* or *Carrigeen*, were a few years ago in much request, and the collection and preparation of them for market afforded a small revenue to the industrious peasantry of the west coast of Ireland, where these plants grow in great profusion. The price at one time was as high as 2*s.* 6*d.* per lb., but the demand has latterly diminished, and the price, of course, fallen considerably. The frond was boiled down to a gelatine, strained, and used as a substitute for isinglass in the manufacture of blanc-manges and jellies, and was at one time a fashionable remedy in consumptive cases. As the demand slackened for these purposes, it was tried as a size, and has been shipped to England for the use of the calico-printers, but

I believe it was not found to answer well for their purposes. It has been more successfully employed in fattening calves, for which purpose it is boiled to a jelly and mixed with milk. *Porphyra vulgaris* and *laciniata* are perhaps, after all, the most valuable of our edible species, being prepared by boiling for several hours till they are reduced to a pulpy substance, which is brought to table under the name of *marine sauce*, *sloke* or *slouk*.

But of all those used for food, *Gracilaria lichenoides*, an East Indian species resembling our *G. compressa*, which, if as abundant, would be equally valuable, deserves the first rank. This, under the name of "*Ceylon moss*," is much used in the East as a nutritive article of food, and for giving consistence to other dishes. It is of a very gelatinous nature, and when boiled down is almost wholly convertible into jelly, which is of a purer nature than that obtained from our *Chondri*. Large quantities are annually sold. The famous *edible nests* of China, the finest of which sell for their weight in gold, were supposed to be constructed from some species of *Gracilaria* or *Gigartina* ; but it is now ascertained that the gelatine they consist of is an animal substance, and, it is believed, is disgorged by the swallows that build the nests, though so greedily swallowed by the Chinese. *Sarcophycus potatorum*, one of the Fucaceæ, is said to be used as food by the natives of Australia, and *Labillardière* "observed the natives of the woods round Van Dieman's Land use portions of its great leaves folded into the form of a pouch, for the purpose of keeping fresh water." Similar uses are assigned to *Durvillæa utilis* and other plants of the family, as applied by the people of the coast of Chili.

Some species have been applied in medicine. The mucus of *Fucus vesiculosus*, and other species, has been recommended, by *Dr. Russell*, in diseases of the glands, for which *iodine*, exclusively obtained from plants of this family, and which probably exists in the mucus, is now considered so powerful a remedy. "It is a curious fact," observes Dr. Greville, "that the stems of a sea-weed are sold in the shops, and chewed by the inhabitants of South America, wherever *goitre* is prevalent, for the same purpose. This remedy is termed by them *Palo coto* (literally goitre-stick), and from the fragments placed in my hands by my friend *Dr. Gillies*, to whom I am indebted for this information, the plant certainly belongs to the order *Laminarieæ*, and is probably a species of *Laminaria*." *Acanthophora muscoides* and *Gigartina helminthocorton* still hold a place in the Pharmacopœia as vermifuges, and are sold in the shops; but they have ceased to be in much esteem.

As highly useful in some of the finer arts I must not forget to mention *Gigartina tenax*, a Chinese species, which is extensively used by the ingenious inhabitants of that country as a glue and varnish. Large quantities of this plant, according to Turner as much as 27,000 ℔s. weight, are annually imported into Canton from the provinces of *Fo-kien* and *Tche-Kiang*, and sold at from 6*d*. to 8*d*. per ℔. It is converted by boiling into a vegetable glue of a very tenacious quality, which cools into a stiff jelly, and again liquifies on the application of heat. It is much used in the manufacture of the lanterns and transparencies for which the Chinese are so celebrated. *Mr. Neill* supposes that it forms a principal ingredient in the gummy matter *chin-chou* or *hai-tsai*, of China and Japan, with which "windows framed simply of slips of bamboo crossed diagonally, have their lozenge-shaped interstices wholly filled up." It is surely probable that when we become better acquainted with these plants, similar valuable properties may be discovered in other species of the genus *Gigartina*, and of the allied genera *Chondrus* and *Geli-*

dium, all of which may be converted into a gelatine by boiling.

The question, *cui bono?* to what useful end are your pursuits? has often been asked of naturalists, and has been already often and triumphantly answered by abler pens than mine. It is no longer necessary to apologise for indulging a love of Natural History, nor shall I waste time in defending it from the aspersions of those who either fear or despise it. Happily the audience to which I should address myself is neither so numerous nor so respectable as it was thirty years ago; it is becoming every day less so, and will soon be confined to the ignorant and the sensual. To those few well-informed persons who still, from old prejudices, accuse us

> " ——— of dropping buckets into empty wells,
> And growing old in drawing nothing up,"

we may say that till the well of creation be emptied there is no danger of our returning from our labours without abundant food for thought; and if we do not always make the best use of it, the blame must rest with us and not with Natural History. The sportsman, it is true, often pursues his game with intense ardour till it is brought down, and then ceases to regard it with interest. So, I fear, it too often is with naturalists, but it is not necessarily so. Nay, of all men, they who are best acquainted with the works of the Divine finger, and who know how justly it may be said "we are fearfully and wonderfully made," are surely most bound to cling to the truths of revelation, for they have continually before them collateral evidences of the certainty of those "invisible things" which are "clearly seen, being understood by the things that are made, even His eternal power and Godhead, so that they are without excuse." If they too often neglect the true *use* of this knowledge, and rest satisfied with the knowledge itself, the fault and the loss is their own, and must not be charged to Science. It is enough for her if she but furnish food which is capable of nourishing the well-directed heart; it is not her province either to cleanse that heart, or to give it powers of digestion. For this she must refer her votary to a higher and a holier voice; and if she ever speak of looking

"Through Nature up to Nature's God,"

she does so with a humble deference to her elder sister, whose province it is to lead the heart to that contemplation. Science and Religion must not be confounded: each has her several path, distinct, but not hostile: each in her way is friendly to man, and, where both unite, they will ever be found to be his best protectors:—the one "a light to his eyes," opening to him the mysteries of the material universe;—the other "a lamp to his feet," leading him to the immaterial, and incorruptible, and eternal. The "eye," it is true, will grow dim when the light of this world fails; and happy is he who then has "a lamp," lighted from heaven and trimmed on earth, to guide him through the hours of darkness. But the eye must not be blamed because it is not the lamp; nor should Science be disdained because she leaves us far short of just conceptions of the invisible world. Her highest flight is but to the threshold of religion; for what a celebrated writer has said of philosophy generally, is equally applicable to every branch of scientific inquiry. "In wonder all philosophy began; in wonder it all ends: and admiration fills up the interspace. But the first wonder is the offspring of ignorance; the last is the parent of adoration. The first is the birth-throe of our knowledge; the last is its euthanasy and apotheosis."

W. H. H.

Cape Town, Cape of Good Hope,
October 5, 1840.

BRITISH ALGÆ.

CLASSIFICATION.

In the earlier days of systematic botany the plants which we now know under the common term *Algæ*, formed, with the *Lichens*, a single order of the class Cryptogamia in the Linnæan system, and a single order of the Acotyledonous plants in the Jussieuian. As these vegetables became better known to botanists, differences in structure were noticed between the aërial Algæ or Lichens, and the submerged, or true Algæ, and these differences led to the establishment and general recognition of two groups, which were supposed to be equivalent to what are called Natural Orders in our modern system.

This separation into two orders was a great improvement in classification, but it has not been found to be sufficient. In every system it is desirable that the same word should express the same value: thus, that the species associated together into an order in one part of the system should be as closely related in character to each other as those which comprise an order in another part of the system.

Applying this rule to the orders of flowering and of flowerless plants, it is obvious that the orders of the former group are defined by characters far more exact; and that each genus included in one of the orders has a much closer connexion with its neighbour (or co-ordinal) than exists among the genera of such cryptogamic "*orders*" (we should rather call them *disorders*) as Algæ, Lichens or Fungi.

To confine ourselves to the Algæ: the differences between the less developed members and the most perfect kinds of these plants are fully as great, perhaps greater, than are to be found between the least and most perfect individuals of either of the great groups Exogens and Endogens. So that it is no longer possible to assign the term Natural Order to a group of such extent, comprising structures so dissimilar one from another.

In modern systems, therefore, we find a more honourable position assigned to the Algæ; and in the 'VEGETABLE KINGDOM' of Professor Lindley they (together with the *Characeæ*, which I regard as vegetables of higher type), constitute his first Alliance, consisting of five natural orders, *Diatomaceæ*, *Conferraceæ*, *Fucaceæ*, *Ceramiaceæ* and *Characeæ*. To the four first of these groups I confine my idea of the class Algæ: the last, though with a simplicity of frond equal to that of some of the less perfect of the Algæ, has organs of fructification so much more developed than any met with among the highest Algæ, that I cannot consent to include it in the class. If we adhere to the established maxim that the fructification of plants and not their organs of nutrition ought to be our guide in classification, we shall probably place the *Characeæ* more nearly on a level with the Hepaticæ than with any section of Algæ. Their exact position in the scale of organization is still, perhaps, doubtful. To me they seem like the remains of a ruined alliance whose species are diminishing, and of which other members, which would connect it with neighbouring alliances, are lost. Such cases are not without parallel in the vegetable world. *Equisetaceæ* is an instance of a small group nearly equally isolated; and we have good reason to suppose that both it and *Characeæ* were much more abundant and of a higher type, in more remote periods than at present. *Podostemaceæ*, among Exogens, may also be mentioned as an example of the combination of considerable perfection of the floral organs, with the greatest imperfection of foliage; and this order seems fully as much below the average development of Exogens as the *Characeæ* is below that of the Hepaticæ.

Admitting the improvement of breaking up the old order Algæ into several, it may yet be questioned whether the groups of genera brought together under the above names are natural orders, or assemblages of a higher value. The first consists of two very distinct groups of plants, the *Diatomaceæ*, whose epidermis is formed of silex; and the *Desmidiaceæ*, in which the external skin consists of simple cellulose. These two groups may either be regarded as well-marked sub-orders, or as separate orders of a common alliance, namely, of the Chlorospermeæ or green Algæ (*Conferraceæ*, Lindl.).

The contents of the three following groups are very much more heterogeneous. *Confervaceæ* (synonymous with our Chlorospermeæ) contains all the green Algæ; *Fucaceæ* (our

Melanospermeæ), all the olive-coloured; and *Ceramiaceæ* (our Rhodospermeæ), all those of a red colour. I think no student of marine plants, who is acquainted with the meaning attached to the words "natural order" among flowering plants, will consent to apply this term to either of the three groups here indicated.

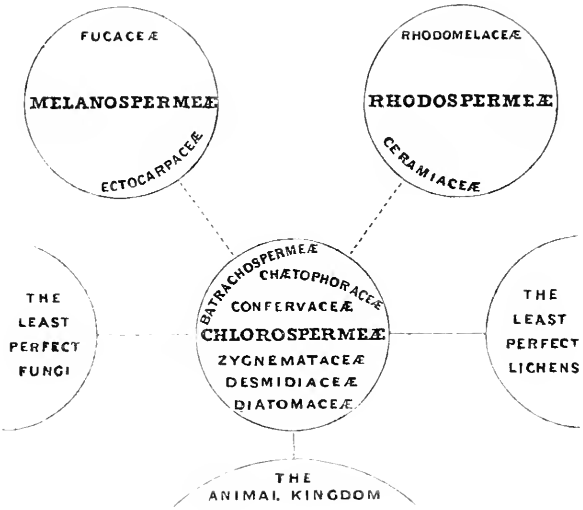
It is not that each of these groups is not a natural assemblage, but that it is a group of much higher value than an order, and must be regarded as a Series or Alliance, consisting of several orders. The orders of which each group consists, while they agree in some general features, differ one from another both in the composition of the frond and of the fructification. Thus *Fucus* and *Ectocarpus* have a certain relation to each other, but it is distant; and in the structure of their frond and fruit there is that dissimilarity which forbids these genera being associated within one order. So also of *Polysiphonia* and *Delesseria*, or other widely dissimilar genera of the series of red Algæ; or of *Codium* and *Nostoc* among the green kinds. These genera therefore we regard as examples of separate orders in parallel series.

The series are, however, not strictly parallel. If we closely examine the organization of each it will be found that the *Chlorospermeæ* or green Algæ are the simplest in structure; that their lowest members are the least compound of all vegetables, some consisting of a single cell, others of a string of cells linked together, end to end; and that the most developed of this group are not on a par with the least complex of either of the other groups. The inferiority of the green Algæ is therefore generally admitted. But it is less clear to which of the others, the *Rhodospermeæ* and *Melanospermeæ*, the palm of superiority ought to be given. Formerly the *Melanospermeæ* were regarded as the most perfect. The great size attained by several of this group, the perfect foliage and distinct organs of fructification of others, seemed to give them eminence: while the delicacy and intricacy of structure of many of the *Rhodospermeæ*, and above all, the more full development of their spores,* which are uniformly parted at maturity into four sporules, entitle this group, in the opinion of several modern writers, to the highest place in the class. Many of the olive group have, however, an equal complexity of spore, and others (as *Sargassum*) show a clearer distinction in the frond into leaves and stem and fructification than

* Sphærospores, *Ag.*; tetraspores, *Dne.*; granules, *Grev.*; gemmules of others.

we meet with among Rhodosperms; so that, on the whole, it is doubtful whether to the olive or the red series belongs the first place. I am more inclined, assuming the *Chlorosperms* as a base, containing what we may regard as the first idea or rude sketch of the class, to regard the Melanosperms and Rhodosperms as parallel developments or branches, springing from nearly the same point, and extending in opposite directions.

And were we to exhibit the classification of Algæ in a diagrammatic form, we should place the groups as follows:—



The characters of the three sub-classes of Algæ are as follows (we take them in the order in which we propose to describe them):—

1. MELANOSPERMEÆ. *Plants* of an olive-green or olive-brown colour. *Fructification* monœcious or diœcious. 1. *Spores* olive-coloured, either external or contained singly or in groups in proper conceptacles; each spore enveloped in a pellucid skin (*perispore*), simple, or finally separating into 2, 4, or 8 sporules. 2. *Antheridia*, or transparent cells filled with orange-coloured, vivacious corpuscles, moving by means of vibratile cilia. *Marine*.

2. RHODOSPERMEÆ. *Plants* rosy-red or purple, rarely brown-red or greenish-red. *Fructification* of two kinds, diœcious, always formed on separate individuals. 1. *Spores* (*gemmules*, Ag.) contained either in external or immersed conceptacles, or densely aggregated together and dispersed in masses throughout the substance of the frond. 2. *Spores* (called *tetraspores, gemmules*, Thw.) red or purple, either external or immersed in the frond, rarely contained in proper conceptacles; each spore enveloped in a pellucid skin (*perispore*), and at maturity separating into four sporules. *Antheridia* (not observed in all) filled with yellow corpuscles. *Marine, with one or two exceptions.*

3. CHLOROSPERMEÆ. *Plants* green, rarely a livid purple. *Fructification* dispersed through all parts of the frond, the whole colouring matter being capable of conversion into propagula. 1. *Spores* (*Sporidia*, Ag.) green or purple, formed within the cells, often (always?) at maturity vivacious, moving by means of vibratile cilia. 2. *Gemmules* (*Coniocystæ*, Ag.) or external vesicles containing a dense, dark-coloured, granular mass, and finally separating from the frond. *Marine, or (more generally) found in fresh-water streams, ponds and ditches, or in damp situations. (The marine species of this sub-class are alone described in the present work).*

Sub-class I.

MELANOSPERMEÆ or FUCALES.

Harv. in Mack. Fl. Hib. part iii. *p.* 167 (1836). Fucoideæ, *J. Ag. Alg. Medit. p.* 24 (1842). Fucoideæ (in part), *Ag. Syst. p.* xxxv. (1824). Aplosporeæ (in part), *Decaisne, An. Sc. Nat.* vol. 17, *p.* 305 (1842). Phyceæ (in part), *Endl. Gen. Pl. 3rd Suppl. p.* 19 (1843). Fucaceæ (in part), *Lindl. Veg. Kingd. p.* 20 (1846).

Diagnosis.—*Plants* of an olive-green or olive-brown colour. *Fructification* monœcious or diœcious. *Spores* olive-coloured, either external or contained, singly or in groups, in proper conceptacles; each spore enveloped in a transparent skin *(perispore)*, simple, or finally separating into several sporules. *Antheridia*, or transparent cells filled with orange-coloured vivacious corpuscles, moving by means of vibratile cilia. *Marine.*

The plants comprised under this head are exclusively marine, and are known from all other sea-weeds by their olive or dark brown colour. In some few the colour of the living plant is a very pale olive, verging to light green; and some others assume verdigris tints in decay or in the process of drying: but as a general rule, it may be said, their colours are rather on the brown than the green side of olive, and become darker in drying, often changing to black.

Though some of the larger kinds inhabit deep water, and are never laid bare on the recess of the tide, by far the greater number are found on tidal rocks, where they are exposed to the influence of sun and air for some hours each day. And this exposure seems necessary to their healthy growth and full development, as is proved in the case of some *Fuci* which are occasionally raised from deep water. In such situations fruit is not produced, and the fronds have a weak and attenuated habit. That these plants are intended for vegetation in shallow water is further proved by the air-vessels with which most of them are furnished, and which enable them to keep their long but flaccid fronds in an erect position, with the uppermost branches either floating on the surface of the water, or submerged but a short distance beneath. In specimens growing in shallow water near high-water mark the air-vessels are either absent or in small quantity, but in those that grow at a lower level they are proportionally abundant. And in the *Sargassum bacciferum*, the famous *Gulf-weed*, which floats on the surface of the great ocean, the air-vessels are in such abundance as to form the most striking feature of the species.

Some of the Melanospermeæ are of great size, by much the largest of known Algæ, surpassing in the length of their fronds the tallest forest tree; but comparatively few of them attain such a proportionate diameter in their stems as to entitle them to be called arborescent. In the deep bays of the southern hemisphere, along the shores of the Falklands and among the Archipelago of Cape Horn, the species of *Lessonia* and *Durvillæa* do indeed resemble submarine trees, with gigantic leaves pendant from the tips of robust branches: and even on our own shores the fronds of the larger tangles (*Laminaria*), seen through clear water of one or two fathoms' depth, have a similar character, and enable us to conceive what glorious objects their greater southern analogues must be when thus seen, waving freely below us. All the larger kinds grow on rocks, to which they are firmly attached by a root or holdfast, which is almost always conical, and which adheres with great force to the rock. In many the cone is solid, a compact mass of tough cellular tissue, but in others, as in most of the *Laminariæ*, the cone is composed of numerous stout, branching fibres, growing out, like the aërial roots of the Screw Pine, one above another, and each with its extremity taking fast hold of the ground; so that, with the increasing growth of the frond, the base is proportionably strengthened. Some few, like *Pycnophycus*, spring from prostrate or creeping stems, which form a matted network over wide spaces of rocks, and throw up at intervals erect fronds, that then appear to be densely crowded together. A great many of the smaller kinds are parasitic, or at least epiphytic, attached to other Algæ by minute disks, in every respect, except size, similar to the conical bases of larger species. Some are true parasites, as the *Elachisteæ* and *Myrionemata*, which seem to be incapable of independent existence: but the majority which grow on other species are merely epiphytes, many of them indifferently growing on living plants or on dead substances. Several are minute, but very few of strictly microscopic size. Almost all have a distinction, in their vegetation, of root, stem and branches, and many possess well formed, and even nerved leaves. In a very few, the frond is a shapeless mass, or a crust lying close on the surface of rocks. None deposit carbonate of lime in their tissues, but most, perhaps all of them, yield iodine, and are the chief source from which that valuable substance is obtained.

In the fructification of these plants there is considerable uniformity in the structure and origin of the *spores*, while there is a great diversity in the position and grouping together of those bodies, and in the supplementary organs which accompany them. The *spores* are always formed from a single cell, within which, as it enlarges, a dense, olive-coloured, granular substance gradually accumulates and acquires consistence. In some this internal matter, or *endochrome*, forms at maturity a single compact mass, giving birth, on germination, to a single plant; but in others it is parted into two, four, or even eight sporules (as in *Fucus* and *Cutleria*), each of which is the germ of a new individual. It is manifest therefore that the spore is the representative rather of a seed-vessel, usually one-seeded, but sometimes many-seeded, than of the seed itself: and therefore the term *utricle*, applied by some botanists to this body, is more consistent with organization. In the simplest individuals of the sub-class the spore is formed out of one of the surface cells, which rises above its fellows, and is either altogether naked, or accompanied by a few jointed threads, to which the name *paranemata* is given. In the *Dictyotaceæ*, in which family the spores are distributed over the surface, the paranemata are in general little developed, consisting, as in *Punctaria* and *Asperococcus*, of a few short, confervoid filaments; but in *Stilophora*, a more compound genus of the same group, they form the principal portion of the masses of fructification, and are considerably organized. In *Chordaria* and *Mesogloia* the whole outer coating of the frond is composed of these organs. It is among the FUCACEÆ, however, that we find them in their highest form; and here there is a manifest separation of the organ into two parts; the jointed filament—simple or branched—and the *antheridia*, little transparent cells full of orange-coloured moving particles, borne by the branches of the filament. These organs, which are supposed to represent the male system, will be more fully described in their proper place. Among the higher families we no longer find the spores scattered over the surface, but collected into proper *receptacles*, formed either at the tips of the branches or in their axils. Each of these receptacles, in the FUCACEÆ, contains a number of hollow chambers, communicating with the water by a pore. These little hollows are called *conceptacles*, and the spores and paranemata are attached to their walls, like the male and female flowers within the hollow chamber of the fig.

The genus *Lichina*, consisting of two minute plants found along the edge of the sea on rocky shores, was formerly associated with the Melanosperms, and constituted a small family called LICHINEÆ, placed immediately after the FUCACEÆ. I was never well satisfied with this position, and in the first edition of this work (p. 2) hinted at the near affinity of these little plants with the true Lichens, among which one of them had been originally placed. Recent observations have detected in their receptacles the presence of *asci*, the peculiar fructification of Lichens, and abundance of *gonidia* in the stems; and M. Montagne has therefore properly transferred the genus to that class of vegetables.

Omitting, then, the group *Lichineæ*, the Melanosperms may be classed under six orders, briefly distinguished as follows:—

SYNOPSIS OF THE ORDERS.

* *Frond leathery or membranaceous, forming a compact, cellular substance.*

1. FUCACEÆ. *Spores* contained in spherical cavities immersed in the frond.

2. SPOROCHNACEÆ. *Spores* attached to external, jointed filaments, which are either free, or compacted together in knob-like masses.

3. LAMINARIACEÆ. *Spores* forming indefinite, cloud-like patches, or covering the whole surface of the frond.

4. DICTYOTACEÆ. *Spores* forming definite groups (*sori*) on the surface of the frond.

*** Frond formed of jointed filaments, which are either free or united into a compound body.*

5. CHORDARIACEÆ. *Frond* cartilaginous or gelatinous, composed of vertical and horizontal filaments interlaced together. *Spores* immersed.

6. ECTOCARPACEÆ. *Frond* filiform, jointed. *Spores* external.

ORDER I. FUCACEÆ.

J. Ag. Sp. Alg. vol. i. *p.* 180. *C. Ag. Syst. Alg. p.* xxxvii. (in part). *Decaisne, Ess. p.* 34 (in part). Fucoideæ, *Grev. Alg. Brit. p.* 1. *Harv. Manual,* 1 *edit. p.* 1. Fuceæ, Cystoseireæ, Sargasseæ and Halochloæ, *Kütz. Phyc. Gen.* p. 349. Fucidæ and Cystoseiridæ, *Lindl. Veg. King. p.* 22.

DIAGNOSIS.—Olive-coloured, inarticulate sea-weeds, whose *spores* are contained in spherical cavities immersed in the substance of the frond.

NATURAL CHARACTER.—*Root* almost always a conical disk, rarely branching or creeping. *Fronds* of an olive-brown or olive-green colour, becoming darker in drying; of a tough, leathery substance and fibrous texture, tearing lengthwise with facility; dichotomous or pinnate, rarely irregularly branched, but very variable in habit. In the simpler kinds (*Splancnidium*) there is no distinction into parts (as stem, leaves and receptacle), but the fructification is equally dispersed through all parts of the plant; in others (*Durvillæa, Sarcophycus*) there is a stem ending in a phyllo-caulon or leaf-like frond, through which the fructifications are scattered; in others (*Himanthalia*) there is a simple frond of small size, and a branching receptacle of fructification resembling a frond; in others (*Fucus, Cystoseira,* &c.) there is a branching or imperfectly leafy frond, some portions of whose branches finally swell, and are converted into receptacles of fruit; and finally, in the most perfect kinds (*Sargassum, Marginaria,* &c.) there is a branching frond, with well-formed, mostly distinct and nerved leaves, and receptacles from their origin set apart as organs of fructification (not formed by swellings of old branches), developed either in the axils or along the edges of the leaves or branches. *Air-vessels* are present in almost all, either as bladdery swellings of the stem or branches (as in *Fucus*), or as distinct organs (in *Sargassum*, &c.), stalked, and mostly springing from the same part as the fructification. *Receptacles* of the fruit mostly more or less distinguishable from the barren portion of the frond, swollen, succulent, often filled with slimy mucus, either formed from the metamorphosed ends of the branches, or evolved from the axils or sides of the branches or leaves. These receptacles (or the whole frond in genera which have no proper receptacle) are pierced by minute pores, which communicate with small, spherical chambers, formed by an introflexion of the walls of the receptacle, at the points where they occur. The little chambers (called *conceptacles* by some writers, *scaphidia* by others) contain sometimes *spores*, or reproductive bodies analogous to the seeds of more perfect plants; sometimes *antheridia*, supposed to be analogues with stamens; sometimes both organs in the same chamber. The *spores* spring from the sides of the chamber. One of the surface-cells being fertilized, gradually enlarges, projects from the wall of the chamber, becomes more or less obovate, and finally is converted into a *perispore*, or membranous, transparent case, in which is contained the spore or spores. These last are formed from the matter contained within the enlarged cell. At first the contents are nearly fluid, of a pale olive colour: gradually they acquire density, become darker, and at length are consolidated either into a single sporule (as in *Cystoseira*, *Halidrys*, &c.), or formed into two, four, or eight sporules (as in *Fucus*, *Himanthalia*, &c.). The *antheridia* are borne on branching, jointed threads, called *paranemata*, which rise, like the spores, from the walls of the conceptacle, and commonly fill the greater part of its cavity. Each *antheridium* is an oblong cell, forming the terminal articulation of the branches of the paranemata, and is filled with minute, orange-coloured bodies (called *sporidia* by J. Agardh) closely resembling the zoospores of the lower Algæ, and, like the latter, endowed with spontaneous movements. The motive organs are vibratory hairs or cilia, with two of which each little body is furnished. The fronds of many species have numerous muciferous pores, analogous to the pores of the conceptacles, but not leading to any internal cavity: from these issue bundles of transparent filaments, whose use is unknown.

The Fucaceæ are readily known from all other olivaceous sea-weeds by a character at once natural and easily ascertained, namely, the position of their spores within little hollows sunk in the substance of the plant, and communicating with the surface by a pore.

This order is much the most extensive among Melanosperms, comprising within its limits upwards of 230 species, which is about equal to the contents of all the other orders of this division put together. More than half of them belong to the genus *Sargassum*, and the rest are distributed among 22 or 23 generic groups, varying in the number of their species from 1 to 20. The order is represented in most climates from high northern and southern latitudes to the equator, but the number of generic forms is much greater between the parallels of 30° and 40°, and the number of specific forms greater within 30 degrees of the equator on either side. Very few vegetate in the polar regions of either hemisphere. In the north the species of *Fucus* and *Himanthalia* alone reach to the Icy Sea; and in the Antarctic Ocean the order is limited to *Durvillæa*, a genus of gigantic growth, resembling *Laminaria* in outward character, and to *Scytothalia Jaquinotii*, a fine Alga allied to sub-tropical forms. The British species, excluding three doubtful natives, are but fourteen, yet from the strictly social habits of several of them they cover more surface of tidal rocks than all the other Algæ put together. It is these plants which impart the deep brown colour to the belts of rock exposed on the recess of the tide. The species of warmer latitudes are much less striking to a casual observer, as they rarely occur in masses, but are more usually dispersed here and there in the recesses of rocks; thus, though the number and variety of species are greatly increased, the general effect to the eye is diminished. The chief centre of the order seems to be along the shores of New Holland, Tasmania and New Zealand, where the generic types are most numerous, and the external characters of the frond most varied. In *Sargassum*, which extends at either side of the line to the parallel of 45°, and gradually increases in number of species towards the equator, we have the most perfect type of frond which the order affords. In this genus there is a regular distinction of parts into stem, branches, leaves and inflorescence: the leaves in most species furnished with a midrib, and developed in a sub-spiral order, like those of more perfect plants.

In an officinal point of view the Fucaceæ are among the most valuable of marine plants. Besides the use made of their decayed fronds for manure, kelp is abundantly procured from their ashes. They are the chief source of iodine; mannite may be prepared in considerable quantity from many; and several afford a grateful winter pasturage to the herds of cattle along the inclement shores of northern Europe.

SYNOPSIS OF THE BRITISH GENERA.

* *Air-vessels stalked.*

I. SARGASSUM. *Branches* bearing ribbed leaves. *Air-vessels* simple. [Plate 1, A.]

II. HALIDRYS. *Frond* linear, pinnate, leafless. *Air-vessels* divided into several cells by transverse partitions. [Plate 1, C.]

** *Air-vessels immersed in the substance of the frond, or none.*

III. CYSTOSEIRA. *Root* scutate. *Frond* much branched, bushy. *Receptacles* cellular. [Plate 1, B.]

IV. PYCNOPHYCUS. *Root* branching. *Frond* cylindrical. *Receptacles* cellular. [Plate 2, A.]

V. FUCUS. *Root* scutate. *Frond* dichotomous. *Receptacles* filled with mucus, traversed by jointed threads. [Plate 1, D.]

VI. HIMANTHALIA. *Root* scutate. *Frond* cup-shaped. *Receptacles* (frond-like) very long, strap-shaped, dichotomously branched. [Plate 2, B.]

I. SARGASSUM. Ag. [Plate 1, A.]

Frond furnished with distinct, stalked, nerved *leaves*, and simple, axillary, stalked *air-vessels*. *Receptacles* small, linear, tuberculated, mostly in axillary clusters, cellular, pierced by numerous pores, which communicate with immersed spherical *conceptacles*, containing parietal *spores* and tufted *antheridia*. Name, altered from *sargazo*, the Spanish term for the masses of floating seaweed common in some latitudes.

1. S. *vulgare*, Ag.; stem flat, slender, alternately branched; leaves linear-lanceolate, serrated, dotted with mucous pores; air-vessels few, spherical, on flat stalks; receptacles cylindrical, racemose. *Grev. Alg. Brit. p.* 2, *t.* 1; *Hook. Br. Fl.* ii. *p.* 264; *E. Bot. t.* 2114.

Occasionally cast ashore. Orkneys, *Mr. P. Neill.*—*Stem* 12—18 inches long, pinnated with simple branches. *Leaves* very variable in breadth. *Colour*, when recent, olive, reddish brown when dry.

2. S. *bacciferum*, Turn.; stem cylindrical, slender, much branched, flexuose; leaves linear, serrated, mostly without pores; air-vessels abundant, spherical, on cylindrical stalks; receptacles unknown. *Grev. Alg. Brit. p.* 3; *Hook. Br. Fl.* ii. *p.* 264; *E. Bot. t.* 1967; *Harv. Phyc. Brit. t.* cix.

Occasionally cast ashore with the preceding. Orkneys, *Mr. P. Neill.* Shore of Castle Eden Dean, Durham, *Mr. W. Backhouse.*—*Root* unknown. *Stems* extremely brittle. *Leaves* 1—2 inches long, and about a line wide, of a very pale olive colour when recent. This and the preceding species have no just claim on our Flora, being natives of the tropics, occasionally driven, together with cocoa-nuts and other tropical productions, by the force of the western currents, on our Atlantic coasts.

II. Halidrys. Lyngb. [Plate 1, C.]

Frond compressed, linear, pinnated with distichous branches. *Air-vessels* lanceolate, stalked, divided into several cells by transverse partitions. *Receptacles* terminal, stalked, cellular, pierced by numerous pores, which communicate with immersed, spherical *conceptacles.* Name, ἅλς, the *sea*, and δρυς, an *oak* or tree.

Obs.—In this and the two following genera the internal substance of the receptacle is composed of small, polygonal cells closely packed together into a solid flesh; a structure technically called *cellular.* In *Fucus* and *Himanthalia* the internal substance is loosely gelatinous, the gelatine traversed by a network of jointed threads.

1. H. *siliquosa*, L.; branches linear, very narrow; air-vessels compressed, linear-lanceolate, slightly constricted at the septa, mucronate. *Grev. Alg. Brit. p.* 9, *t.* 1; *Hook. Br. Fl.* ii. *p.* 266; *E. Bot. t.* 474; *Wyatt, Alg. Danm. No.* 53. *Harv. Phyc. Brit. t.* lxvi.—β. *minor*; smaller in every part, with fewer vesicles. *Turn. Syn.* i. *p.* 61.

On rocks and stones in the sea, at and below half-tide level. Common on the British shores. Perennial. Winter and spring. β. in shallow pools left by the tide.—*Root* an expanded disk, from which spring several fronds 1—4 feet long, alternately branched; branches about a line wide, pinnated with similar ramuli, and in the upper part with air-vessels and receptacles. *Air-veessels* resembling pods or siliquæ, whence the specific name. The beautiful *Fucus osmundaceus*, Turn. Hist. t. 105, is a second species of this genus.

III. Cystoseira. Ag. [Plate 1, B.]

Frond much branched, occasionally leafy at base; *branches* becoming more slender upwards, and containing strings of simple air-vessels within their substance. *Receptacles* terminal, small, cellular, pierced by numerous pores, which communicate with immersed sphærical *conceptacles*, containing parietal *spores* and tufted *antheridia*. Name, κυστις, a *bladder*, and σειρα, a *chain*; because the air-vessels are generally arranged in strings or series.

1. C. *ericoides*, Good. & Woodw.; stem thick, woody, short, cylindrical, beset with numerous, slender, filiform branches, variously divided, and densely clothed with small, spine-like, awl-shaped ramuli (or leaves); air-vessels small, solitary near the apices; receptacles cylindrical, terminal, spiny. *Grev. Alg. Brit. p.* 4; *Hook. Br. Fl.* ii. *p.* 265; *E. Bot. t.* 1968; *Wyatt, Alg. Danm. No.* 1; *Harv. Phyc. Brit. t.* cclxv.

Rocks between tide-marks, chiefly in the S. West of England and West and South of Ireland; common. Perennial. Summer and autumn.—*Root* a large and very hard disk. *Frond* one or two feet long, remarkably bushy, of a fine olive or yellowish green when removed from the water, but appearing, whilst growing beneath the surface, to be clothed with the richest iridescent tints. *Air-vessels* generally solitary, and immediately subtending the terminal receptacles, very small; sometimes scattered along the branches.

2. C. *granulata*, L.; stem cylindrical, covered with elliptical knobs, each of which bears a slender, repeatedly divided, dichotomo-pinnated, cylindrical branch, irregularly set with scattered, incurved, awl-shaped, spine-like ramuli; air-vessels small, linear-oblong, two or three together in the upper part of the branches; receptacles elongated. *Grev. Alg. Brit. p.* 5, *t.* 2; *Hook. Brit. Fl.* ii. *p.* 265; *E. Bot. t.* 2169; *Wyatt, Alg. Danm. No.* 101. *Harv. Phyc. Brit. t.* lx.

Rocky pools left by the tide on the coasts of England and Ireland, not uncommon. Perennial. Summer.—*Root* a flattish disk. *Stem* about the thickness of a goose-quill, 7 or 8 inches high; branches very slender, a foot or more in length, very much divided, each having at its base a hard bulbous *knob*, which forms one of the most striking characters of the species. *Colour* a semi-transparent olive-green.

3. C. *barbata*, Turn.; frond cylindrical, stem furnished with elliptical knobs, each producing a branch many times dichotomo-pinnate and filiform; air-vessels lanceolate, chain-like; receptacles ovate-elliptical, mucronate. *Grev. Alg. Brit. p.* 6; *Hook. Br. Fl.* ii. *p.* 265; *E. Bot. t.* 2170.

A native of the Mediterranean, said to have been gathered on the Devonshire coast by Hudson.—Distinguished from the last species by the receptacles being tipped with a spine-like point.

4. C. *fœniculacea*, L.; stem compressed, branches long, slender, rough with hard points, repeatedly dichotomo-pinnate; air-vessels small, solitary or two together, elliptic oblong, near the apices of the branches; receptacles minute, linear-lanceolate. *Grev. Alg. Brit. p.* 7; *Hook. Br. Fl.* ii. *p.* 265; *Turn. Hist. t.* 252; *E. Bot. t.* 2130 *and t.* 2131; *Wyatt, Alg. Danm. No.* 51; *Harv. Phyc. Brit. t.* cxxii.

On rocks in tide-pools: coasts of the South and S. West of England. Jersey. Perennial. Summer.—*Frond* 1—2 feet long; stem destitute of knobs, nearly cylindrical, 4—6 inches high, and bearing numerous, long, sub-simple, slender branches, which are generally naked toward the base, but in the upper part closely set with distichous, alternately pinnate or sub-dichotomous, secondary branches. In the young state, and especially when growing in deep water, this plant is furnished with long, flat, pinnatifid leaves, 1—2 lines broad, midribbed, dotted, and irregularly serrated at the margins, and then constitutes the *Cys. discors* of Agardh (*Fucus discors*, L.; *E. Bot. t.* 2131); but these leaves, as was long since shown by Mrs. Griffiths, and as has been confirmed by Turner, Greville, and subsequent observers, finally elongate and become branches, and the plant assumes the appearance as above described.

5. C. *fibrosa*, Huds.; stem woody, compressed, bushy, very much branched; branches slender, alternately branched, the upper ones repeatedly divided, and furnished with lineari-setaceous, flattish ramuli; air-vessels elliptical, mostly solitary, immersed in the branches remote from the apices; receptacles filiform, much elongated. *Grev. Alg. Brit. p.* 8; *Hook. Br. Fl.* ii. *p.* 266; *E. Bot. t.* 1969; *Wyatt, Alg. Danm. No.* 52. *Harv. Phyc. Brit. t.* cxxxiii.

On rocks near low-water mark and in tide-pools: also in 4—15 fathom water. Perennial. Summer. Frequent on the shores of England and Ireland. Not found in Scotland.—*Root*, a hard, spreading disk. *Frond* three feet long or more; *stem* mostly undivided, gradually diminishing upwards, and thickly set with distichous, alternate branches, slightly swollen at base, and furnished with one or two series of smaller ramuli, the terminal ones being long and setaceous. *Air-vessels* larger than in any other British species, and generally occurring near the base of the branches, solitary or two or three together. *Colour* olive-green.

IV. Pycnophycus. Kütz. [Plate 2, A.]

Root composed of branching fibres. *Frond* cylindrical, dichotomous. *Air-vessels*, when present, innate, simple. *Receptacles* terminal, cellular, pierced by numerous pores, which communicate with immersed spherical *conceptacles*, containing parietal *spores* and tufted *antheridia*. Name, from πυκνος, *thick*, and φυκος, a *sea-weed*.

1. P. *tuberculatus*, Huds.; *Grev. Alg. Brit. p.* 18; *Hook. Br. Fl.* ii. *p.* 269; *Wyatt, Alg. Danm. No.* 103; *E. Bot. t.* 726; *Harv. Phyc. Gen. t.* lxxxix.

In rock-pools left, on the recess of the tide, near low-water mark. Perennial. Summer and autumn. Cornwall and Devonshire. West of Ireland. Jersey.—*Root* fibrous, matted over the surface of the rocky bottom. *Fronds* gregarious, 12—20 inches long, as thick as a goosequill, repeatedly forked: the axils obtuse. *Air-vessels* frequently absent. *Receptacles* terminating the branches, cylindrical, obtuse, more or less tuberculated, composed of compact cellular tissue. *Colour*, when growing, a clear olive; when dry, black. *Substance* brittle when dry.—This plant, separated from *Fucus* by Kützing, appears to me to be the type of a distinct genus, known from *Fucus* by its branching root and the compact cellular structure of its receptacles. By Prof. J. Agardh it is included in what appears to me a very heterogeneous group, which he calls *Fucodium*.

V. Fucus. L. [Plate 1, D.]

Root scutate. *Frond* linear, either flat, compressed or cylindrical, dichotomous (rarely pinnated). *Air-vessels*, when present, innate, simple. *Receptacles* either terminal or lateral, filled with gelatinous matter traversed by a network of jointed fibres, pierced by numerous pores, which communicate with immersed spherical *conceptacles*, containing parietal *spores*, or *antheridia*, or both. Name, φυκος, a *sea-weed*.

* *Frond flat, with a midrib.*

1. F. *vesiculosus*, L.; frond plane, coriaceous, thick, linear, dichotomous, quite entire at the margin, midribbed; air-vessels globose, mostly in pairs; receptacles elliptical, terminal. *Hook. Br. Fl.* ii. *p.* 267; *E. Bot. t.* 1066; *Grev. Crypt. t.* 319; *Wyatt, Alg. Danm. No.* 152; *Harv. Phyc. Brit. t.* cciv.—β. *balticus*; very small, densely tufted, with an indistinct midrib, and destitute of vesicles or receptacles. *F. balticus, Ag.*; *Grev. Crypt. t.* 181.

Rocky shores, most abundant. β. in salt-marshes, occasionally flooded by the sea. — Very variable in size and general appearance, often destitute of air-vessels. β. is a remarkable state, 1 or 2 inches high, scarcely a line wide, and of a tawny yellow colour, forming dense masses. This plant is extensively used in the manufacture of *kelp*, and furnishes besides excellent winter food for the cattle in the western islands of Scotland. See *Lightfoot, Fl. Scot. vol.* ii. *p.* 906.

2. F. *ceranoides*, L.; frond plane, coriaceo-membranaceous, linear, subdichotomous, entire at the margin, midribbed, without vesicles; lateral branches alternate, dichotomous, multifid, level-topped; receptacles subcylindrical, acuminated. *Grev. Alg. Brit. p.* 14; *Hook. Br. Fl.* ii. *p.* 267; *E. Bot. t.* 2115; *Wyatt, Alg. Danm. No.* 153.

Sea-shores, less common than the last. Perennial. Spring and summer.—Nearly related to the last species, but "it is far less tough, much thinner and more transparent in every part, both in the growing and the dried state. The midrib is finer and more clearly defined."—*Grev.*

3. F. *serratus*, L.; frond plane, coriaceous, linear, dichotomous, serrated, midribbed, without air-vessels; receptacles flat, solitary, terminating the branches, serrated. *Grev. Alg. Brit. p.* 15; *Hook. Br. Fl.* ii. *p.* 267; *E. Bot. t.* 1221; *Wyatt, Alg. Danm. No.* 2; *Harv. Phyc. Brit. t.* xlvii.

Rocky sea-shores, very common. Perennial. Spring and summer.—*Frond* 2—6 feet long, very variable in breadth, dark olive-green. This is sometimes used in the manufacture of kelp, but rarely, as it is far less productive than *F. vesiculosus*. It however forms excellent manure, and in Norway it is used, mixed with meal, as provender for cattle.

*** Frond flat or compressed, without a midrib.*

4. F. *nodosus*, L.; frond compressed, coriaceous, sub-dichotomous; branches linear, somewhat pinnated, attenuated at base, remotely denticulate, here and there swelling into oblong air-vessels; receptacles lateral, globose, stalked, springing from the axils of the serratures. *Grev. Alg. Brit. p.* 16; *Hook. Br. Fl.* ii. *p.* 268; *E. Bot. t.* 570; *Wyatt, Alg. Danm. No.* 154; *Harv. Phyc. Brit. t.* clviii.

Sea-shores, very common. Perennial. Winter and spring.—*Root* a large, hard, conical mass, from which spring several *fronds* 2—4 or even 6 feet long, which are once or twice forked, and irregularly pinnated with alternate simple branches. *Vesicles* large. *Substance* extremely tough and leathery. *Colour* full olive-green, glossy.

5. F. *Mackaii*, Turn.; frond cylindrical or subcompressed, slender, much branched; branches dichotomous; air-vessels elliptical, solitary; receptacles lateral, lanceolate, ovate or

forked, pendulous, scattered, near the base of the branches. *Grev. Alg. Brit. p.* 7; *Hook. Br. Fl.* ii. *p.* 268; *E. Bot. t.* 1927; *Harv. Phyc. Brit. t.* lii.

Muddy sea-shores, usually in land-locked bays, and among boulders. Perennial. April and May. West of Ireland and north and west of Scotland.—*Frond* 6—10 inches long, densely tufted, branches crowded, spreading, compressed at base, cylindrical upwards. *Vesicles* wider than the frond. *Substance* leathery, when dry somewhat horny. *Colour* dull olive-green.

6. F. *canaliculatus*, L.; frond coriaceous, linear, channelled on one side, dichotomous, without air-vessels; receptacles terminal, oblong-wedge-shaped, swollen, bipartite. *Grev. Alg. Brit. p.* 18; *Hook. Br. Fl.* ii. *p.* 268; *E. Bot. t.* 823; *Wyatt, Alg. Danm. No.* 102; *Harv. Phyc. Brit. t.*

Rocky coasts, near high-water mark. Perennial. Summer and autumn. —*Frond* 2—6 inches high, densely tufted, several times dichotomous, of an olive-brown or yellowish colour.

VI. Himanthalia. Lyngb. [Plate 2, B.]

Frond top-shaped. *Receptacles* very long, strap-shaped, repeatedly forked, springing from the centre of the frond, filled with mucus traversed by jointed fibres, and pierced by numerous pores, which communicate with immersed, spherical *conceptacles*, containing either parietal *spores* or *antheridia*. Name, from ἱμας, a *strap*, and θαλος, a *branch*, or ἁλς, the *sea;* a translation of the common English name "*sea-thongs*."

1. H. *lorea*, Lyngb.; frond top-shaped, at length collapsing, plano-concave, stalked; receptacles repeatedly dichotomous, linear, slightly tapering at the extremity. *Grev. Alg. Brit. p.* 20. *t.* 3; *Hook. Br. Fl.* ii. *p.* 269; *E. Bot. t.* 569; *Wyatt, Alg. Danm. No.* 3.

Rocky sea-shores, common. Biennial. Winter and spring.—*Fronds* gregarious, about an inch high; receptacles 2—10 feet long, coriaceous, thong-like, dark olive-green. Authors are at variance as to the duration of this plant, and also as to the name properly applicable to the long, branching part, here called a receptacle. From recent observations I have no doubt that this plant is biennial; and its development, I think, justifies the views here adopted as to the nature of its several parts. It is a common habit of biennial plants to spend the first year in perfecting the organs of vegetation, and to start into fruit in the following season. This is exactly what takes place in this sea-weed. The top-shaped, or finally cup-shaped base which is here called a frond, but which in the view of some authors is a vesicle, takes a whole year to arrive at perfection, and is fully formed before any part of the strap-shaped *receptacle* makes its appearance. This last commences the second year, rapidly attains its full size, forms its fruit, and falls off at the end of the season. I have never observed the old fronds to sprout again, but Carmichael asserts that they do so.

Order II. SPOROCHNACEÆ.

Sporochnoideæ, *Grev. Brit. Alg. p.* 36. *J. Ag. Sp. Alg. vol.* i. *p.* 160. *Kütz. Phyc. Gen. p.* 342. *Endl.* 3*rd Suppl. p.* 28. Chordarieæ, in part. *Ag. Syst. p.* xxxvi. Sporochnidæ, and part of Dictyotidæ, *Lindl. Veg. King. p.* 22.

Diagnosis.—Olive-coloured, inarticulate sea-weeds, whose spores are attached to external, jointed filaments, which are either free or compacted together into knob-like masses.

Natural Character.—*Root* usually a small, scutate disk, rarely bulbous, and coated with woolly fibres. *Fronds*, when living, usually of a clear and rather bright olive colour, and cartilaginous, firm substance, rapidly becoming flaccid and changing to a verdigris-green colour in the air; of mediocre size and much branched, frequently bushy. *Stems* and *branches* uniform, destitute of distinct leaves, inarticulate, either cylindrical and filiform, often exceedingly slender, or more or less compressed; sometimes flattened, leaf-like, and furnished with a distinct midrib, and occasionally lateral nervelets; the branches very frequently opposite, and almost always distichous. *Air-vessels* none. Almost all bear, at some period of their growth, pencils of delicate, jointed, confervoid filaments. In some these accompany vegetation, sprouting out from all the growing apices, and continuing while the branchlet is in active growth, after which they fall away: such may possibly discharge the office of leaves in these leafless plants. In other kinds the filaments spring from and crown the receptacles of the fructification, falling away, in like manner, when the spores arrive at maturity. The organs of *fructification* are varied considerably in this order. In some the spores are developed on the pencilled filaments, which spring from all parts of the branches. In others, proper receptacles, formed of minute, branching filaments closely whorled round a central axis, and compacted together by lateral cohesion, either terminate the larger divisions of the frond, or are borne on short, lateral ramuli or peduncles. To the filaments composing these *capitula* or knob-like receptacles are attached the *spores*, which are generally pear-shaped, containing a single mass, lodged in a pellucid perispore. The *antheridia* are unknown.

A small group, of which five (or, according to the views of some authors, six) genera, comprising twenty-four species, are at present known to botanists. Notwithstanding such a discrepancy in the organs of fructification as obliges us to break the order into two families, yet there is so much similarity in the structure and habit of these plants, and all so closely agree in the remarkable property of changing themselves from olive to a verdigris colour, and then causing the rapid decay of all delicate Algæ brought into contact with them, that I cannot but regard the assemblage as a natural one. Their power of destroying other Algæ has long been known, and another curious property, first observed in *Arthrocladia*, is common to many, namely, that of rendering paper for the moment transparent, as if the branches gave out an oil. This acts but temporarily, ceasing when the plant is perfectly dry.

The *Sporochnaceæ* are chiefly characteristic of cold or temperate latitudes, between the parallels 64° and 40°. One genus, *Chnoospora*, is tropical. *Arthrocladia* appears to be confined to the shores of Europe. Of seven species of *Desmarestia*, four are known only in the higher latitudes of the Southern Ocean, while the other three, our British species, are dispersed throughout the Atlantic and Pacific, both North and South. *D. viridis* is excessively common in the Antarctic Ocean, and *D. ligulata* is found on the N. West coast of America, at the Cape of Good Hope and at Cape Horn. Of six species of *Sporochnus*, three belong to the shores of Europe, and three to those of Australia. Of *Carpomitra* four species are known, all of them found on the Australian coasts, three of them exclusively so; the fourth (our *C. Cabreræ*) is a native of New Zealand, of the south of Spain, and of the south of England and Ireland. The distribution of this last-named species is very singular, particularly as it seems to be rare in all its recorded stations.

None of the species are used in the arts.

SYNOPSIS OF THE BRITISH GENERA.

Fam. 1. ARTHROCLADIEÆ (J. Ag.). *Spores* attached to pencilled filaments, issuing from the branches.

I. DESMARESTIA. *Frond* solid, filiform or flat, distichously branched. [Plate 5, D.]

II. ARTHROCLADIA. *Frond* traversed by a jointed tube, filiform, nodose. [Plate 5, C.]

Fam. 2. SPOROCHNEÆ. *Spores* produced in knob-like receptacles, composed of whorled filaments, compacted together.

III. SPOROCHNUS. *Receptacles* lateral, on short peduncles. [Plate 5, A.]

IV. CARPOMITRA. *Receptacles* terminal, at the tips of the branches. [Plate 5, B.]

FAMILY 1. ARTHROCLADIEÆ.

I. DESMARESTIA. Lamour. [Plate 5, D.]

Frond linear, either filiform, compressed or flat, distichously branched, cellular, traversed by an internal, single-tubed, jointed filament; branches producing, when young, marginal tufts of byssoid, branching fibres. *Fructification* unknown. Name, in honour of *A. G. Desmarest*, a celebrated French naturalist.

1. D. *ligulata*, Lightf.; frond flat, with an obscure midrib, repeatedly pinnate; pinnæ and pinnulæ linear-lanceolate, tapering at base, opposite. *Grev. Alg. Brit. p.* 36, *t.* 5; *Hook. Br. Fl.* ii. *p.* 273; *E. Bot. t.* 1636; *Wyatt, Alg. Danm. No.* 55. *Harv. Phyc. Brit. t.* cxv.

On rocks and stones between tide-marks and at a greater depth. Annual. Summer. Frequent on the southern shores of England, and the south and west of Ireland. Frith of Forth, *Lightfoot*. Orkneys, *Rev. C. Clouston*. Yarmouth, *Mr. Wigg*.—*Frond* 2—6 feet long, of a clear olive brown while growing, but soon fading in the air to a verdigris-green; yellowish when dry. *Branches* variable in breadth, but all linear-lanceolate in outline, and exactly opposite in insertion.

2. D. *aculeata*, L.; stem short, cylindrical, throwing forth

numerous slender, flattish branches, which are repeatedly irregularly pinnate; pinnæ and pinnulæ alternate, tapering at base, filiform, either fringed with minute tufts of delicate fibres, or set with erect, awl-shaped, alternate, distichous spines. *Grev. Alg. Brit. p.* 38, *t.* 5, *f.* 2, 3; *Hook. Br. Fl.* ii. *p.* 273; *E. Bot. t.* 2445; *Wyatt, Alg. Danm. No.* 158, α. and β.; *Harv. Phyc. Brit. t.* xlix.

On rocks, stones and Algæ between tide-marks, and in 4—5 fathom water. Perennial. Common on most shores.—*Fronds* 1—3 feet long. In the young plant the branches are soft and flaccid, and furnished along their whole length with tufts of bright green conferva-like filaments, which drop off as soon as the branch has completed its growth. Old plants are rigid, destitute of these fibres, and the branches set with short awl-shaped spines or ramuli; but whenever they shoot out new branches, these are constantly clothed with the green fibres, which seem to be an indispensable accompaniment to the process of growth, and perhaps perform the functions of *leaves*. No fructification has yet been observed either in this species or in *D. ligulata*.

3. D. *viridis*, Müll.; frond cylindrical, filiform, repeatedly pinnate; pinnæ and pinnulæ capillary, opposite. *Dichloria viridis, Grev. Alg. Brit. p.* 39, *t.* 6; *Hook. Br. Fl.* ii. *p.* 274; *E. Bot. t.* 1669; *Wyatt, Alg. Danm. No.* 56.

In the sea, growing on stones and the larger Algæ between tide-marks. Annual. Summer. Not uncommon on the British shores.—*Root* disk-like. *Frond* 2—3 feet long, excessively branched in a pinnated manner, all the branches and ramuli exactly opposite; the main stem about half a line in diameter at base, gradually attenuated upwards; the branches becoming in each series more and more slender and capillary; the whole plant having a strikingly feathery and delicate appearance. *Colour*, whilst growing, dark olive or "foxy" (*Dr. Drummond*); quickly becoming a verdigris-green when removed from the water. *Substance* at first harsh and rigid, but soon becoming flaccid on exposure, in which state it closely adheres to paper.

II. Arthrocladia. Duby. [Plate 5, C.]

Frond filiform, cellular, with an articulated, tubular axis, nodose; the nodes producing whorls of delicate, jointed filaments. *Fructification:* pedicellate, moniliform pods, borne on the filaments, and containing, at maturity, a string of elliptic *spores*. Name, αρθρον, a *joint*, and κλαδος, a *branch*.

1. A. *villosa*, Huds.; *Harv. Phyc. Brit. t.* lxiv. *Sporochnus villosus, Grev. Alg. Brit. p.* 42; *Hook. Br. Fl.* ii. *p.* 274; *E. Bot. t.* 546; *Wyatt, Alg. Danm. No.* 105.

On submarine substances, in 4—5 fathom water, rather rare. Annual. Summer and autumn. Coast of England in several places, chiefly in the south. Frith of Forth, *Mr. Hassell.* Ardthur, *Capt. Carmichael.* Wicklow and Downshire coasts.—*Fronds*, several from the same base, 6 inches to nearly 3 feet long, very slender, once or twice pinnated; pinnæ distant, opposite, or rarely alternate, patent, simple, or again pinnated with similar simple pinnules; all the branches furnished, at intervals of from half a line to a line, with minute joint-like swellings or knobs, which are whorled with very delicate, branched, jointed, confervoid filaments, of a pale green colour. *Substance* of the branches cartilaginous, soon becoming flaccid. *Fructification:* minute, articulated, lanceolate *pods*, which are finally much elongated and contracted at the joints in a moniliform manner, and contain at maturity in each joint a well-formed oval *sporule*, of an olive colour, which finally breaks through the membrane and falls away. These *pods* are borne by the jointed fibres, several often together, in a secund manner. The credit of having first pointed out this fructification, which, now that it has been observed, is found to be very common, is due to the Rev. M. J. Berkeley.

Family 2. SPOROCHNEÆ.

III. Sporochnus. Ag. [Plate 5, A.]

Frond filiform, solid, cellular, the axis more dense. *Fructification:* lateral, crested, stalked *receptacles*, composed of horizontal, branching filaments, whorled round a central axis, and producing obovate *spores*. *Crest* deciduous, consisting of byssoid, jointed fibres. Name, *σπορος*, a *seed*, and *χνοος*, *wool;* because tufts of fibres accompany the fructification.

1. S. *pedunculatus*, Huds.; stem undivided; branches lateral, long, simple, horizontal; receptacles elliptical. *Grev. Alg. Brit. p.* 41, *t.* 6; *Hook. Br. Fl.* ii. *p.* 274; *E. Bot. t.* 545; *Wyatt, Alg. Danm. No.* 104; *Harv. Phyc. Brit. t.* lvi.

On submarine substances, about low-water mark, and in 4—10 fathom water. Annual. Summer. Not uncommon on the eastern and southern shores of England and Ireland. Frith of Forth.—*Stem* 6—18 inches long, filiform, quite simple, closely set throughout its length with long slender branches. *Colour* at first a full olive-brown, soon changing to a yellow-green on exposure.

IV. Carpomitra. Kütz. [Plate 5, B.]

Frond filiform, or flat and midribbed, subdichotomous, cellular, the axis more dense. *Fructification:* mitriform *receptacles* terminating the branches, composed of horizontal branching filaments whorled round a vertical axis, and producing elliptic-oblong *spores.* Name, *καρπος*, *fruit*, and *μιτρα*, a *cap* or *mitre.*

1. C. *Cabreræ*, Clem.; frond irregularly dichotomous, linear, narrow, flat, midribbed; branches here and there constricted. *Harv. Phyc. Brit. t.* xiv. *Sporochnus Cabreræ, Ag.; Harv. in Mack. Fl. Hib. part* 3, *p.* 154; *Turn. Hist. t.* 140.

Thrown up from deep water, very rare. Perennial? Winter. Youghal, County Cork, *Miss Ball.* Plymouth Sound, *Rev. W. S. Hore* and *Dr. Cocks.*—*Root* a shapeless woolly tuber. *Stems* 6—8 inches high, much branched in an irregularly dichotomous manner, flat, nerveless, except near the base, where there is an obscure midrib, coriaceo-cartilaginous. *Branches* erect, with acute axils, distichous, alternate, narrow below, becoming rather broader upwards, here and there constricted, the apices truncate and often discoloured.

ORDER III. LAMINARIACEÆ.

Laminarieæ, *Grev. Alg. Brit. p.* 24. *J. Ag. Symb. p.* 4. *Sp. Alg. p.* 121. *Endl.* 3*d Suppl. p.* 26. *Kütz. Phyc. Gen. p.* 344, and part of Chordeæ, *p.* 333. Laminaridæ, *Lindl. Veg. King. p.* 22.

DIAGNOSIS.—Olive-coloured, inarticulate sea-weeds, whose spores are superficial, either forming indefinite cloud-like patches or covering the whole surface of the frond.

NATURAL CHARACTER.—*Root* rarely a simple disk, commonly a conical mass composed of numerous stout branching fibres compacted together. *Fronds* of an olive-brown or olive-green colour, becoming darker on exposure to the air; sometimes tough and leathery, sometimes delicately membranaceous, fibroso-cellular; frequently of very large size, either simple and tubular, or furnished with a more or less distinct stipes or stem, terminating in a leafy frond. In the simplest kinds the frond is a hollow, membranous bag, contracted at the base into a little stalk, and gradually tapering to the apex; in others a little more perfect, the frond is tubular, the tube divided into several compartments by transverse partitions placed at equal distances across its cavity. In more perfect genera the frond is distinctly divisible into two portions; a cylindrical or compressed stem, and a flattened leafy blade. The stem is either simple or branched, and is usually solid, at least in its lower part, and in all cases bears the leafy expansion at its summit, or at the summits of its branches. This expansion is sometimes ribbon-shaped, quite simple and tapering to the extremity; sometimes it is cloven vertically into many narrow segments; sometimes it is pinnatifid (as in *Ecklonia*); and sometimes (in *Agarum* and *Thalassiophyllum*) it is perforated like a sieve. In some it is ribless, in others furnished with a more or less perfect midrib. *Air-vessels* often absent; where they occur they are formed by swellings at the base of the leaf, in the general stipes or in its branches. In those species which are perennial the stipes lasts for several years, but the leaf is changed at the end of each season. New growth, therefore, commences at the apex of the stipes and base of the leaf, and continues till the old leaf is gradually pushed off. The fructification consists in innumerable minute spores, packed vertically together, in strata, extending either over the whole surface of the plant or covering spaces of the surface of considerable extent. In the simplest kinds the whole frond becomes covered with spores (as in *Chorda*); in more perfect genera indefinite cloud-like patches are dispersed over the leafy portion; and in the most organized examples (as *Alaria*) the spores form distinct sori of large size, situated in proper leaflets. The *spores* are either simple, or contain, at maturity, four sporules. Very generally they are stipitate, or taper at base into a more or less evident pedicel, formed from the lower half of the sporular cell. In some genera they are mixed with *paranemata*, among which *antheridia* occur; in others the whole stratum is composed of spores.

The plants of this family are almost all of large size, and many of them gigantic, greatly exceeding in bulk any other marine vegetables. The *Oar-weeds* and *Tangle* of our own coasts have frequently stems six or eight feet long, and fronds expanding from their summits to as great a length; and the sea-thong (*Chorda*) often measures forty feet in length. But these dimensions are small compared with their kindred on the shores of the Pacific Ocean. The *Nereocystis*, a plant of this family inhabiting the north-western shores of America, has a stem, no thicker than whipcord, but upwards of 300 feet in length, bearing at its apex a huge vesicle, six or seven feet long, shaped like a barrel, and crowned with a tuft of upwards of fifty forked leaves, each from 30 to 40 feet in length. The vesicle, being filled with air, buoys up this immense frond, which lies stretched along the surface of the sea: here the sea-otter has his favourite lair, resting himself upon the vesicle, or hiding among the leaves while he pursues his fishing. The cord-like stem which anchors this floating tree must be of considerable strength; and, accordingly, we find it used as a fishing-line by the natives of the coast. But great as is the length of this sea-weed, it is exceeded by the *Macrocystis*, though the leaves and air-vessels of that plant are of small dimensions. In the *Nereocystis* the stem is unbranched; in *Macrocystis* it branches as it approaches the surface, and afterwards divides by repeated forkings, each division bearing a leaf, until there results a floating mass of foliage some hundreds of square yards in superficial extent. It is said that the stem of this plant is sometimes 1500 feet in length. These are the most lengthy of the family. There are others whose fronds would weigh more. The *Lessoniæ*, which inhabit the deeper parts of the Laminarian zone in the latitude of Cape Horn, and along the shores of Chili, have branching trunks of considerable diameter and length, each branch crowned with bunches of long ribbon-like leaves, and the whole plant resembling a submarine arborescent aloe of large size. The *Eckloniæ*, a noble genus with pinnated fronds, may be compared to submarine palm-trees. The best known species, *E. buccinalis*, the *trumpet weed* of South Africa, has a stem often more than twenty feet long, two inches in diameter at the base, where it is solid, gradually widening upwards and becoming hollow, and crowned with a fan-shaped cluster of leaves, each twelve feet long or more. The stem of this plant when dried is often used in the colony as a siphon; and by the native herdsmen is formed into a trumpet, for collecting the cattle at evening. But perhaps the most remarkable of the order are the arctic forms, *Thalassiophyllum* and *Agarum*, both furnished with broad leaves regularly pierced with holes at short distances. In the first of these genera the sieve-like fronds grow, in spiral order, round a branching shrubby stem; in the latter the fronds are solitary, as in our own simple-leaved species of *Laminaria*.

The order contains about fifty species, comprised under three genera, and characteristic of the colder climates both north and south. *Macrocystis*, *Laminaria* and *Ecklonia* extend into the tropics.

SYNOPSIS OF THE BRITISH GENERA.

* *Frond stipitate; the stipe ending in an expanded leafy portion.*

I. ALARIA. *Leaf* membranaceous, with a cartilaginous, percurrent midrib. [Plate 3, A.]

II. LAMINARIA. *Leaf* (simple or cleft) without any midrib. [Plate 4.]

** *Frond simple, leafless.*

III. CHORDA. *Frond* cylindrical, hollow; the cavity interrupted by transverse partitions. [Plate 3, B.]

I. ALARIA. Grev. [Plate 3, A.]

Root fibrous. *Frond* stipitate, membranaceous, furnished with a percurrent, cartilaginous midrib, the stem pinnated with ribless leaflets. *Fructification:* pyriform *spores*, vertically arranged in the thickened leaflets. Name, *ala*, a *wing*, from the winged base of the frond.

1. A. *esculenta*, L.—*Grev. Alg. Brit. p.* 25, *t.* 4; *Hook. Br. Fl.* ii. *p.* 271; *E. Bot. t.* 1759; *Harv. Phyc. Brit. t.* lxxix.

On rocks, at low-water mark. Perennial. Winter and spring. Common on the shores of Scotland, and of the North and West of Ireland, and West of England.—*Root* consisting of several cylindrical fibres. *Frond* solitary, 2—12 feet long or more; *stem* 4—8 inches long, pinnated about the middle with several flat nerveless leaflets, and bearing from its summit a long, linear-lanceolate, ribbon-like *leaf*, of delicate texture, through which the stem is continued as a midrib. "The midrib stripped of the membrane, and sometimes also the leaflets, are eaten in Ireland, Scotland, Iceland, Denmark and the Faroe Islands. It is called in Scotland *Badderlocks* or *Henware*, and in the Orkney Islands *Honey-ware.* Dr. Drummond informs me that in some parts of Ireland it bears the name of *Murlins.*" *Grev. Alg. Brit.* 6.

II. LAMINARIA. Lamour. [Plate 4.]

Frond stipitate, coriaceous or membranaceous, flat, undivided, or irregularly cleft, ribless. *Fructification:* cloudy spots of *spores*, imbedded in the thickened surface of some part of the frond. Name, *lamina*, a *thin plate*, descriptive of the flat frond.

1. L. *digitata*, L.; stem woody, cylindrical, gradually tapering and somewhat compressed upwards, expanding into a leathery, roundish-oblong frond, deeply cleft into many linear

segments. *Grev. Alg. Brit. p.* 27, *t.* 5; *Hook. Br. Fl.* ii. *p.* 271; *E. Bot. t.* 2274; *Wyatt, Alg. Danm. No.* 166; *Harv. Phyc. Brit. t.* ccxxiii.

Rocks in the sea, in deep water, common. Perennial.—*Root* consisting of numerous, rigid, woody fibres, 2—3 inches long. *Stem* 1—6 feet high, solid, very tough, expanding into a flat frond, 1—5 feet long and 1—3 feet wide, which is deeply cleft from the apex into an uncertain number of strap-shaped segments. The power of reproducing its frond, noticed by Turner and Greville in *L. digitata*, has been observed by Mrs. Griffiths (to whom I am indebted for a beautiful series of specimens) to exist also in *L. saccharina* and *bulbosa*: it may therefore, perhaps, be considered characteristic of the mode of growth in the *genuine* Laminarieæ. It exists in individuals of all ages. Some of Mrs. Griffiths' specimens of *L. digitata* exhibiting the new frond, are not more than four inches high, and she has traced the process upwards to plants of large size. The new frond at first appears like a roundish expansion between the base of the old frond and the apex of the stem: this gradually enlarges, becoming of an oval form, and in large specimens is frequently cleft into segments long before the apex is free from the base of the old lamina; thus proving that the splitting of the frond in this species does not arise from the fortuitous action of the waves, but from an inherent principle of growth. Fig. 2, in our plate, represents a young, growing beneath an old, frond.

2. L. *bulbosa*, Huds.; stem flat, with a waved margin, once twisted at the base, rising from a roundish, hollow, rough, bulbous root; frond oblong, deeply cleft into many linear segments. *Grev. Alg. Brit. p.* 29; *Hook. Br. Fl.* ii. *p.* 271; *E. Bot. t.* 1760; *Wyatt, Alg. Danm. No.* 4, (young plant); *Harv. Phyc. Brit. t.* ccxli.

On rocky shores, mostly in deep water, frequent. Perennial.—*Young* plant with an oblong, undivided, or slightly cleft frond, 4—12 inches long and 2—3 wide, with a filiform stem about an inch long, furnished with a swelling or dilatation in the centre, and springing from several clasping fibres. As the plant increases in size the stem becomes more and more expanded, and finally waved at the margin, and what was at first a mere knot-like expansion results in a large, bulbous, hollow body, which throws out from its surface stout roots, and becomes the main support of the full-grown frond. This bulb, in a specimen measured by Mrs. Griffiths from deep water in Torbay, was a foot in diameter, and supported a frond which, when spread out on the ground, formed a circle of at least 12 feet in diameter. Common specimens are about half these dimensions.

3. L. *saccharina*, L.; stem cylindrical, filiform, expanding into a cartilaginous or submembranaceous, lanceolate, undivided frond. *Grev. Alg. Brit. p.* 31; *Hook. Br. Fl.* ii. *p.* 272; *E. Bot. t.* 1376; *Wyatt, Alg. Danm. No.* 54.—*β. latifolia;* frond very broad, ovate-elliptical, submembranaceous. *L. latifolia, Ag.*

On rocks between tide-marks. Perennial. Very common. β. in deep water.—*Root* consisting of numerous clasping fibres; stem varying from a few inches to several feet in length, slender; frond 2—12 feet long and 4—16 inches wide, flat, or waved and curled at the margin. *Substance* equally variable; sometimes leathery or cartilaginous, sometimes delicate and membranaceous. *Colour* a deep olive green inclining to brown.

4. L. *Phyllitis*, Stack.; stem somewhat flattened, filiform, expanding into a delicately membranaceous, flat, linear-lanceolate, undivided frond. *Grev. Alg. Brit. p.* 34; *Hook. Br. Fl.* ii. *p.* 272; *E. Bot. t.* 1331; *Harv. Phyc. Brit. t.* cxcii.

Between tide-marks, growing either on stones or on the stems of the larger Algæ. Annual? *Turner;* Biennial? *Greville.* Not uncommon.—I own that I share the doubts entertained by my friends Dr. Greville and Mrs. Griffiths, regarding the claim of this beautiful plant to rank as a species distinct from *L. saccharina.* The more lanceolate form, delicate substance, and pale yellowish green colour, constitute the chief marks of distinction. *Stem* 1—2 inches high; frond 8 inches to 3 feet or more in length, and 1—6 inches in width.

5. L. *fascia*, Müll.; stem very short, setaceous, gradually expanding into a membranaceous, broadly oblong, wedge-shaped, lanceolate, or linear frond. *Ag. Syst. p.* 273; *Wyatt, Alg. Danm. No.* 157; *Harv. Phyc. Brit. t.* xlv. *L. debilis, Ag. Grev. Crypt. t.* 277; *Alg. t.* 5.

In the sea, on sand-covered rocks. Annual?—*Root* a minute disk. *Stem* setaceous, 1—6 lines high, compressed, insensibly passing into the frond. *Frond* 4—12 inches long or more, and from 2 lines to an inch in breadth, either ovate or cuneate, and often much attenuated at base, sometimes tapering at the apex to an acute point, but oftener blunt and somewhat truncate, of a delicate membranous substance and olivaceous colour.

III. Chorda. Stack. [Plate 3, B.]

Root scutate. *Frond* simple, cylindrical, tubular; its cavity divided by transverse, membranous septa, into separate chambers. *Fructification:** a stratum of obconical *spores*, much attenuated at the base, covering the whole external surface of the frond. Among these are found elliptical *antheridia.* Name, *chorda*, a *cord.*

1. C. *filum*, L.; frond cartilaginous, lubricous, clothed with pellucid hairs, filiform, very long, tapering to each extremity, not constricted at the dissepiments. *Grev. Alg. Brit. p.* 47, *t.* 7; *Hook. Br. Fl.* ii. *p.* 276; *Wyatt, Alg. Danm. No.* 159; *E. Bot. t.* 2487; *Harv. Phyc. Brit. t.* cvii. *β. to-*

* What are here called *spores* are by J. Agardh considered as *paranemata*, and what are here termed *antheridia* are the *spores* of that author. Which is the correct view?

mentosa; of small size, more densely clothed with coloured, olive or green hairs.

On rocks and stones in the sea, between tide-marks; and extending, in still water, to the depth of 10—15 fathoms. Annual. Summer.—*Fronds* from 1 to 20—40 feet long, scarcely twice as thick as a hog's bristle at base, gradually increasing in thickness to their middle, where they are from a quarter to half an inch in diameter, and again gradually diminishing to the attenuated apex. *Colour* dark olive-brown. *Substance* lubricous.

2. C. *lomentaria*, Lyngb.; frond membranaceous, constricted at distant intervals, the interstices inflated. *Grev. Alg. Brit. p.* 48; *Hook. Br. Fl.* ii. *p.* 276; *Wyatt, Alg. Danm. No.* 6; *Harv. Phyc. Brit. t.* cclxxxv. *Asperococcus castaneus, Carm.; Hook. Br. Fl.* ii. *p.* 277.

On rocks and stones, between tide-marks. Annual. Summer and autumn.—*Fronds* 3—16 inches long, 1—4 lines in diameter, attenuated at each extremity, constricted at irregular intervals into a series of bag-like articulations. *Substance* membranaceous, flaccid. *Colour* a brownish or yellowish olive. *Asperococcus castaneus* of the British Flora is the young of this species: so also, according to a specimen, communicated by the author, is *Chlorosiphon Shuttleworthianus*, Kütz., which I formerly referred to *Litosiphon pusillus*; but when I made this reference I had seen no authentic specimen of Kützing's plant.

ORDER IV. DICTYOTACEÆ.

DICTYOTEÆ, *Grev. Alg. Brit. p.* 46. *J. Ag. Sp. Alg. vol.* i. *p.* 68. *Endl. 3d Suppl. p.* 24. Dictyoteæ, Encœlieæ, and part of Chordeæ and Phycoserideæ, *Kütz. Phyc. Gen.* pp. 337, 336, 333, 296. Dictyotidæ, *Lindl. Veg. King. p.* 22.

DIAGNOSIS.—Olive-coloured, inarticulate sea-weeds, whose *spores* are superficial, disposed in definite spots or lines (*sori*).

NATURAL CHARACTER.—*Root* a disk-like expansion, sometimes naked, sometimes coated with woolly, jointed fibres. *Fronds* of an olive-green or olive-brown colour, usually becoming paler on exposure to the air; of a membranaceous, flexible substance, rarely coriaceous or cartilaginous, scarcely at all juicy; and of a cellular structure composed of two or more strata of cells, of which the internal are usually largest: the outer surface very generally having an areolated or netted appearance under a lens of moderate power. In outward habit there is considerable diversity among the plants of this order. The simplest are flat, undivided expansions, consisting of three strata of cells, of which the central one is colourless, the two superficial coloured. In others the frond is a simple bag, closed at both ends. Others, of rather higher type, are cylindrical and branching, the branches of some being hollow, those of others solid. Some have flat fronds pinnated or dichotomously divided; in others the fronds take a more or less perfectly fan-shaped outline. In the first of these, the cells of which the structure is composed are arranged in parallel series; in the last they radiate from the base of the frond as from a central point. One genus only (*Haliseris*) is furnished with a distinct midrib, running through a flat, membranaceous frond; and in no member of the order is there a distinction into stems and leaves, but whatever form the frond assumes in its first growth is repeated in its after developments. Many of them, and perhaps all, at some period of their growth, are clothed with exceedingly fine, articulated hairs, which often decompose the rays of light, reflecting prismatic colours. These are most observable in *Padina* and *Cutleria*, but exist in *Punctaria*, in *Asperococcus*, and other low forms.

The *fructification* appears under almost as many phases as the organs of vegetation. In nearly all the *spores* are simple; a single, elliptical or obovate embryonic mass being contained in a hyaline perispore: but in *Cutleria* the perispore contains eight sporules. The spores of some are scattered singly; of others, and these the greater number, they are collected into spots or *sori*, which are round, oblong, or linear, and either dotted irregularly over the whole surface, or confined to a definite portion of it, or ranged in transverse, horizontal or concentric bands. In some species both scattered and aggregated spores occur on the same or on different individuals. In most instances the *spores* are accompanied by *paranemata*, sometimes few in number and of low organization as in *Asperococcus* and *Punctaria*); sometimes as in *Stilophora*) constituting the larger portion of the fructification. In a few (as *Cutleria*) *antheridia* sometimes occupy the place of spores; and in others (*Punctaria*, *Dictyota*, &c.) *gemmules* (?) of round shape and large size occur on the same frond which produces true spores, or on different individuals of the same species. Perhaps the so-called spores of *Striaria* and *Dictyosiphon* are of this description.

Next to the *Fucaceæ* this order is the most extensive among Melanosperms, and the species are for the most part objects of great beauty: some, like the singular *Padina* or peacock's tail, almost without a parallel among sea-weeds. None are of very large size, and none can be called microscopic. Those that are found between tide-marks generally grow in open pools, not far from high-water mark, where they are exposed to the full play of sunshine for some hours each day. The deep-water species generally frequent quiet, sandy or muddy bays, or estuaries. Many kinds (like *Asperococcus Turneri*), which attain the length of but a few inches when they grow between tide-marks, form fronds many feet in length when growing in deep water. Some are nearly confined to the southern shores (as *Padina*, *Taonia*, and *Haliseris*). Others are equally abundant in all parts of Britain. The order is, however, chiefly characteristic of the warmer and more sheltered parts of the sea. The species are very few in high northern and southern latitudes, and gradually increase from the fortieth parallel to the equator. Most of the genera have a wide range, and many of the species are cosmopolites. *Padina Pavonia* abounds throughout the tropics and along the shores of Southern Europe, and reaches its northern limit in the South of England. Here, however, it shows its sun-loving propensities by growing in very shallow pools, the temperature of which, during the recess of the tide, rises considerably: and in warm summers its fronds are double the size of those developed in cold seasons. Our *Dictyota dichotoma* is found from the shores of northern Europe to the tropics; then at the Cape of Good Hope, the Antarctic Lands, the western side of South America, and in New Zealand. The *Asperococci* have as wide a range. *Haliseris polypodioides* extends from the tropics to lat. 54° on the West of Ireland. Of the beautiful genus to which it belongs ten species are known, all of them natives of tropical or subtropical regions. *Zonaria parvula* is another straggler, belonging to a genus all the rest of whose species are natives of warm countries.

None of the *Dictyoteæ* are used in the arts.

SYNOPSIS OF THE BRITISH GENERA.

* *Root coated with woolly fibres. Frond flat.*

I. CUTLERIA. *Frond* ribless, irregularly cleft. *Sori* dot-like, scattered. *Spores* pedicellate, containing eight sporules. [Plate 6, A.]

II. HALISERIS. *Frond* dichotomous, with a midrib. [Plate 6, B.]

III. PADINA. *Frond* ribless, fan-shaped, concentrically striate. *Sori* linear, concentric, bursting through the epidermis. [Plate 6, C.]

IV. ZONARIA. *Frond* ribless, lobed, concentrically striate. *Sori* roundish, containing spores and jointed threads. [Plate 6, D.]

V. TAONIA. *Frond* ribless, irregularly cleft, somewhat fan-shaped. *Sori* linear, concentric, superficial, alternating with scattered spores. [Plate 7, B.]

VI. DICTYOTA. *Frond* ribless, linear, dichotomous. *Sori* roundish, scattered, bursting through the epidermis, or (on distinct individuals) scattered spores. [Plate 7, A.]

** *Root a minute, naked disk. Frond cylindrical, branched.*

VII. STILOPHORA. *Spores* concealed among moniliform threads, which are collected into convex, wart-like *sori*. [Plate 7, C.]

VIII. DICTYOSIPHON. *Spores* irregularly scattered, solitary or in dot-like *sori*. [Plate 7, D.]

IX. STRIARIA. *Spores* in dot-like *sori*, ranged in transverse lines. [Plate 8, A.]

*** *Root a minute, naked disk. Frond cylindrical or flat, unbranched.*

X. PUNCTARIA. *Frond* flat, leaf-like. [Plate 8, B.]

XI. ASPEROCOCCUS. *Frond* membranous, tubular, either cylindrical or compressed. *Spores* in dot-like *sori*, mixed with a few jointed threads. [Plate 8, C.]

XII. LITOSIPHON. *Frond* cartilaginous, filiform, subsolid. *Spores* scattered, subsolitary. [Plate 8, D.]

I. Cutleria. Grev. [Plate 6, A.]

Root clothed with woolly fibres. *Frond* flat or compressed, cartilagineo-membranaceous, ribless, somewhat fan-shaped, irregularly cleft. *Fructification:* dot-like tufts of pedicellate *spores*, scattered over both surfaces of the frond; each spore containing several *sporules*. *Antheridia* on distinct plants, linear, transversely dotted, attached to minute, tufted filaments, occupying the position of the *sori*. Named by Dr. Greville in honour of *Miss Cutler*, a distinguished British Algologist.

1. C. *multifida*, Sm.; frond thickish, polymorphous, flabelliform, irregularly cleft into numerous, narrow laciniæ; axils very acute; apices attenuated, pencilled. *Grev. Alg. Brit. p.* 60, *t.* 10; *Hook. Br. Fl.* ii. *p.* 281; *Wyatt, Alg. Danm. No.* 61; *E. Bot. t.* 1913 (Ulva); *Harv. Phyc. Brit. t.* lxxv.

In the sea, on rocks and shells, in 4—15 fathom water. Annual. Summer and autumn. Coasts of England and Ireland; very rare in Scotland. Orkney.—*Frond* 2—8 inches long, of a broadly wedge-shaped, or somewhat fan-shaped outline, cleft into several segments, often nearly to the base, and these again splitting into others; segments linear, 1—3 lines wide, slightly dilated upwards. *Fructification* scattered over the whole frond, dot-like, prominent. *Substance* between cartilaginous and membranaceous, at first crisp, but becoming flaccid and closely adhering to paper in drying. *Colour* olivaceous, often with a rusty hue: young and perfect plants are frequently fringed with minute fibres.

II. Haliseris. Tozzetti. [Plate 6, B.]

Root, a mass of woolly filaments. *Frond* flat, linear, membranaceous, with a midrib. *Fructification:* ovate *spores*, forming distinct *sori* or groups, mostly arranged in longitudinal lines. *Grev.*—Name, ἁλς, the *sea*, σεϱις, *endive*.

1. H. *polypodioides*, Desf.; frond dichotomous, entire at the margin, spots of fructification linear, elongated, forming a line at each side of the midrib. *Grev. Alg. Brit. p.* 63, *t.* 8; *Hook. Br. Fl.* ii. *p.* 282; *Wyatt, Alg. Danm. No.* 12; *E. Bot. t.* 1758; *Harv. Phyc. Brit. t.* xix.

On rocks and stones in the sea, in tide-pools, and in 2—5 fathom water. Biennial?—*Grev.* August to October. Several places in the south of England. Shields beach, *Mr. Winch.* West and south of Ireland.—*Root* a spreading mass of matted threads. *Fronds* tufted, 4 — 12 inches high, about half an inch wide, several times dichotomous, with a strong, percurrent midrib; segments linear, mostly obtuse, sometimes acute, the margin quite entire; surface dotted with tufts of white hairs issuing from minute pores. Along the midrib are frequently found minute, oval, fleshy protuberances or *buds*, from which new branches frequently spring, so that the frond often appears as if proliferous. *Fructification* of two kinds, on distinct individuals: 1st, oblong spots of spores, often confluent, arranged along each side of the midrib; 2nd, large oval spores, scattered irregularly over the surface of the frond; these were discovered by Mrs. Griffiths, in August, 1828. The same accomplished lady has also observed a curious state of frond, probably connected in some manner with fructification, where the membrane is marked, in the portion usually occupied by spores, with brown, wavy, map-like lines, inclosing spaces which are usually more transparent than the rest of the frond. *Substance* of the membrane thin, somewhat rigid, not adhering to paper in drying, tearing with facility in an oblique direction toward the midrib, the cellules of which it is composed particularly large. *Colour* a brownish olive. *Smell*, when fresh gathered, very powerful and offensive.

III. Padina. Adans. [Plate 6, C.]

Root coated with woolly fibres. *Frond* flat, ribless, fan-shaped, marked at regular distances with concentric lines, fringed with articulated filaments; the apex involute. *Fructification:* linear, concentric *sori*, bursting through the cuticle of the upper surface of the frond, consisting, at maturity, of numerous obovate *spores*, fixed by their bases; each spore containing four *sporules.* Name, invented by Adanson, who has not explained its meaning.

1. P. *Pavonia*, L.; frond wedge-shaped at base, erect, broadly fan-shaped, entire or deeply cleft, powdery on the outer surface, and marked with numerous concentric lines, the margin revolute and fringed. *Grev. Alg. Brit. p.* 62, *t.* 10; *Hook. Br. Fl.* ii. *p.* 281; *Wyatt, Alg. Danm. No.* 11; *E. Bot. t.* 1276; *Harv. Phyc. Brit. t.* xci.

On rocks in shallow tide-pools, at half-tide level. Along the extreme southern shores of England in several places, rare. Annual. Summer and autumn.—*Fronds* tufted, 2—5 inches high, stipitate or sessile, broadly fan-shaped or reniform, sometimes entire, sometimes repeatedly and deeply cleft; the segments all fan-shaped. The whole frond is marked with numerous concentric zones, one or two lines apart, and mostly covered with a whitish powdery substance on the under-side. The substance in the lower part is somewhat leathery and opaque; above it is delicately membranous and transparent. The margin, which always preserves its circular outline, is rolled backwards, and fringed with extremely delicate, reddish-brown filaments. The *spores* are produced in lines along the concentric zones, originating beneath the epidermis of the frond, through which they finally burst and drop off. This most beautiful plant, not incorrectly compared to a peacock's tail, is found pretty extensively in the seas of warm countries in both hemispheres, perhaps reaching its highest latitude on our shores.

IV. Zonaria. [Plate 6, D.]

Root coated with woolly fibres. *Frond* flat, ribless, fan-shaped, entire or variously cleft, marked with concentric lines; the cells of the surface radiating. *Fructification:* roundish, or irregular, scattered *sori*, bursting through the cuticle of both surfaces of the frond, consisting, at maturity, of numerous *spores*, nestling among jointed threads. Name, from ζώνη, a *girdle* or *zone*.

1. Z. *parvula*, Grev.; frond procumbent, attached by fibres issuing from its lower surface, membranaceous, suborbicular, variously lobed; lobes free, rounded, scarcely marked with concentric lines. *Grev. Alg. Brit. p.* 63; *Hook. Br. Fl.* ii. *p.* 282; *Grev. Crypt. t.* 360.

On rocks and corallines, between tide-marks, and in 4—15 fathom water. Annual? Spring and summer. All round the coast.—*Fronds* spreading over the rocks in patches, one to several inches in diameter, attached by means of whitish fibres, except at the margins, which are free and lobed; the lobes rounded, smooth, entire, often imbricated. The substance is membranous, somewhat transparent, and highly reticulated; the cells quadrangular. The colour is an olivaceous green. The fructification has not yet been observed in Britain, but is described, on Swedish specimens, by Dr. Areschoug.

V. Taonia. J. Ag. [Plate 7, B.]

Root coated with woolly fibres. *Frond* flat, ribless, imperfectly fan-shaped, irregularly cleft, highly reticulated, marked with concentric lines. *Fructification:* linear, wavy, concentric, superficial *sori*, on both surfaces of the frond, consisting of clustered, naked *spores*, destitute of filaments. Scattered *spores* occupy the intermediate spaces. Name, ταὼν, a *peacock*.

1. T. *atomaria*, Good. & Woodw.; frond membranaceous, broadly wedge-shaped or somewhat fan-shaped, deeply and irregularly cleft and laciniated; spores forming waved, transverse lines, with intermediate scattered ones. *Grev. Alg. Brit. p.* 58; *Hook. Br. Fl.* ii. *p.* 280; *Wyatt, Alg. Danm. No.* 60; *E. Bot. t.* 419; *Harv. Phyc. Brit. t.* i.

Rocks between tide-marks, rare. Annual. Summer. East and south of England. Frith of Forth, *Grev.* Ballycotton, coast of Cork, *Miss Ball.*—*Fronds* tufted, 3—12 inches long, with a broadly wedge-shaped or palmate outline, triangular at base, deeply cleft into numerous segments, which are again divided into lesser ones, the apices truncate. The colour is a brownish-olive; the substance thin and transparent, and the whole surface beautifully marked with broad wavy lines of dark brown spores, from a quarter to half an inch asunder, the intermediate spaces mottled with scattered groups of spores.

VI. Dictyota. Lamour. [Plate 7, A.]

Root coated with woolly fibres. *Frond* flat, ribless, membranaceous, reticulate, dichotomous or pinnatifid; the surface cells parallel, those at the apices of the segments converging. *Fructification:* roundish, scattered *sori*, bursting through the cuticle on both surfaces of the frond, consisting, at maturity, of numerous, obovate, tufted *spores;* or, on distinct plants, solitary, scattered spores. Name, *δικτυον*, a *net*, because the surface is reticulated.

1. D. *dichotoma*, Huds.; frond regularly dichotomous, linear; the segments becoming gradually narrower towards the extremities; spores scattered irregularly or clustered.—*Grev. Alg. Brit. p.* 57, *t.* 10; *Hook. Br. Fl.* ii. *p.* 280; *Wyatt, Alg. Danm. No.* 10; *E. Bot. t.* 774; *Harv. Phyc. Brit. t.* ciii.—*β. intricata*, Grev.; frond very narrow, much branched, twisted and entangled.

On rocks and sea plants in the sea, between tide-marks, and in 4—15 fathom water. Both varieties common. Annual. Summer.—*Fronds* 3—12 inches long, 1—4 lines wide, of a clear olive-green colour and membranous substance, regularly dichotomous. *Spores* either scattered over the surfaces, or (in distinct plants) collected into dense spots.

VII. Stilophora. J. Ag. [Plate 7, C.]

Root a small, naked disk. *Frond* filiform, solid or tubular, branched. *Fructification:* convex, wart-like *sori* scattered over the surface, composed of obovate *spores* nestling among moniliform, vertical filaments. Name, *στιλη*, a *point* or *dot*, and *φορεω*, *to bear*, in allusion to the dot-like fructification.

1. S. *rhizodes*, Ehr.; frond subsolid, much and irregularly branched. the branches subdichotomous, acute; ramuli scattered, forked; sori densely covering the branches and ramuli. *Grev. Alg. Brit. p.* 43, *t.* 6; *Hook. Br. Fl.* ii. *p.* 275; *E. Bot. t.* 1688; *Wyatt, Alg. Danm. No.* 5; *Harv. Phyc. Brit. t.* lxx.

Near low-water mark, growing on rocks or Algæ. Annual. Summer. Frequent on the shores of England and Ireland. Jersey.—*Fronds* solitary or tufted, 6—24 inches in length, filiform, either pretty regularly dichotomous, or alternately branched; the branches forked. *Ramuli* more or less abundant, irregularly scattered. *Apices* acute or acuminate. The warts of *fructification* densely cover the whole frond, giving the branches a beaded appearance. When young the frond is solid, but in advanced age, owing to the decay of the central strata of cells, it becomes hollow. *Substance* cartilaginous, dissolving into a slimy jelly if macerated in fresh water. *Colour*, a yellowish or olive-brown.

2. S. *Lyngbyei*, J. Ag.; frond tubular, at length distended, much branched, the branches dichotomous, spreading, with wide, rounded axils, much attenuated towards the apices; ramuli scattered, forked, capillary; sori subdistant, disposed in transverse lines. *Harv. Phyc. Brit. t.* ccxxxvii. *Sporochnus rhizodes, β. paradoxa, Ag.* i. *Harr. Man.* 1 *ed. p.* 27. *Chordaria paradoxa, Lyngb. t.* 14. *Striaria Grevilliana, Pollexfen MS.*

Dredged, generally on a muddy bottom, in 4—10 fathom water. Annual. Summer. Land-locked bays on the coasts of Scotland and Ireland, abundant in many places.—*Fronds* from two to four feet long or more, forming large tufts, or spreading, in society, over wide spaces, excessively branched, nearly regularly dichotomous, tapering to a capillary fineness towards the apices. *Substance* membranaceous, at first crisp and very fragile, becoming soft in a short time. *Colour*, a pale olive-brown, or foxy, becoming greenish olive in drying.

VIII. Dictyosiphon. Grev. [Plate 7, D.]

Root a small, naked disk. *Frond* filiform, tubular, branched; its walls composed of several rows of cells, of which the inner are elongated, and connected in longitudinal filaments; the outer small, polygonal, forming a membrane. *Fructification:* solitary or aggregated naked *spores*, scattered irregularly over the surface. Name, δικτυον, a *net*, and σιφων, a *tube;* from the tubular, reticulated frond.

1. D. *fœniculaceus*, Huds.; *Grev. Alg. Brit. p.* 56, *t.* 8; *Hook. Br. Fl.* ii. *p.* 279; *Wyatt, Alg. Danm. No.* 205.

Between tide-marks, on stones, or parasitic on other Algæ. Annual. Spring and summer. All round the coast.—*Fronds* 1 to many feet long, tufted, very much branched and bushy; the main stem nearly a line in diameter, undivided, bearing through its whole length alternate, elongate, capillary branches, which again bear a second and a third series, each more slender than the last, and all tapering at the extremity. *Fructification* rare. *Colour* yellowish olive or rusty brown.

IX. Striaria. Grev. [Plate 8, A.]

Root naked and scutate. *Frond* filiform, tubular, continuous, membranaceous, branched. *Fructification*: groups of roundish *spores* forming transparent lines. *Grev.* — Name, from the transverse *striæ* formed by the lines of fructification.

1. S. *attenuata*, Grev.; *Hook. Br. Fl.* ii. *p.* 279; *Grev. Crypt. Scot. t.* 288; *Grev. Alg. Brit. p.* 55, *t.* 9; *Wyatt, Alg. Danm. No.* 160; *Harv. Phyc. Brit. t.* xxv.

Between tide-marks, and in 4—5 fathom water, growing on other Algæ, rare. Annual. Summer. Found all round the coast. — *Fronds* tufted, 3—12 inches high, half a line to a line in diameter, set with many patent, elongate, simple or sub-simple, mostly opposite branches, much attenuated at both extremities, and sometimes bearing a second series of similar branches. When in fructification the branches are marked, at spaces of half a line asunder, with transverse rings or bands composed of clusters of spores, sometimes accompanied with filaments. The substance is delicately membranaceous, and the colour a pale olive. The branches are sometimes irregularly scattered, sometimes, especially in the Devonshire plants, whorled, 3, 4 or 5 in a whorl. This plant is also a native of the Mediterranean.

X. Punctaria. Grev. [Plate 8, B.]

Frond undivided, membranaceous, flat, ribless, with a naked scutate root. *Fructification* scattered over the whole frond, in minute, distinct dots, composed of roundish, prominent *spores*, intermixed with club-shaped filaments. Name, *punctum*, a *dot*; from the dot-like fructification.

1. P. *latifolia*, Grev.; frond pale olive-green, thickish, gelatinous and tender, oblong or obovate, suddenly tapering at base. *Grev. Alg. Brit. p.* 52; *Hook. Br. Fl.* ii. *p.* 278; *Wyatt, Alg. Danm. No.* 9; *Harv. Phyc. Brit. t.* viii.

On rocks and Algæ between tide-marks. Annual. Spring and summer. Sidmouth and Torquay, *Mrs. Griffiths*. Near Belfast, *Dr. Drummond*. West of Ireland. *Root* a minute disk. — *Fronds* generally tufted, 8—16 inches long, 1 — 3 wide, oblong or lanceolate, flat or curled, generally obtuse at both extremities, occasionally tapered, delicately membranaceous and semitransparent, somewhat gelatinous, of a pale olive-green colour. *Dots* of fructification minute, roundish, scattered over both surfaces.

2. P. *plataginea*, Roth; frond dark brown, coriaceo-membranaceous, obovate, much attenuated at base. *Grev. Alg. Brit. p.* 53, *t.* 9; *Hook. Br. Fl.* ii. *p.* 278; *E. Bot. t.* 2136; *Wyatt, Alg. Danm. No.* 206; *Harv. Phyc. Brit. t.* cxxviii.

Between tide-marks, attached to rocks, stones, corallines, or some of the larger Algæ. Annual. Summer. Various places on the coasts of England, Ireland and Scotland.—*Fronds* 4—12 inches long, ½ an inch to 1½ inch wide, obtuse, generally much tapered at the base, of a thickish membranous, tough, subopaque substance and full brown colour. *Dots* of fructification oblong, larger than in the preceding species, from which this character, with the thicker substance and darker colour, serve to distinguish it. This has very much the outline and general appearance of *Laminaria fascia*, with which it has sometimes been confounded.

3. P. *tenuissima*, Grev.; frond sub-linear, very thin, transparent. *Grev. Alg. Brit. p.* 54; *Hook. Br. Fl.* ii. *p.* 279; *Harv. Phyc. Brit. t.* ccxlviii.

Parasitic on *Zostera marina*, &c. Annual. Summer.—*Fronds* 2—8 inches long, 1—3 lines wide, fringing the plant on which they grow, always tapering at base, and often also at the apex, of an exceedingly delicate, transparent substance, closely adhering to paper; the margin more or less toothed. *Fruit* unknown. According to Mrs. Griffiths this is the young of *P. latifolia*.

XI. Asperococcus. Lamour. [Plate 8, C.]

Frond unbranched, tubular, cylindrical or (rarely) compressed, continuous, membranaceous. *Root* minutely scutate, naked. *Fructification* scattered over the whole frond, in minute, distinct *dots* (*sori*), composed of roundish, prominent *spores*, mixed with club-shaped filaments. Name, *asper*, *rough*, and κοκκος, a *seed*.

1. A. *compressus*, Griff.; frond compressed, flat, linear, obtuse, tapering at base into a short stem; dots of fructification oblong. *Hook. Br. Fl.* ii. *p.* 278; *Wyatt, Alg. Danm. No.* 8; *Harv. Phyc. Brit. t.* lxxii.

Cast up from deep water; rare. Annual. Summer. South coast of England.—*Fronds* 6—18 inches long, from a quarter to nearly an inch wide, tapering from within an inch of the base into a minute, setaceous stem; thence upwards nearly of equal breadth, obtuse, formed of two membranes closely appressed and cohering together. *Colour* a yellowish or olivaceous green. *Substance* tender and adhering to paper. *Dots* of fructification large, oblong, irregular, densely scattered over both surfaces. The frond is sometimes constricted at intervals. I have gathered at the Cape of Good Hope specimens exactly agreeing with those from Devonshire, except in being of larger size.

2. A. *Turneri*, Dillw.; frond inflated, cylindrical, obtuse, oblong or club-shaped, suddenly contracted at base into a short stem, thin and membranaceous; dots of fructification minute, roundish. *Grev. Alg. Brit. p.* 51; *Hook. Br. Fl.* ii. *p.* 277; *E. Bot. t.* 2570; *Wyatt, Alg. Danm. No.* 59; *Harv. Phyc. Brit. t.* xi.

Between tide-marks, on stones and the larger Algæ; also in 4—15 fathom water in muddy bays. Annual. Summer. All round the coast. —*Fronds* 8—16 inches to 6 feet in length, half an inch to 2 or 6 inches in diameter, suddenly contracted at base into a cylindrical stem, inflated, here and there occasionally contracted, of an oblong, linear or club-shaped outline, a semi-transparent, delicately membranous substance and pale olive colour, adhering to paper. *Dots* of fructification very minute, roundish, densely scattered over the surface.

3. A. *echinatus*, Mert.; frond cylindrical, obtuse, linear, gradually tapering at base. *Grev. Alg. Br. p.* 50. *A. fistulosus, Hook. Br. Fl.* ii. *p.* 277; *Wyatt, Alg. Danm. No.* 7. *Ulva fist. t.* 642; *Harv. Phyc. Brit. t.* cxciv. *β. vermicularis, Griff.;* frond setaceous, filiform, twisted. *A. vermicularis, Moore, Ord. Survey, Londonderry, Bot. p.* 9; *β. Wyatt, Alg. Danm. No.* 207.

Rocks between tide-marks; common. Annual. Summer and autumn. *β.* Torquay, *Mrs. Griffiths.*—Very variable in size; the fronds from two inches to two feet in length, and from the thickness of a hog's bristle to half an inch in diameter, linear, more or less tapered at base. *Dots* of fructification crowded, and often completely covering the surface. *β*, which is usually as slender as a bristle, and at most scarcely a line in diameter, might easily pass, at first sight, for a distinct species, but there are intermediate sizes between it and the normal state. *Encœlium Lyngbyanum, Grev. Crypt. t.* 290, represents a large variety of this species.

XII. Litosiphon. Harv. [Plate 8, D.]

Frond unbranched, cylindrical, filiform, cartilaginous, subsolid, at length tubular, composed of several rows of cells; the surface areolated. *Fructification:* solitary or aggregated naked *spores*, scattered irregularly over the surface of the frond. Name, λιτος, *slender*, and σιφων, a *tube.*

1. C. *pusillus*, Carm.; fronds tufted, thread-shaped, very long, equal in diameter throughout, reticulated, clothed with pellucid hairs; spores scattered. *Asperococcus pusillus, Carm. Hook. Br. Fl.* ii. *p.* 277; *Wyatt, Alg. Danm. No.* 58; *Harv. Man. ed.* 1, *p.* 35; *Harv. Phyc. Brit. t.* cclxx.

Parasitical on *Chorda filum.* Annual. Summer.—*Fronds* 2—6 inches long, as thick as a hog's bristle, straight or curled, densely covering the fronds of the *Chorda* in patches 1—2 feet or more in length. *Spores* oval, prominent, scattered, or one or two together.

2. C. *Laminariæ*, Lyngb.; fronds stellately tufted, short, subulate, tapering to an obtuse point, smooth, transversely banded, the bands close together; spores four or more in each transverse band. *Bangia Laminariæ, Hook. Br. Fl.* ii. *p.* 316; *Harv. Man. ed.* 1, *p.* 172.

Parasitical on *Alaria esculenta*. Annual. Summer.—*Fronds* ¼ to ½ inch long, straight, growing in stellate tufts, scattered over the surface of the leafy portion of the *Alaria*, tapering from a widish base to a blunt point, dull olive-brown.

ORDER 5. CHORDARIACEÆ.

Chordarieæ, *Harv. in Mack. Fl. Hib. part* 3, *p.* 183. *Man. p.* 45. *J. Ag. Sp. Alg. p.* 45. Chordarieæ (excl. gen.), *J. Ag. Alg. Medit. p.* 31. *Endl. 3d Supp. p.* 23. *Dne. Ess. p.* 33. Mesogloiaceæ, *Kütz. Phyc. Gen. p.* 329. Chordaridæ (excl. gen.), *Lindl. Veg. King. p.* 22.

DIAGNOSIS.—Olive-coloured sea-weeds, with a gelatinous or cartilaginous frond, composed of vertical and horizontal filaments interlaced together. *Spores* attached to the filaments, concealed within the substance of the frond.

NATURAL CHARACTER.—*Root* in the more perfect kinds a conical disk, in others forming the under surface of a crustaceous frond. *Frond* very variable in form, in all cases composed of articulated threads, variously combined together, lying in a transparent gelatine of rather firm consistence. This gelatine is sometimes in small quantity, and then the fronds are firmly coriaceous: but more generally the gelatine is abundant, causing the threads to lie separate one from another, and giving to the substance of the frond either a cartilaginous and elastic or a soft and gelatinous nature. The least organized genus of this family (*Ralfsia*) has a crustaceous frond, spreading over the surface of rocks in circular or oblong patches, and bearing on its surface small prominences, which eventually contain spores. Next to this in development is *Leathesia*, whose frond is either shapeless or variously lobed, resembling small tubers heaped together. This genus is closely allied in structure to *Mesogloia*, whose frond assumes a branching, more or less regularly pinnated habit; and in *Chordaria* we reach the greatest compactness and composition that our waters supply. A further advance, however, is found in the genus *Scytothamnus* of New Zealand, where the frond, still clearly consisting of filaments lying in gelatine, is so firmly knit together as to resemble in substance one of the FUCACEÆ. *Elachistea* and *Myrionema* are somewhat abnormal in character, partaking in much of the structure of ECTOCARPACEÆ, but allied in their fructification too strongly to *Leathesia* to be separated from that genus. The *spores* in this order are very generally obovate, tapering to their lower extremity and very obtuse above, always furnished with a pellucid perispore, and containing a dark-coloured homogeneous mass. They are attached to the sides of the filaments composing the *periphery* or outer stratum of the frond, and very generally are surrounded by *paranemata*. In *Ralfsia* alone they form prominent wart-like sori, similar to those of DICTYOTACEÆ. The prevalent colour of the frond is olivaceous, varying from a dark brown to a light greenish olive, nor is it much changed by drying.

In this order we have an obvious declension from the structure of the more perfect Melanosperms; as it were, the resolution of a compound frond into its constituent parts. In the *Fucaceæ*, the highest plants in the series, the frond is similarly constructed of interlacing filaments; but in that order the filaments are so closely pressed together and compacted into a fleshy substance, that they cease to be obvious except after a minute dissection. But in the *Chordariaceæ* the structure is so loose that the filamentous nature of the frond is apparent the moment that a branch is brought under a moderate magnifying power.

The plants comprised in this order, notwithstanding a considerable difference in habit, form a natural group allied through *Ralfsia* to the DICTYOTACEÆ, and through *Elachistea* to the ECTOCARPACEÆ. There are collateral affinities also with *Gloiocladieæ* and BATRACHOSPERMACEÆ, whose fronds have a similar structure.

The CHORDARIACEÆ are widely dispersed; the genera *Mesogloia* and *Chordaria*, and perhaps some others, cosmopolitan. *Leathesia tuberiformis* is as common on the shores of South Africa as on those of Britain; and so is *Chordaria flagelliformis*.

SYNOPSIS OF THE BRITISH GENERA.

* *Frond cylindrical, branching.*

I. CHORDARIA. *Axis* cartilaginous, dense; filaments of the circumference unbranched. [Plate 10, A.]

II. MESOGLOIA. *Axis* gelatinous, loose; filaments of the circumference branching. [Plate 10, B.]

** *Frond either tuber-shaped or crustaceous and spreading.*

III. Leathesia. *Frond* tuber-shaped. [Plate 10, C.]

IV. Ralfsia. *Frond* crustaceous. [Plate 10, D.]

*** *Parasites, consisting of densely tufted filaments, connected at the base, free above.*

V. Elachistea. *Filaments* pencilled, rising from a tubercular base, composed of vertical fibres. [Plate 10, E.]

VI. Myrionema. *Filaments* pulvinate, rising from a flat base, composed of decumbent fibres. [Plate 10, F.]

I. Chordaria. Ag. [Plate 10, A.]

Frond filiform, much branched, cartilaginous; the *axis* composed of densely packed, longitudinal, interlaced, cylindrical filaments; the periphery of simple, club-shaped, horizontal, whorled filaments, and long, byssoid, gelatinous fibres. *Fructification:* obovate *spores*, seated among the filaments of the periphery.—Name, from *Chorda*, a *cord.*

1. C. *flagelliformis*, Mull.; frond filiform, equal throughout; branches alternate, long and mostly simple; filaments of the periphery club-shaped. *Grev. Alg. Brit. p.* 44; *Hook. Br. Fl.* ii. *p.* 275; *E. Bot. t.* 1222; *Wyatt, Alg. Danm. No.* 57; *Harv. Phyc. Brit. t.* cxi.

Between tide-marks, on rocks and stones, common. Annual. Summer. —*Root* small, discoid. *Fronds* from three inches to three feet long, slender, about half a line in diameter, with a central stem, which is either simple or irregularly divided in its upper part, and bears numerous lateral, irregularly inserted, long, generally simple *branches*, of equal thickness. The colour is dark olivaceous green; the substance firm and cartilaginous. The whole frond, if viewed in the water, appears fringed with exceedingly fine colourless fibres, which give to the surface a slimy feel. They have some resemblance to the colourless fibres of *Myriotrichia.*

2. C. *divaricata*, Ag.; frond irregularly divided; branches divaricate, subdichotomous, flexuous, furnished towards the apices with short, very patent, mostly forked ramuli; filaments of the periphery capitate. *Harv. Phyc. Brit. t.* xvii.

Thrown up from deep water, at Carrickfergus, *Mr. M'cCalla.* Annual. Autumn.—*Fronds* 1—3 feet long, not a line in diameter, forming globose tufts, the branches spreading in all directions from a centre; very irregularly divided. *Branches* mostly forked, with very patent axils. The surface is slimy, the colour olive, much paler than in the preceding species, and the filaments of the periphery are of a different form. It shrinks much in drying.

II. Mesogloia. Ag. [Plate 10, B.]

Frond filiform, much branched, gelatinous; the *axis* composed of longitudinal, sub-simple, interlacing fibres, invested with gelatine; the *periphery* formed of radiating, dichotomous, coloured filaments. *Fructification:* ovate or elliptical olivaceous *spores*, attached to the ramuli of the periphery.—Name, μεσος, the *middle*, and γλοιος, *viscid;* from the gelatinous axis.

1. M. *vermicularis*, Ag.; frond clumsy; branches irregularly pinnate, thick, worm-like, lineari-fusiform; ramuli copious, long, flexuous, resembling the branches. *Hook. Brit. Fl.* ii. *p.* 387. *Riv. verm. E. Bot. t.* 1818; *Wyatt, Alg. Danm. No.* 100; *Harv. Phyc. Brit. t.* xxxi.

On rocks and stones between tide-marks, common. Annual. Summer.—*Fronds* 1—2 feet high, gelatinous and flaccid; the branches clumsy, of unequal diameter, generally much attenuated at each end. *Colour* pale olive-green or yellowish. *Spores* ovate, commonly produced.

2. M. *Griffithsiana*, Grev.; frond slender, equal throughout; branches alternate or irregular, filiform, long, simple, nearly bare of ramuli. *Hook. Br. Fl.* ii. *p.* 387; *Wyatt, Alg. Danm. No.* 48.

Between tide-marks, rare. Annual. Summer. South of England and West of Ireland.—*Fronds* 8—16 inches high, of a rather pale olive-green, which becomes greener in fresh water. *Stem* sub-simple, beset throughout with very long, slender, simple, opposite or alternate *branches;* the surface covered with long colourless fibres, similar to what occur in *Chordaria flagelliformis*, which make the plant, as it waves in the water, look of much greater diameter than it really is. *Spores* pyriform.

3. M. *virescens*, Carm.; frond filiform, gelatinous; branches long, erecto-patent, slender, villous; ramuli numerous, patent, short, flexuous, obtuse. *Hook. Br. Fl.* ii. *p.* 387; *Wyatt, Alg. Danm. No.* 49; *Berk. Gl. Alg. t.* 17, *f.* 2; (*also M. affinis, Berk., and M. gracilis, Carm.; Berk. l. c. t.* 16, 2, *and t.* 17, 1); *Harv. Phyc. Brit. t.* lxxxii.

Sea shores. Annual. Summer. Not uncommon.—*Fronds* 8—12 inches high, olive-green, tender, gelatinous, slippery, excessively branched;

branches long, simple or forked, furnished with numerous alternate or secund, spreading, flexuous ramuli. *Frond* to the naked eye appearing villous, owing to the filaments composing the periphery being very much protruded beyond the gelatine, and accompanied also by colourless fibres, similar to those of *M. Griffithsiana*. I have examined the *M. gracilis* of Carmichael, and do not consider it specifically distinct from the present; and though I have not seen specimens of Mr. Berkeley's *M. affinis*, yet, judging from the figure and description given in the '*Gleanings*,' I venture to refer it to the young of this species.

III. Leathesia. Gray. [Plate 10, C.]

Frond globose or lobed, carnoso-cartilaginous, composed of jointed, colourless, dichotomous filaments, issuing from a central point; their apices (which constitute the fleshy coating of the frond) coloured and tufted. *Fructification:* oval *spores* attached to the coloured tips of the filament.—Name, in honour of the *Rev. G. R. Leathes*, a well-known British naturalist.

1. L. *tuberiformis*, Sm.; fronds olivaceous, tuberous, when young filled with cottony fibres, at length hollow. *Corynephora marina, Ag.*; *Hook. Br. Fl.* ii. *p.* 390; *Wyatt, Alg. Danm. No.* 149. *Rivularia tuberiformis, Sm., E. Bot. t.* 1956.

Between tide-marks, on rocks, corallines and Algæ, abundantly. Annual. Summer.—*Fronds* fleshy, forming many hollow lobed or distorted tubers, and spreading over a large surface, olive-brown. "In young plants the central cavity is traversed by a system of very wide, inflated, jointed, hyaline tubes, branching dichotomously, while they radiate in all directions to the surface, where each branch terminates in a tuft of short, club-shaped, moniliform, coloured ramuli; among these last, which by their lateral cohesion form the whole *substance* of the plant, the *sporidia* are found nestling. They are obovate, smooth, and mostly solitary."—*Carm. MSS.*

2. L. *Berkeleyi*, Grev.; fronds dark brown, depressed, fleshy, solid; filaments densely packed. *Harv. Phyc. Brit. t.* clxxvi. *Chætophora Berkeleyi, Grev. in Berk. Gl. t.* 1, *f.* 2; *Harv. in Hook. l. c. p.* 390; *Wyatt, Alg. Danm. No.* 231.

On submarine rocks, between tide-marks. Annual. Summer. South of England and West of Ireland.—*Fronds* gregarious, 1—2 inches in diameter, $\frac{1}{4}$—$\frac{1}{2}$ inch thick, convex, but depressed, soft and fleshy. *Filaments* very densely packed. *Spores* pear-shaped, produced in autumn.

IV. Ralfsia. Berk. [Plate 10, D.]

Frond coriaceo-crustaceous, fixed by its inferior surface, orbicular, concentrically zoned; composed of densely packed, vertical, simple filaments. *Fructification:* depressed warts, scattered over the upper surface, containing obovate spores fixed to the bases of vertical filaments.—Name, in honour of *John Ralfs, Esq.*, of Penzance, the well-known author of a monograph on British *Desmidieæ* and other works.

1. R. *verrucosa*, Aresch.; frond orbicular, spreading; the margin thin and closely adherent; the disk densely covered with irregular warts. *R. deusta, Berk.*; *Harv. Phyc. Brit. t.* xcviii. (*not of Ag.*). *Padina deusta, Hook. Br. Fl.* ii. *p.* 281; *Harv. Man. Ed.* 1, *p.* 31.

On rocks between tide-marks, common. Perennial. Winter.—*Fronds* forming lichen-like patches on the surface of flat rocks, from one to six inches in diameter; when young orbicular, but becoming very irregular in outline when old. In young specimens the surface is nearly flat and even; but in full-grown plants is exceedingly rough, with wart-like prominences. *Structure* very dense and opaque. *Fruit* rare, and difficult to find. *Colour* a dark brown. *Substance* leathery, hard.

V. Elachistea. Fries. [Plate 10, F.]

Frond parasitical, consisting of a dense tuft of free, simple, articulated, olivaceous filaments, rising from a common tubercular base, composed of vertical branching fibres closely combined into a cartilaginous mass. *Fructification:* pear-shaped spores attached to the bases of the filaments, concealed in the tubercle, and frequently accompanied by *paranemata.*—Name, ἐλαχιστα, the *least;* from the small size of these plants.

1. E. *fucicola*, Velley; tufts pencilled; filaments elongate, flaccid, membranaceous, attenuated upwards; articulations once or twice as long as broad; tubercle hemispherical. *Harv. Phyc. Brit. t.* ccxl. *Conferva fucicola, Hook. Br. Fl. p.* 354; *Wyatt, Alg. Danm. No.* 192; *Dillw. Conf. t.* 66.

Parasitical on *Fucus vesiculosus*, very common. Annual. Summer.—*Tufts* an inch long, olivaceous or rusty brown, rising from a hemispherical tubercle composed of dichotomously branching fibres. The filaments rise from the terminal cells, and are surrounded at their origin by four or five slender, club-shaped *paranemata*, among which the spores nestle, and which, by their lateral cohesion, form the periphery of the tubercle.

2. E. *flaccida*, Dillw.; tufts pencilled; filaments elongate, flaccid, membranaceous, much attenuated to the base; the lower articulations half as long as broad, upper of equal length and breadth; tubercle hemispherical. *Conferva flaccida, Dillw. Conf. t.* G. *Harv. l. c. p.* 355; *Wyatt, Alg. Danm. No.* 292; *Harv. Phyc. Brit. t.* cclx.

Parasitical on *Cystoseira fibrosa*, common. Annual. Summer.—*Filaments* half an inch long, dull olive-brown; tubercle similar to that of *E. fucicola*.

3. E. *curta*, Dillw.; filaments minute, rising from a tubercle, rather rigid, pencilled; articulations about as long as broad. *Dillw. Conf. t.* 76; *Harv. l.c. p.* 355.

On Fuci.—*Filaments* 1—3 lines long. A very little-known plant, not found by any recent collector.

4. E. *pulvinata*, Kütz.; tufts very minute, globose; filaments fusiform, much attenuated towards both ends, the basal articulations 3—4 times, the middle once and a half, the apical about as long as broad; spores linear-obovate, subsessile at the base of the filaments. *E. attenuata, Harv. Phyc. Brit. t.* xxviii. A.

Parasitical on *Cystoseira ericoides*. Annual. Summer and autumn. South of England and West of Ireland.—*Tufts* about a line in diameter, globose, very dense, composed of innumerable minute filaments. A beautiful microscopic object. This is the *Myriactis pulvinata* of Kützing, a fact of which I was ignorant when I published the figure in *Phyc. Brit.* Kützing's specimens came from the Mediterranean.

5. E. *stellulata*, Griff.; tufts very minute, starry; filaments tapering to the base, short, clavate, surrounded by paranemata, and rising from a tubercle; articulations twice as long as broad. *Harv. Phyc. Brit. t.* cclxi. *Conf. stellulata, Griff. in Harv. Man. Ed.* 1, *p.* 132.

Parasitical on the fronds of *Dictyota dichotoma*. Torquay, *Mrs. Griffiths*.—*Tufts* half a line in diameter, resembling minute stars, or Echini. *Filaments* rising from a distinct tubercle, composed of large ellipsoidal cells, disposed in forking series or strings. Paranemata inserted with the filaments, and about one-third their length. I have not seen spores.

6. E. *scutulata*, Sm.; filaments short, rising from an oblong, convex, shield-like tubercle, composed of densely-packed branching fibres; articulations about as long as broad. *Conf. scutulata, Sm. E. Bot. t.* 2311; *Harv. l. c. p.* 355; *Wyatt, Alg. Danm. No.* 223.

Parasitical on the thongs of *Himanthalia lorea*. Annual. Summer.—*Tubercles* resembling long warts, half an inch to an inch or more in length.

7. E. *velutina*, Grev.; spreading in thin, indefinite, velvety patches; filaments very minute, equal in diameter throughout, dissepiments slightly contracted; articulations as long as or rather longer than broad; spores elliptical, pedicellate. *Harv. Phyc. Brit. t.* xxviii. B. *Sphacelaria velutina, Grev. Crypt. t.* 350; *Harv. l. c. p.* 325.

Parasitical on the thongs of *Him. lorea*, frequent; also on *Fucus serratus*, fide *Greville*. Annual. Summer.—It often accompanies the last species, to which it is closely allied.

VI. Myrionema. Grev. [Plate 10, E.]

Minute *parasites*, consisting of a mass of short, erect, simple jointed filaments, which spring from a thin expansion formed of decumbent, cohering filaments, spreading in patches on the surface of other Algæ. *Spores* oblong, affixed either to the erect or to the decumbent filaments.—Name, μυριος, *numberless*, and νημα, a *thread*.

1. M. *strangulans*, Grev.; patches convex, confluent, brown, vertical filaments clavate, densely set, spores obovoid, on short stalks, attached to the decumbent filaments. *Grev. Crypt. t.* 300; *Hook. Br. Fl.* ii. *p.* 391; *Harv. Phyc. Brit. t.*

Parasitical on *Ulvæ* and *Enteromorphæ*. Annual. Summer.—Forming a small, dark brown, dot-like patch on the flat frond of the *Ulva*, or a ring-like collar round the branches of *Enteromorpha*.

2. M. *Leclancherii*, Chauv.; patches orbicular, thin and with few vertical filaments towards the edges, convex with crowded filaments in the centre; vertical filaments cylindrical; spores on long stalks, attached to the decumbent filaments. *Harv. Phyc. Brit. t.* xli. A.

On decaying fronds of *Rhodymenia palmata*; also on *Ulva latissima* in deep water. Annual. Summer and autumn.—*Patches* from a line to a quarter inch in diameter, at first appearing like a thin expansion, very similar to a *Coleochæte*; at length, from the growth of the vertical filaments, becoming convex.

3. M. *punctiforme*, Lyngb.; patches globose; filaments tapering to the base; spores linear-obovate, affixed to the vertical filaments, near the base. *Harv. Phyc. Brit. t.* xli. B.; *Hook. l. c. p.* 391.

Parasitical on *Ceramium rubrum*, *Chylocladia clavellosa*, &c.—*Patches* very minute, at first flat, then globose. *Spores* very narrow.

4. M. *clavatum*, Carm.; "very minute, rather convex; filaments clavate, mostly bifid; spores pedicellate, affixed to

the filaments." *Carm. Alg. Ap. ined.*; *Harv. in Hook. l. c. p.* 391.

"On a thin purplish crust (*Hildenbrantia rubra* ?) which covers the pebbles at the half-tide level. The parasite is so much of the colour of the crust that it requires a microscope to detect it."—*Capt. Carmichael.* I have never seen this plant.

Order VI. ECTOCARPACEÆ.

Ectocarpeæ, *C. Ag. Spec. Alg. vol.* ii. *p.* 9, (excl. gen.) *Harv. Man. p.* 36. Ectocarpeæ and Sphacelarieæ, *J. Ag. Alg. Medit. p.* 26. *Sp. Alg.* i. *p.* 6—27. *Dne. Ess. p.* 33—42. *Kütz. Phyc. Gen. pp.* 287, 291. Ectocarpidæ (in part) and Sphacelaridæ, *Lindl. Veg. King. p.* 22.

Diagnosis.—Olive-coloured, articulated, filiform seaweeds, whose spores are (generally) external, attached to the jointed ramuli.

Natural Character.—*Root* generally a small disk, which is occasionally coated with woolly fibres. *Frond* filiform and slender (in technical language, *filamentous*), more or less conspicuously articulated, each articulation composed either of several cells disposed in a ring round an axis, or of a single cell, in which latter case the frond is a *filament*, formed of a series of simple cells, placed end to end, and strung together. In some of the higher forms (*Cladostephus* and some *Sphacelariæ*) the main stem and the larger branches are inarticulate, formed of a multitude of minute cells, the central ones of which are frequently four-sided, closely compacted together into a firm, somewhat horny, rigid substance. The frond is rarely unbranched; very generally it is excessively divided, the branches disposed differently in different genera. In *Cladostephus* the branchlets are whorled round the stem and branches, and deciduous at the close of each season. In *Sphacelaria* the whole frond is distichous, the lesser divisions being repeatedly pinnate, and in this genus also, a portion of the smaller ramuli appears to be deciduous. In *Ectocarpus* the stem is sometimes, but rarely, simple; sometimes branched in a subdichotomous manner; but in the majority of cases it is distichous, the branches being either alternate or opposite, usually rather distant one from another; but sometimes closely pinnated, and occasionally secund and pectinated. In one or two instances the thread-like fronds are bundled together into ropes, which, branching at intervals, constitute a spongy, compound frond. The *fructification* is perhaps of two kinds; the first, or *spore*, being oval or spherical, furnished with a pellucid skin or *perispore* and containing a dark coloured granular mass. Such spores are sometimes sessile, sometimes stalked, and either scattered over the branches or confined to particular parts of the frond. The second description of fruit (called *propagulum* by Agardh) is in *Ectocarpus* lanceolate or linear, often shaped like a pod, or sometimes conical, transversely striate, and containing an olive, granular substance; in *Sphacelaria* it is mostly club-shaped, and contained in the distended tips of the branches and ramuli. The plants of this order are seldom gelatinous: some of the more delicate kinds are very soft, and liable to be rapidly decomposed; but the majority are membranous, and almost all of the first sub-order are of a singularly rigid, almost horny substance. The colour varies from dark brown to pale greenish olive, and is subject to a little change in fresh water.

This order is closely connected with the last, especially through the genera *Myrionema* and *Elachistea*, the latter of which is, by J. Agardh, placed here. The free filaments of that genus do indeed associate well with the similar filaments of the simple *Ectocarpi*, but the remaining part of the organization has so much in common with *Leathesia*, an undoubted Chordariaceous plant, that I am unwilling to place it in a different order.

Continental authors, in general, regard our two sub-orders as distinct ordinal assemblages, and in the system of Endlicher they are widely separated from each other. To me the connection between them appears close; the difference chiefly technical, — one being a simpler form of the other, — and I am unwilling to sanction what seems an unnecessary division of orders. Such plants as *Ectocarpus Mertensii* are nearly intermediate between the two groups.

The Ectocarpaceæ are the least compound, the lowest in organization, of the olive-coloured Algæ, yet among them we find, as not rarely happens in similar cases, some of the most elegant and delicately beautiful structures of the group. None are of large size, and many require the aid of the microscope to develope their full beauty. The genera, and several of the more common species, are very widely dispersed, nor are there any generic forms known which are not represented in our flora.

SYNOPSIS OF THE BRITISH GENERA.

Sub-order 1. SPHACELARIEÆ. *Frond* rigid; each articulation composed of numerous cells.

I. CLADOSTEPHUS. Ramuli whorled. [Plate 9, A.]

II. SPHACELARIA. Ramuli distichous, pinnated. [Plate 9, B.]

Sub-order 2. ECTOCARPEÆ. *Frond* flaccid; each articulation composed of a single cell.

III. ECTOCARPUS. *Frond* branching; ramuli scattered. [Plate 9, C.]

IV. MYRIOTRICHIA. *Frond* unbranched; ramuli whorled, tipped with pellucid fibres. [Plate 9, D.]

Sub-order 1. SPHACELARIEÆ.

I. CLADOSTEPHUS. Ag. [Plate 9, A.]

Frond inarticulate, rigid, cellular, whorled with short, articulated, sub-simple ramuli. *Fruit* elliptical, pedicellate. *Spores* borne by accessory ramuli.—Name, κλαδος, a *branch*, and στεφος, a *crown*.

1. C. *verticillatus*, Lightf.; branches slender, ramuli mostly forked, regularly whorled, the whorls at short intervals.—*Hook. Br. Fl.* ii. *p.* 322; *Wyatt, Alg. Danm. No.* 82; *E. Bot. t.* 1718, and *t.* 2427, *f.* 2; *Harv. Phyc. Brit. t.* xxxiii.

In the sea, on rocks and corallines, frequent. Summer and winter. —*Filaments* 3—9 inches high, irregularly dichotomous, the lesser branches often opposite. *Colour* a dull olive-green. Mrs. Griffiths notices that in summer the ramuli of this and the following species frequently contain dark grains imbedded in their withered tips, as in the genus *Sphacelaria*. In winter most of the whorled ramuli fall off, and the frond becomes clothed with irregularly disposed, slender (accessory) ramuli, which bear numerous lateral, stalked spores, furnished with a transparent border, and containing a dark olive mass.

2. C. *spongiosus*, Huds.; branches thick and clumsy; ramuli mostly simple, irregularly whorled, densely imbricated. *Hook. Br. Fl.* ii. *p.* 322; *Wyatt, Alg. Danm. No.* 169; *E. Bot. t.* 2427, *f.* 1; *Harv. Phyc. Brit. t.* cxxxviii.

In the sea, on rocks and stones, common. Summer and winter.—*Filaments* 3—4 inches high, irregularly branched, the branches thick and flexuous, obtuse, densely clothed with crowded, mostly simple, but occasionally forked ramuli. *Colour* dull brown or dirty olive-green. *Fructification* as in the preceding.

II. Sphacelaria. Lyngb. [Plate 9, B.]

Filaments jointed, rigid, distichously branched, pinnated, rarely subdichotomous. *Apices* of the branches distended, membranous, containing a dark, granular mass. *Fructification*, oval spores, borne on the ramuli.—Name, Σφακελος, *gangrene;* from the *withered* tips of the fertile branches.

* *Frond beset with woolly fibres at the base or lower part.*

1. S. *filicina*, Gratel.; frond shaggy at the base, slender, irregularly branched; branches lanceolate, erecto-patent, bi-tripinnate; pinnæ alternate erect; pinnules fasciculato-multifid; axils all very acute and narrow. *Hook. Br. Fl.* ii. *p.* 323; *Wyatt, Alg. Danm. No.* 170. *S. hypnoides, Grev. Crypt. Fl. t.* 348. *Harv. Phyc. Brit. t.* cxlii.

On rocks and Algæ near low-water mark. Perennial. Winter. South of England and Ireland, very rare.—*Stems* 2—4 inches high, covered with curled brown fibres at the base, slender, simple or irregularly branched, often bearing from the summit numerous branches displayed like a fan; the branches of a linear-lanceolate outline, bi-tripinnate; the lower pinnæ short, gradually lengthening upwards, generally producing two pinnules from the upper side (one of which is axillary), before one issues from the lower, erecto-patent. *Striæ* evident in the lower part of the stem, and in old specimens throughout: less obvious in young plants and in the young shoots or branches. Specimens sometimes occur, many of whose branches are as bare of ramuli as those of *S. scoparia* in its denuded state, and then they can only be recognised by their greater delicacy.

2. S. *Sertularia*, Bonnem.; frond slightly shaggy at the base, weak and slender, irregularly branched; branches somewhat lanceolate or linear, horizontally patent, tripinnate; pinnæ alternate, divaricate; pinnules very patent, multifid; axils all very obtuse and wide. *Harv. Phyc. Brit. t.* cxliii. *S. filicina β. patens, Harv. Man.* 1*st. ed. p.* 37.

Parasitical on various Algæ, at a depth of from four to fifteen fathoms. Perennial. Very rare. South shores of England, Jersey, and the North and West of Ireland.—A smaller and slenderer plant than *S. filicina*, with very patent branches and ramuli.

3. S. *scoparia*, L.; dark brown, coarse, the lower part shaggy with woolly fibres; upper branches once or twice pinnated; the pinnæ erecto-patent, awl-shaped, alternate,

the lower ones slightly divided. *Hook. Br. Fl.* ii. *p.* 323; *Wyatt, Alg. Danm. No.* 36; *E. Bot. t.* 1552; *S. disticha, Lyngb.?* *Harv. in Hook. Br. Fl.* ii. *p.* 323; *Harv. Phyc. Brit. t.* xxxvii.

Southern coasts of England, frequent. Frith of Forth, *Dr. Greville.* Irish coast in several places, but not common. — *Stems* 2—4 inches high, shaggy at the base, robust, much and irregularly divided or sub-simple, densely set with quadrifarious, pinnate or bipinnate branches, which spread from the summits of the main divisions in broad, brush-like, rigid tufts; pinnæ either short, simple and spine-like, or long and again pinnate. There is no axillary pinnule as in the last species. *Joints* of the stem and branches longitudinally striate. *S. disticha* of the British Flora is merely the autumn and winter state of this species.

** *Stems naked at the base* (*without woolly fibres*).

4. S. *plumosa*, Lyngb.; filaments naked at base, elongated, irregularly branched, inarticulate; branches pectinato-pinnate; pinnæ opposite, simple, very close, elongated. *Hook. Br. Fl.* ii. *p.* 324. *Conf. pennata, E. Bot. t.* 2330, (*left hand fig.*); *Wyatt, Alg. Danm. No.* 300; *Harv. Phyc. Brit. t.* lxxxvii.

On rocks, near low-water mark. Perennial. Several places, from Orkney to the Land's End; but rare: the northern specimens most luxuriant. —*Stems* 2—6 inches high, many springing from the same disk-like base, irregularly branched, as thick as a hog's bristle, opaque, unjointed; branches tufted or scattered, ½ an inch to 1½ inch long, resembling feathers, closely pinnated with opposite, patent, obtuse, simple (or rarely pinnulated) pinnæ, which are often sphacelate at the tips.

5. S. *cirrhosa*, Roth; filaments naked at base, short, densely tufted, simple or branched, jointed throughout; stem (or branches) pinnate; pinnæ opposite, alternate or irregular, simple. *Harv. in Hook. l. c. p.* 324; *Wyatt, Alg. Danm. No.* 171. *Conf. pennata, E. Bot. t.* 2330 (*right hand fig.*); *Harv. Phyc. t.* clxxviii. *β. ægagropila;* forming a dense round ball. *γ. patentissima;* ramuli irregular, issuing at right angles. *Grev. Crypt. t.* 317.

In the sea, on other Algæ and on corallines, very common. *α.* commonest on the South coast of England. *β.* West of Ireland. *γ.* shores of Bute, *Dr. Greville.* — This is a most variable plant. In *α.* the filaments are very slender, simple, forming star-like, fastigiate tufts, or closely investing the stems of Algæ; about an inch long, articulated, pinnated throughout with short, erecto-patent, attenuated, opposite or alternate ramuli, at distances of every second or third joint. These ramuli are either simple or furnished with a few others which are often three-forked. Articulations about as long as broad. This variety something resembles small specimens of *S. plumosa*, but the ramuli are far less close and regular, and the joints of the stem very evident. In *β.* the tufts are globose and very dense. The filaments robust and much branched; the larger branches quadrifariously or irregularly furnished with lesser ones, which are long, erecto-patent, set in a very irregular manner with sub-pinnated or quadrifarious, spine-like ramuli, which are either simple or bearing others. *Spores* spherical, containing a dark mass, sessile or stalked near the base of the ramuli, one or two together; as correctly figured by Dillwyn. *Colour* a dark brown, and substance rigid. Another variety is found by *Mrs. Griffiths* and *Miss Cutler* on the stems of *Desmarestia aculeata*. It is a very dwarf plant, with curved, simple stems, pretty regularly pinnated, and sometimes hooked at the apex. The filaments of this are rarely half an inch long.

6. S. *fusca*, Dillw.; filaments brown, distantly and irregularly branched; branches long and simple, bearing a few clavate, occasionally trifid ramuli; articulations twice as long as broad, marked by a transverse band; spores globose. *Dillw. Conf. t.* 95; *Hook. Br. Fl.* ii. *p.* 324; *Harv. Phyc. Brit. t.* cxlix.

Shores of Wales, *Dillw.* Sidmouth, *Mrs. Griffiths.* St. Michael's Mt. Cornwall, *Mr. Ralfs.*—Tufts "3 to 5 inches long, varying in colour from a dull to a reddish brown," *Dillw.* A very obscure plant, which I only know through Dillwyn's figure and description, and from a specimen marked "Sidmouth, June, 1827," which I have received from my valued friend, Mrs. Griffiths, and which agrees with Dillwyn's figure very exactly. The filaments in this specimen are an inch and a half long, deep brown, very slender, sub-simple, with a few alternate, long, simple, distant branches, some of which bear near the apex one or two lineari-clavate ramuli, attenuated at the base, and trifid at the apex. The joints are marked with a pale brown band, and about twice as long as broad. *Mr. Ralfs'* plant, above noticed, is more branched, rigid, and with shorter joints than that of Dillwyn.

7. S. *radicans*, Dillw.; filaments decumbent, sending out fibrous radicles in the lower part, with a few irregular, simple, straight, naked branches; spores clustered, sessile. *Harv. in Hook. Br. Fl.* ii. *p.* 324. *Conf. radicans, Dillw.*; *E. Bot. t.* 2138. *Harv. Phyc. Brit. t.* clxxxix. *S. cirrhosa, ζ, simplex, Ag. Sp. Alg.* ii. *p.* 29; *Wyatt, Alg. Danm. No.* 301. *S. olivacea, Hook. l. c.*; *E. Bot. t.* 2172.

In the sea, on sand-covered rocks, in various parts of Great Britain and Ireland; first noticed by the late *Miss Hutchins* at Bantry. *Filaments* rising from a few decumbent fibres, forming small tufts from half an inch to an inch in height. *Branches* few, scattered, and mostly simple. *Spores* abundant, scattered over the branches. *Colour* a dull greenish olive. *Substance* rigid.

8. S. *racemosa*, Grev.; "filaments short, tufted, olivaceous, dichotomous; capsules ovate, racemose, pedunculate." *Grev. Crypt. Fl. t.* 96; *Hook. Br. Fl.* ii. *p.* 325.

Frith of Forth, *Sir John Richardson.*—Allied to the last, but larger, and chiefly distinguished by its racemose spores.

Sub-order 2. Ectocarpeæ.

Ectocarpus. Lyngb. [Plate 9, C.]

Filaments capillary, jointed, olivaceous or brown, flaccid, without longitudinal striæ. *Fruit* either spherical or elliptical, external or imbedded *spores*; or lanceolate, linear or conical *silicules* (pod-like bodies); or granular masses formed in consecutive cells of the branches..—Name εκτος, καρπος, *external fruit.*

* *Secondary branches alternate, fascicled or secund.*

1. E. *siliculosus*, Lyngb.; tufts yellowish or pale olive-green, somewhat gelatinous, soft; filaments slender, excessively branched; ultimate branchlets alternate or secund; silicules stalked, subulate, very acute. *Hook. Br. Fl.* ii. *p.* 325; *E. Bot. t.* 2319; *Wyatt, Alg. Danm. No.* 172. *Harv. Phyc. Brit. t.* clxii.

Between tide-marks, on Algæ, corallines, &c. common. Annual. Summer.—*Tufts* 6—18 inches long, cloud-like, of a yellowish or pale colour, occasionally rusty brown. *Filaments* excessively slender, much and irregularly branched, somewhat gelatinous, quickly decomposing in fresh water; branches irregularly set, of various lengths, bearing a second and third series of multifid ramuli; all the divisions alternate or secund, the extreme ramuli long and very frequently secund, erect. *Silicules* subulate, resembling *pods*, borne on short stalks by the ramuli.

2. E. *amphibius*, Harv.; tufts short, loose, soft, pale olive; filaments very slender, subdichotomous; ultimate branches alternate, spreading; articulations twice or thrice as long as broad; silicules linear-attenuate, spine-like, mostly sessile, scattered. *Harv. Phyc. Brit. t.* clxxxiii.

In muddy ditches of brackish water, near the coast. Tide ditches of the Avon, near Bristol, *Mr. Thwaites.*—*Filaments* 2—3 inches long, forming small indefinite tufts. *Ramuli* scattered, thorn-like.

3. E. *fenestratus*, Berk.; pale green, very slender, forming small tufts; filaments not much branched; branches distant, alternate, furnished with a few long and simple, alternate ramuli; articulations of the branches twice or thrice as long as broad, pellucid; silicules stalked, scattered, at first clavate, then elliptic-oblong, obtuse, densely striate transversely and cross-barred, dark brown. *Harv. Phyc. Brit. t.* cclvii.

Salcombe, *Mrs. Wyatt.* May. The habitat not exactly stated.—It forms a small tuft, an inch or two high. The filaments are very slender, distantly branched, with a few long, alternate ramuli. The silicules are plentiful, scattered along the branches. Their shape, so different from that of those organs in *E. siliculosus*, readily distinguishes the present from that species.

4. E. *fasciculatus*, Harv.; tufts olivaceous, dense; main filaments slightly branched; branches distant, bearing throughout alternate or secund fascicles of multifid ramuli; silicules sessile, ovato-acuminate, secund on the ramuli; joints very distinct. *Wyatt, Alg. Danm. No.* 302; *Harv. Phyc. Brit. t.* cclxxiii.

Between tide-marks, on the larger Algæ. Not uncommon. Annual. Summer.— *Tufts* 1—2 inches high, dense, dark olive-green. *Filaments* less branched than in most of the genus; the branches alternate or sub-dichotomous, bearing throughout short tufts of multifid branchlets, which are very often secund. *Silicules* sessile.

5. E. *Hincksiæ*, Harv.; tufted, dark olive; filaments irregularly and distantly branched; branches flexuous, furnished with secund ramuli pectinated on their upper side; silicules conical, sessile, lining the inner face of the ramuli. *Harv. Phyc. Brit. t.* xxii.

In the sea, parasitical on *Laminaria bulbosa.* Coasts of England, Ireland and Scotland: first noticed at Ballycastle, Giant's Causeway, by *Miss Hincks.*— *Filaments* 1—2 inches high, dark olive, somewhat rigid for the genus (substance of *E. littoralis*), irregularly and rather distantly branched, not matted together; branches set in the upper part with secund, spreading or slightly recurved ramuli, bearing on their inner faces a second series of subulate ones, so as to resemble little combs. *Silicules* conical, sessile, borne on the inner face of the ramuli, one rising from almost every joint, giving the ramulus the appearance, under a low power, of being serrated. In a variety of this species, more robust than usual, the silicules are much less abundant, and of rather a different form, being somewhat elliptical. I had once regarded this variety as a distinct species, and proposed to name it *E. scorpioides*, but I fear it has not characters sufficiently marked.

6. E. *tomentosus*, Huds.; filaments flexuous, very slender, irregularly branched, interwoven into a dense, sponge-like, branching frond; silicules stalked, linear-oblong, obtuse. *Hook. Br. Fl.* ii. *p.* 326; *Grev. Crypt. t.* 316; *Wyatt, Alg. Danm. No.* 37; *Harv. Phyc. Brit. t.* clxxxii.

In the sea, on rocks and the larger Algæ.—Plant 1—8 inches long, forming an irregularly divided, spongy *frond*, of an olivaceous or dull brown colour. This *frond* is composed of a dense mass of slender filaments, intricately woven together, flexuous and irregularly branched, jointed throughout; the joints mostly colourless, and about twice as long as broad. *Silicules* linear-oblong, pedunculate. The lesser branches are sometimes somewhat free and feathery, when the plant bears some resemblance to certain varieties of *E. siliculosus.*

7. E. *crinitus*, Carm.; filaments decumbent, forming extensive strata, sparingly branched; the branches sub-simple, distant, elongated; spores globose, scattered, sessile. *Hook. Br. Fl.* ii. *p.* 326.

Muddy sea shores. Appin, *Capt. Carmichael.* Watermouth, Devonshire, *Mrs. Griffiths.*— Spreading over the mud in " extensive fleeces of a bright bay colour." *Filaments* about two inches long, with long, sub-simple, distant branches. *Spores* rare. When dry it has a slight gloss, and the colour changes to a dull, but rather pleasant green. Mrs. Griffiths' specimens are not in fruit, but in other respects agree very closely with Capt. Carmichael's.

8. E. *pusillus*, Griff.; filaments sub-simple or sparingly branched, interwoven; branches bearing a few short, flexuous fibres; spores sessile, roundish-oblong, plentiful, often two or three together. *Wyatt, Alg. Danm. No.* 303; *E. Bot. t.* 2872; *Harv. Phyc. Brit. t.* cliii.

Parasitical on *Polysiphonia nigrescens* and other Algæ. Torquay, *Mrs. Griffiths.* Land's End, *Mr. Ralfs.*—" Like a tuft of pale brown wool. *Filaments* long, slender, simple or slightly branched, set with a few short, flexuous, divaricating fibres, tendril-like, which hold the filaments together." *Griff. Branches* distant, naked. *Spores* plentifully scattered along the threads, often two or three together or whorled. *Joints* twice as long as broad. A smaller and more slender plant than *E. crinitus;* the ramuli different, and capsules more oblong. This comes near *E. simpliciusculus* of Agardh, but is a larger plant.

9. E. *distortus*, Carm.; filaments very much branched, matted together, dark brown, angularly bent: branches spreading at obtuse angles; ramuli divaricated or recurved, obtuse, spine-like; spores obovate, sessile or sub-sessile. *Hook. Br. Fl.* ii. *p.* 326.

On *Zostera* at Appin, *Capt. Carmichael.*—*Tufts* 4—8 inches long, dense, matted, deep chesnut-brown. *Filaments* bent here and there at acute angles, zigzag, apparently distorted; the branches long, spreading at obtuse angles, and beset with spine-like, divaricated ramuli. *Spores* scattered, obvate or elliptical, with a pellucid limbus, containing a dark brown mass, sessile or slightly stalked. The whole plant is remarkably brittle, if moistened after having been dried.

10. E. *Landsburgii*, Harv.; filaments dark brown, tenacious, intricate, much branched; branches irregularly forked, divaricate, zigzag, bristling with numerous, short, spine-like, horizontal ramuli; articulations shorter than broad, the endochrome filling the cell, and recovering its shape on remoistening, after having been dried. *Harv. Phyc. Brit. t.* ccxxxiii.

Dredged in deep water. Annual. Summer. Lamlash, *Rev. D. Landsborough.* Roundstone Bay, *W. H. H.*—Forming small, intricate tufts.

This has the habit of *E. distortus*, but is of a much more rigid, tenacious substance, remaining undecayed after long steeping in fresh water. The endochrome quite fills the cells, leaving exceedingly narrow dissepiments.

** *Secondary branches and ramuli opposite.*

11. E. *litoralis*, L.; tufts dense, interwoven, dirty brown; filaments much and irregularly branched, coarse; ultimate branchlets somewhat patent, frequently opposite; masses of fructification oblong or sub-globose, imbedded in the substance of the branches. *Hook. Br. Fl.* ii. *p.* 325; *E. Bot. t.* 2290; *Wyatt, Alg. Danm. No.* 129; *Harv. Phyc. Brit. t.* cxcvii.

In the sea, on the larger Algæ, very common, at all seasons.—*Tufts* 6—12 inches long, coarse, shaggy, entangled, brownish-olive or rust-coloured; the main stems somewhat massed together, the lesser divisions free; the ramuli multifid, very irregular in position. According to J. Agardh, this is different from the true *litoralis* of Linnæus.

12. E. *longifructus*, Harv.; tufts large, branching, the divisions feathery; filaments robust, excessively branched, branches mostly opposite, the lesser ones set with short, spine-like, opposite or rarely alternate ramuli; articulations as long as broad; silicules very long, linear lanceolate, attenuate, densely striate transversely, terminating the principal branches and ramuli. *Harv. in Herb. T. C. D; Harv. Phyc. Brit. t.* cclviii.

Skail, Orkney, *Mrs. Moffatt.*—Habit of *E. litoralis*, and very nearly related to that species, but the fruit is more luxuriant, and the branching more regularly opposite. *Tufts* 6 inches long.

13. E. *granulosus*, Sm.; tufts greenish or yellowish; main filaments slightly entangled; lesser branches distinct and feathery; upper branches and ramuli opposite, spreading, the apices often transparent; spores solitary, elliptical, sessile. *Hook. Br. Fl.* ii. *p.* 326; *E. Bot. t.* 2351; *Wyatt, Alg. Danm. No.* 38; *Harv. Phyc. Brit. t.* cc.

Between tide-marks, parasitical on the smaller Algæ. Annual. Summer. Shores of England and Ireland, not uncommon.—*Tufts* 4—8 inches long, greenish or yellowish; main branches frequently, and lesser ramuli almost constantly opposite, erecto-patent, the extreme ones occasionally secund. *Spores* large, oblong-elliptical, dark brown, sessile on the ramuli or near the tips of the branches.

14. E. *sphærophorus*, Carm.; filaments slender, short, tufted, much branched; upper branches patent, opposite or in fours, bearing patent opposite ramuli; spores globose, sessile, either opposite to each other or to a branchlet. *Hook.*

Br. Fl. ii. *p.* 326; *Wyatt, Alg. Danm. No.* 173. *E. brachiatus, Ag. (not of E. B.), Harv. Phyc Brit. t.* cxxvi.

Between tide-marks, parasitical on the smaller Algæ; chiefly on *Ptilota sericea*; sometimes on *Cladophora rupestris.* Annual. Summer. Various places from Orkney to Cornwall, but rare.—*Filaments* 1—3 inches long, finely tufted, straight, the main stems somewhat matted, the branches free, repeatedly divided, all the divisions opposite or quadrifarious, spreading. *Colour* olivaceous, or rusty or yellowish brown. *Spores* abundant on the upper branches, placed either opposite to each other on opposite sides of the stem, or opposite to a ramulus; occasionally in fours, sessile, globose and prominent.

15. E. *brachiatus*, Harv.; finely tufted, feathery, much branched; the branches free, opposite or quaternate; ramuli opposite, patent, spores imbedded in the filaments, forming oblong swellings, scattered on the ultimate branchlets or in the axil of two opposite ramuli. *Wyatt, Alg. Danm. No.* 174! *Hook. Br. Fl.* ii. *p.* 326? *Conf. brachiata, E. Bot. t.* 2571? *Harv. Phyc. Brit. t.* iv.

Parasitical on *Rhodymenia palmata.* Annual. Summer; rare—*Filaments* 2—4 inches high, finely tufted, wavy and feathery; the main stems slightly entangled, excessively branched, all the branches and branchlets opposite or quaternate; the lesser branches generally naked at the base, their upper half bearing, at distances of 6—8 joints, a pair of opposite, patent ramuli, which again throw off from their upper half a second and third series. *Spores* imbedded in the branchlets. *Colour* a pale olive-green. Such is the plant published by Mrs. Griffiths in the *Algæ Danmonienses* and which I had formerly confounded with *E. sphærophorus.* From that species, however, it strikingly differs in habit (as can better be seen by a glance at the specimens in the Alg. Danm. than understood from the most laboured description), and also, as first pointed out by Mrs. Griffiths, in the fructification. Whether or not it be the same species as the plant figured in Eng. Bot., the original *brachiatus*, I cannot say, having never seen an authentic specimen of that plant; nor am I aware whether any authentic specimens exist. The figure in Eng. Bot. was taken from a specimen picked up on the Norfolk coast, by Sir W. J. Hooker, many years ago, but no such plant now exists in Sir William's herbarium; and nothing more nearly resembling it than the present has since been found.

16. E. *Mertensii*, Turn.; distichous; branches opposite, of unequal length, linear, mostly undivided, closely set throughout their whole length with slender, subulate, opposite ramuli; joints of the stem longitudinally striate, transparent, with a central coloured band, rather shorter than broad; spores imbedded in the ramuli. *Hook. Br. Fl.* ii. *p.* 327; *Wyatt, Alg. Danm. No.* 130; *E. Bot. t.* 999; *Harv. Phyc. Brit. t.* cxxxii.

On mud-covered rocks and stones, near low-water mark, and at a greater depth. Annual. April and May. Rare; but found from Orkney to Cornwall, and on the Irish coast.—Main stems 2 — 5 inches long, nearly simple, set throughout with opposite, or by suppression, alternate branches of unequal length; the branches linear and undivided, furnished for their whole length, and at distances of every second or third joint, with slender, spreading, subulate ramuli, one-third the diameter of the branch, and at intervals bearing a larger pinnated ramulus; all the divisions exactly distichous and opposite; the branches resembling delicate feathers. *Joints* of the stem marked with a central, longitudinal, coloured band, those of the ramuli bright green, very short. *Spores* imbedded in the distended ramuli, containing a dark-coloured mass. *Colour* a fine olive-green. A highly beautiful species, unlike any other of the genus, and in many respects showing affinity with *Sphacelaria*, from which it is chiefly distinguished by its *flaccid* substance.

IV. Myriotrichia. Harv. [Plate 9, D.]

Filaments capillary, flaccid, jointed (simple), beset on all sides with simple, spine-like ramuli, clothed with byssoid fibres. *Fructification:* elliptical *spores*, containing a dark-coloured, granular mass, within a transparent perispore. Name, from μυριος, *numberless*, and θριξ, a *hair*.

1. M. *clavæformis*, Harv.; stem densely beset with quadrifarious ramuli, which gradually increase in length from the base upwards, giving the frond a club-shaped figure. *Harv. in Hook. Journ. of Bot. Vol.* i. *p.* 300, *t.* 138; *Fl. Hib. p.* 182; *Wyatt, Alg. Danm. No.* 131; *Harv. Phyc. Brit. t.* ci.

Parasitical on *Chorda lomentaria*. Annual. Summer.—*Fronds* half an inch long, tufted, flaccid, sub-gelatinous, simple, lineari-clavate, olivaceous, surrounded by colourless fibres. *Primary thread* running the whole length of the plant, simple, attenuated at base, articulated, naked below, towards the apex densely clothed with ramuli; the young plants destitute of ramuli, or merely bearing rudimentary processes. *Ramuli* quadrifarious, whorled or irregularly scattered, obtuse, the lower ones short and naked; the upper (like the *primary thread*), bearing lesser ramuli, from whose tips spring long, colourless, simple, long-jointed fibres, of a very thin membranous texture and flaccid substance. *Joints* of the primary thread very short, transversely dotted, the dots proliferous (finally becoming ramuli); of the ramuli oblong, with pellucid dissepiments. *Spores* sessile, elliptical or ovate, with a pellucid limb, and containing a dense olivaceous mass. Miss Hutchins appears to have been the earliest discoverer of this plant, having communicated it to Dr. Mackay forty years ago, as "*a curious new Conferva.*"

2. M. *filiformis*; stem filiform, slender, often flexuous or curled, beset at irregular intervals with oblong clusters of

minute, papillæform ramuli. *Wyatt, Alg. Danm. No.* 304; *Harv. Phyc. Brit. t.* clvi.

Parasitical on *Chorda lomentaria* and *Asperococcus echinatus*, sometimes accompanying the preceding.—*Fronds* an inch or more in length, very slender, straight, or more usually flexuous, often twisted or several bundled together into rope-like tufts; the stem quite simple, at intervals appearing thickened into dark-coloured knobs, which are found, under the higher powers of the microscope, to consist of very dense, minute, papillæform ramuli, from whose apices issue, as in the last species, long, simple, colourless fibres. The intervals between the *knobs* or papillated portions are cylindrical and jointed, the joints being rather shorter than broad. This is a much taller and slenderer plant than *M. clavæformis*, and easily distinguished by its *interrupted* ramuli, which are besides very much shorter than in that species, and do not increase in length toward the upper part of the stem. I believe it to be a much more common plant than *M. clavæformis*, and perhaps some of the stations assigned to that species belong to this.

Sub-class II.

RHODOSPERMEÆ or CERAMIALES.

Harv. in Mack. Fl. Hib. part iii. *p.* 185 (1836). Florideæ, *J. Ag. Alg. Medit. p.* 54 (1842). Florideæ, with part of Confervoideæ and Fucoideæ, *Ag. Syst. p.* xxxiii. (1824). Florideæ, Gastrocarpeæ, Spongiocarpeæ and Furcellarieæ, *Grev. Alg. Brit. pp.* 66, 68, 71, 157. Choristosporeæ, *Dne. Ess. p.* 52 (1842). Ceramiaceæ, *Lindl. Veg. King. p.* 23. Heterocarpeæ, *Kütz. Phyc. Gen. p.* 369.

Diagnosis.—*Plants* rosy red, or purple, rarely brown-red or greenish red. *Fructification* of two kinds, diœcious, always formed on separate individuals: 1, *spores* contained either in external or immersed conceptacles, or densely aggregated together and dispersed in masses through the substance of the frond; 2, *spores* (called *tetraspores*) red or purple, either external or immersed in the frond, rarely contained in proper conceptacles; each spore enveloped in a pellucid skin (*perispore*), and at maturity separating into four sporules. *Antheridia* (not observed in all) filled with yellow corpuscles. *Marine, with one or two exceptions.*

A red colour, of greater or less purity, now verging to purple, now passing into brown, and fading through all tints of red, green and yellow, into dirty white, is the most obvious characteristic of the plants of this sub-class. Almost all are marine; the few exceptions exist in the orders *Ceramiaceæ* and *Rhodomelaceæ*, the lowest and the highest of the group. The greater part belong to the deeper regions of the zone of Algæ, very few growing where they are exposed to air and sunshine, or flourishing when they grow in shallow and open tide-pools. The red tint is never developed in purity in such situations. It requires the shade of a deep, steep-sided pool, or the darkness of a considerable depth of water, to bring out the delicate rosy tint of the frond in perfection. In the former situation we invariably find the best coloured and most luxuriant Rhodosperms at the side of the pool that faces the north, or in places where overhanging Melanosperms form a protection from the rays of the sun. Such species as habitually grow exposed to light assume either the brown tints of the Fuci or else the green and yellow of the Confervæ and Ulvæ. Some *Polysiphoniæ*, especially *P. fastigiata*, are instances of the first change of colour; and the *Chondri*, *Laurenciæ*, *Gracilariæ*, *Ceramia*, &c., of the latter.

This sub-class is by much the most numerous of the class of Algæ, so far at least as the vegetation of the sea is concerned. In our own Flora they constitute about one half of the whole number of sea-weeds; and if we take in the Flora of the world generally the proportion will be still greater. Between two and three hundred species of *Polysiphonia* have been described, and several other genera, though of less extent, contain a large number of species. None attain to the gigantic dimensions of some Melanosperms, although some are of considerable size, having fronds that would cover twenty square feet in expansion. Even on our own coast *Nitophyllum punctatum* has been seen five feet in length by three in width; and some of the *Iridææ* of the southern ocean are as large. But red sea-weeds of this size are not common. We do not find many that exceed two feet in length, and great numbers never grow higher than six inches.

The natural habit is much varied. The simplest are filaments, simple or more generally branched, composed of a row of cells strung together: these are exactly analogous to the *Ectocarpaceæ* among Melanosperms. Next, we find a frond consisting of a number of such filaments, bound together by a gelatinous matrix, just as we have in *Chordari-*

aceæ. Those in which this character prevails are considerably diversified, according to the quantity and consistence of the gelatine; some being flaccid and slimy, others of a cartilaginous or horny nature. In others there is no distinct arrangement of the cells into filaments, but the frond consists of a multitude of six- or twelve-sided cells homogeneously packed together, and compressed into a membranous or fleshy substance. Such a structure is technically called *cellular*, in contradistinction to the former, which is said to be *filamentous*. In some cases all the cells of the frond contain colouring matter; in others, colour is confined either to the surface cells or to a stratum of varying thickness beneath the surface. In the latter cases the colourless cells contain either a granular matter or are wholly empty. So far for the internal nature of the frond. Externally it is formed, sometimes into twiggy bushes, sometimes into broad laminæ; and very frequently both these characters are combined; the lower part being cylindrical, the upper branches expanding at the apex into flat phyllodia. Regularly formed leaves sometimes, but rarely, make their appearance, as in *Delesseria;* or in the beautiful exotic genus *Polyzonia*, which has the stem and branches of a *Polysiphonia*, the fruit of *Dasya*, and leaves that resemble those of a *Jungermannia.* But the most curious and beautiful varieties of form are found in certain exotic genera, formed, on various systems, into pieces of net-work, resembling fine lace, and, like that article, wrought in divers elegant patterns. One of these lacy plants occurs in the Mediterranean. It resembles a *Callithamnion* in structure, but all its ramuli anastomose into a net-work, instead of forming a branching stem. The seas of the tropics afford a much more complex structure, with a central stem, round which is coiled, in spiral order, a delicate lacy net; and Australia gives us several genera in which the idea is further improved upon. One (*Thuretia*) resembles the skeleton of an oak-leaf, but, when seen under the microscope, is found to be much more complex. Another (*Claudea*) exhibits the retiform structure in its highest perfection; for here each fibre of the net-work is itself a little leaf, with its midrib and lamina, and the net is formed by the growing together of these little leaves, on a regular plan; the tip of one constantly uniting itself to the rib of another.

Several of this sub-class assimilate carbonate of lime in large quantities, so that the frond becomes perfectly stony, and not recognizable, except by its vegetable form, from mineral masses. Such are the corallines or Nullipores, the humblest of which are simple incrustations covering rocks or the stems of other Algæ; nor can we determine their vegetable nature until we have subjected them to chemical examination. Acid will remove the mineral matter and leave behind a cellular body, in form resembling the original mass and in composition similar to many of the Algæ. Thus their nature is established. Under similar treatment the jointed corallines will be found to be bodies of a similar nature. Some of these are among the most beautiful of marine plants. I speak of those of tropical countries, for this group is peculiarly characteristic of the tropics, and those of our own shores are few and not very beautiful. The shores of Australia seem to be peculiarly rich in beautiful corallines; some forming fans, like our *Padina*, but rose-coloured; others triply pinnate, like the most delicate *Callithamnion;* others with whorled ramuli, like *Charæ*, &c.

The fructification of this sub-class is deserving of much attention, and has been the cause of no small trouble to systematic botanists. We here find plants, seemingly furnished with two sorts of spores, both fertile, both equally capable of reproducing the species; each always developed by itself, the two being never found on the same individual, though both have been found on different individuals of almost the whole of the known species. Analogy forbids our regarding both these organs as *spores*, of the same value, and formed by similar agency. There is no such thing as two systems of fructification among other plants. But we do find many plants in which the species is propagated by two modes; first, by the ordinary way of seeds; and secondly, by *gemmæ* or buds, which, originating like ordinary buds, do not develope into branches on the parent, but drop off in a bud-like form, acquire roots, and grow into independent plants. Hence it has been held that the double fruit of the Rhodosperms should be explained in a similar manner; the *bud* or *gemmule* being here reduced to its simplest form, consisting of a single cell. But here, too, the *spore* or representative of a seed is equally simple; and thus it becomes a matter of uncertainty, in the present state of our knowledge, to determine to which of the spore-like bodies the rank of spore, and to which that of gemmule, shall be assigned. We are ignorant, at present, of the circumstances attending the formation of these bodies: we must therefore take them as we find them formed in the plant, and reason on the appearances presented

F 2

to our observation. One sort of fruit,—the *tetraspore*,—though extremely various in position, is uniform in structure throughout the whole sub-class. It consists invariably of a membranous, sub-gelatinous sac or *perispore*, containing a mass of red colouring matter that separates, at maturity, into four parts or *sporules;* sometimes by a transverse division (*zoned* or *annular*); sometimes by two cross lines into four equal parts (*cruciate*); and sometimes by triradiate lines into four unequal parts (*ternately-parted*). This little body is very rarely found in a proper conceptacle or capsule, as we should expect the representative of a seed to be. In the *corallines*, in the Australian genus *Ctenodus*, and in a few other instances, we do find tetraspores enclosed in hollow cases. In many others they are found in pod-shaped bodies called *stichidia*, as in *Rytiphlæa*, *Dasya*, *Plocamium*, &c.; these stichidia being sometimes formed by alteration of portions of branchlets or leaves, and sometimes independently developed from definite points of the frond. In others the tetraspores are naked (as in *Callithamnion*), scattered over the sides, or fixed at the tips of the branchlets. But in by far the greater number of cases these little bodies are immersed in the substance of the branches or leaves, making no external show, except that the parts where they congregate are of darker colour than the rest; and they must be sought by careful examination and dissection under a lens. In these latter cases they appear to be formed either from the cells of the external coat, or from those immediately beneath the surface-cells. If we give due weight to the evidence derived from position, it appears to me that the weight of that evidence would favour the supposition that tetraspores were *gemmules*, and not true *spores*. And such is the opinion advocated by Mr. Thwaites, contrary to that of Decaisne, of J. Agardh, and of almost all modern writers of repute. In cases where they occur dispersed through the frond, one can hardly conceive their formation by a sexual process; and in such plants as *Callithamnion* they clearly originate in the alteration of one of the cells of the ramuli. In this genus also we frequently find them viviparous, or converted into innumerable graniform cells, strung together. Such bodies have been called *antheridia*, but, I think, without sufficient warrant. To me they have always appeared to be metamorphic tetraspores. Again, the advocates of the opposite view, who regard the tetraspore as a true spore, appeal to its perfectly regular structure, uniform through the whole sub-class, and one of the principal characteristics of the sub-class. But there is no reason why similar regularity should not accompany the formation of gemmules, if this latter be one of the modes of propagation which Nature has specially assigned to these vegetables.

The second kind of fruit — the simple *spore* (or *gemmule* of J. Agardh) is a much less organized body than the tetraspore, and more irregular in form; but it is superior, for the most part, in the position it occupies. That is to say, simple spores are never, like tetraspores, dispersed through the tissue of the frond, but are always grouped together in definite masses, which very generally are enclosed in a more or less perfectly formed *pericarp* or conceptacle. They have therefore, to the unassisted eye, much more the appearance of fructification than tetraspores have, unless where the latter are placed in *stichidia*. In the simplest form of *conceptacular* fruit, such as we find in *Halymenia* and *Dumontia*, there is no proper conceptacle, but the spores are collected in spherical masses, and either attached to the wall of the frond or imbedded in its substance, in which case, the tissue surrounding the mass of spores is destitute of colouring matter. Such a fructification is called a *favellidium*; and the name is commonly extended to fruits of a similar structure, but which are not perfectly immersed, such as we find in *Gigartina*, *Gelidium*, &c., where they exist as tubercular swellings of the branches. In some cases these swellings communicate at maturity with the surface by a pore, through which the spores find exit. When such a fructification is wholly external, as in *Callithamnion* and *Ceramium*, it is called a *favella*. Nearly related to this, and especially to the semi-external favellidia of *Gigartina*, &c., is the fruit called *coccidium*, the characteristic conceptacle of *Rhodymenia*, *Delesseria*, *Nitophyllum*, &c. This may either be borne on lateral branches, or sessile on the surface of the frond. It consists of a hollow case, with thick, cellular walls, containing a dense tuft of angular spores attached to a central placenta. Most generally it is impervious, but occasionally pierced by a pore, through which the spores are discharged. Lastly, in the *ceramidium* the conceptacular fruit is brought to its highest development. This organ is ovate or urn-shaped, furnished with an apical pore, and containing a tuft of pear-shaped spores, rising from the base of the cavity. The walls are usually thin and membranous, and the hollow space considerable. Such is the conceptacle of *Polysiphonia*, *Dasya*, *Laurencia*, &c. These are the principal varieties of conceptacular fruit, properly speaking. But there are other bodies, called *nemathecia*, sometimes confounded with fructification, but in which nothing resembling spores are found. They exist as external warts, of very irregular shape, often of considerable size and thickness, composed altogether of vertical filaments, resembling those of which the frond is composed (for they are only met with in *Crytonemiaceæ*), but generally of larger calibre. I am disposed to regard them as imperfect conceptacles, a view which is favoured by their sometimes occurring (as in *Phyllophora membranifolia*) on the same individuals that bear proper conceptacles. With these *nemathecia* must not be confounded the wartlike fructification of *Gymnogongrus*, which is a form of sorus, composed of *tetraspores*.

The conceptacular fruit is perfectly regular in its position and uniform in structure in the same species at all times. It therefore bears every impress of being a normal function of the Rhodosperms, whether we consider its contents as gemmules or spores. In the filiform kinds, as *Polysiphonia*, the *ceramidium* is formed by the metamorphosis of one of the ramuli; but in the leafy genera of the same group (*Odonthalia*, and many exotic genera) these organs spring from the margin on the surface of the phyllodia, and can by no means be regarded as altered ramuli, for they do not occupy the same position. *Coccidia* are very frequently seated on the midribs in leafy plants, but occasionally occupy the lamina; and in ribless fronds they very frequently are formed along the margin. Sometimes, in these last, they occur where the frond has been accidentally injured, and this fact has been seized on to prove their abnormal character. But the cases in which they are formed on definite points of uninjured fronds greatly out-number those in which they have been observed to spring from injured ones; and the latter must therefore be regarded as exceptions to a general practice. On the whole, I am of opinion that the evidence in favour of the conceptacles being a form of fructification and not of gemmation, is at least as strong as that advanced in favour of tetraspores, nor do I think that we are yet sufficiently informed on the development of either fructification to determine *absolutely* the relative value of *tetraspore* and *spore*: that is, to which the term gemmule should be applied.

In the mean time, certain arguments, supported by strong analogies, appear to me to favour the supposition that the contents of the conceptacles should be regarded as true *spores*, or fructification; and that the *tetraspore* is a *gem-*

mule or vegetating bud. I do not pretend that analogical inferences are here to be received as proof; I merely wish to claim for them plausibility—and force, quite equal to that of the evidence brought forward by the advocates of tetraspores.

Arguments in favour of the conceptacular fruit may be derived from watching its developments and that of the frond, and reasoning on the morphological relations of the parts. *Polysiphonia* offers a peculiarly favourable field of observation. If we examine a young growing specimen of a plant of this genus, we find the tips of all its branches to terminate in a tuft of dichotomous fibres. These are peculiarly obvious in *P. fibrata* and *P. fibrillosa;* but will be found in every species, if the specimen examined be in a sufficiently young state. In *P. byssoides* they are persistent, and found at all ages on every part of the frond, constituting the *single-tubed* ramelli of that species; and in *Dasya* they form the ramelli which clothe the branches. The branch which bears these fibres or *ramelli* consists of a number of elongated cells (siphons) placed, in a radiant manner, like the spokes of a wheel, round a central cavity. Round the tips of the branches these radiating cells are gradually shorter, and each cell of the uppermost whorl or wheel ends in one of the dichotomous fibres (*ramelli*). The *ramellus* never changes its shape or character till it falls away, but the cells of the branch below it lengthen, and grow wide till they assume their proper size and shape. Growth, in this case therefore, takes place below the insertion of the ramellus. Such is the case in the primary branches. When a new lateral branch is about to be given off from a primary one, a *ramellus,* similar to those at the apex of the old branch, makes its appearance opposite to one of the dissepiments of the old branch. At the base of this ramellus a cellular nucleus begins to be formed, which increases in size and gradually assumes the appearance of one of the ordinary branches, new ramelli being developed at its apex as it acquires complexity. As such ramelli are *constantly* found on all the growing apices, it is natural to suppose that they are actively concerned in causing the growth which takes place exactly at the point of their attachment; for, if they were unnecessary, we should scarcely find them so universally present on growing points. Besides, similar fibres occur on the young parts of other Algæ, especially of the Sporochnoideæ and Dictyotaceæ, in the former of which orders they are evidently very essential organs. Everything connected with these fibres—their production — their position — their supposed office — tends to show that they are of the nature of acrogenous leaves :—performing such of the functions of leaves as the exigencies of the plant require, some of which functions are, I admit, discharged by the surface of the branches generally, as is the case in all frondose plants, whether cryptogamous or phænogamous. No arguments, based on their imperfect developement, affect their morphological relations : — and if we may be allowed to regard these *ramelli* as the representatives of *leaves*, we establish the first step in our argument.

We have next to determine the morphology of the ceramidium, or spore-case, in which the tuft of spores is contained. The inspection of any *Polysiphonia*, *Dasya*, *Rhodomela* or *Laurencia* is sufficient to show that, in these genera, the ceramidium is simply a truncated branch of the frond : — a branch diverted from its normal character and changed into an ovate or pitcher-shaped, hollow body, pierced at the apex and containing a tuft of spores. Let us observe how this metamorphosis has occurred. The ceramidium makes its appearance as a young branch does, from the side of an old one ; or else it is formed at the apex of an old branch. In either case it is at first a little round knob, destitute of apical fibres (*ramelli*). This knob gradually swells, but does not greatly lengthen—becomes urceolate or ovate—and is at last pierced at the apex. On opening it we find a tuft of fibres with their terminal cells converted into pear-shaped spores, attached to the cellular placenta at the base of the spore-case. How are we to understand this structure ? The lengthening of the branch is arrested at a definite point, and the powers of life are concentrated on the elaboration of the contents of the ceramidium. The placenta at the base is evidently the apex of the branch ; the fibres that carry spores are evi-

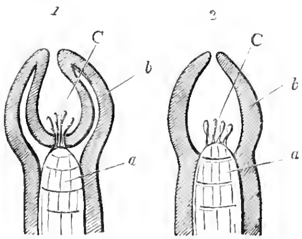


Diagram of supposed Structure of a *Ceramidium*.*

* *Explanation of Diagram.* Fig. 1.—Supposes the peripheric stratum (*b*) to have grown beyond the true apex (*a*) to a certain point, forming the outer membrane of the wall of the *ceramidium*, and then to have doubled back, and returned along the inside of the wall to the insertion of the spores, (*c*) ; forming thus a double membrane. Fig. 2.—Simply supposes the stratum (*b*) to have grown beyond the apex (*a*) leaving a cavity, containing the spores (*c*) at its base.

dently metamorphosed ramelli. But how shall we account for the walls of the *ceramidium?* We must either suppose these walls to be formed of the union of the first developed or lowest ramelli; or, which I think more probable, consider the ceramidium as an introverted branch, whose apex either turned inwards, or stopped short while the cells of the periphery continued to grow around and above it, until they finally enclosed it. In either case the ceramidium would be formed as shown in the imaginary diagram annexed. The cells of the walls are always of irregular shape and irregularly placed, as if pushed from their position. Such dislocation would naturally result from the continued lateral growth of the radiating cells of the apex of the branch, after the cessation of growth upward, however that cessation originate. Were the walls formed from the coherence of ramelli into a membrane, we should expect to find their fibrous origin indicated in the structure of the membrane; but no fibrous structure appears in the walls. Whatever the nature of the walls of the *ceramidium*, there seems no reason to doubt that its contents—the tuft of spore-bearing fibres—are a metamorphosed condition of the *ramelli*, which would have tipped the ceramidium, had it been developed into an ordinary branch. I have already endeavoured to show that the *ramelli* are the representatives of leaves; and if the structure now attributed to the ceramidium be considered established, we shall have strong analogical evidence in favour of the spores being considered of the nature of *seeds*, and not as buds; and by consequence, that *tetraspores* should be regarded as gemmules. For we find, in flowering plants, transformations strikingly similar to what I have been describing. In them the flower is a truncated branch, and all its parts are metamorphoses of leaves: this flower produces *seeds*. In *Polysiphonia*, &c., the ceramidium is a truncated branch, and its contents are modifications of ramelli (or supposed leaves): this ceramidium produces *spores*. The seeds in the first case, and the spores in the second, are formed—so far as position goes — under analogous circumstances; and therefore it seems not unreasonable to infer that an analogical relationship exists between them. More than this I do not consider established, for we do not yet know the cause of the formation of conceptacles and the production of spores. We know that seeds result from the joint agency of stamens and pistils. But we do not know whether any process similar to fertilization takes place with the spores of these Algæ. It is true that bodies supposed to be of the nature of stamens (and called *antheridia*) are found on many Algæ, but how they act, or whether they act on the spore at all, has not been ascertained. But granting that *antheridia* are stamens, the analogical arguments now put forward in favour of spores being seeds would be materially strengthened. For, in flowering plants, with whose metamorphoses we have been comparing those of Algæ, we know that *stamens* and *pistils* are modifications of a common type, altered for a special purpose, and now assuming one form and function, now the other. And in *Polysiphonia* we find both *spore* and *antheridium* having a common origin, both being a cellular growth of the apical fibres or ramelli; the *spore* being formed on the ramelli when the branch is metamorphosed into a conceptacle, and the antheridium on the ramelli of the unchanged branches and developed externally.

These organs (*antheridia*), supposed to be representatives of the male system, have been observed in several genera. They are especially obvious in Rhodomelaceæ (*Polysiphonia*, *Rhodomela*, &c.), when they consist of minute, pod-shaped bodies, full of yellow, vivacious granules, and borne on the colourless fibres in which the branches and ramuli terminate. In *Laurencia* the antheridia are contained in cup-shaped bodies, resembling very open ceramidia, and occupying the place of those organs.

The Rhodosperms are distributed in seven orders, as follows:—

SYNOPSIS OF THE ORDERS.

7. Rhodomelaceæ. *Frond* cellular, areolated or articulated. *Ceramidia* external. *Tetraspores* in rows, immersed in ramuli or contained in proper receptacles (*stichidia*).

8. Laurenciaceæ. *Frond* cellular, continuous. *Ceramidia* external. *Tetraspores* scattered, immersed in the branches and ramuli.

9. Corallinaceæ. *Frond* calcareous or crustaceous, rigid. *Ceramidia* external, containing the *tetraspores*.

10. Delesseriaceæ. *Frond* cellular, continuous, areolated. *Coccidia* external. *Tetraspores* collected into definite clusters (*sori*).

11. Rhodymeniaceæ. *Frond* cellular, continuous, the superficial cells minute. *Coccidia* external. *Tetraspores* scattered through the frond, or forming undefined, cloud-like patches.

12. Cryptonemiaceæ. *Frond* fibroso-cellular, composed of articulated fibres, connected together by gelatine. *Favellidia* immersed in the frond, or sub-external. *Tetraspores* immersed in the frond.

13. Ceramiaceæ. *Frond* filiform, consisting of an articulated filament, simple, or coated with a stratum of small cells. *Favellæ* naked, berry-like masses. *Tetraspores* external, or partially immersed.

Order VII. RHODOMELACEÆ.

Rhodomeleæ, *J. Ag. in Linn. vol.* xv. *p.* 23. *Alg. Medit. p.* 116. *Endl. Gen. pl.* 3, *Suppl. p.* 44. *Harv. Ner. Austr. p.* 9. Rytiphlææ, *Dne. Class. p.* 62. Ceramieæ, Chondrieæ, and Thamnophoreæ (in part) and Anomalophylleæ, *Dne. l. c.* Dasyeæ, Polysiphonieæ, Chondrieæ (partly), Botryocarpeæ (partly), Amansieæ, Rhytiphlæaceæ, Carpoblepharideæ (partly), and Claudieæ, *Kütz. Phyc. Gen.* 414—451. Rhodomeleæ, *Lindl. Veg. Kingd. p.* 25.

Diagnosis.—Red or brown-red seaweeds, with a leafy or filiform, areolated or articulated frond, composed of polygonal cells. *Fruit* double: 1. *Conceptacles* (ceramidia) external, ovate or urn-shaped, furnished with a terminal pore, and containing a tuft of pear-shaped spores: 2. *Tetraspores* immersed in distorted ramuli or in lanceolate receptacles (*stichidia*), usually in rows.

Natural Character.—*Root* mostly a simple disk, in some accompanied by creeping fibres; and in some the principal stems are prostrate and creeping, the branches erect. *Frond* very variable in aspect (if we take in the exotic forms of the order); sometimes forming a net-work, sometimes filiform. The leafy forms of the order are more numerous in the seas of warm countries, and exhibit, as we approach the tropic, leaves of more perfect formation. The flat, thin frond, with its obscure midrib, of our *Odonthalia*, which is the nearest to a leafy form that we possess, is replaced in the more genial waters of the Mediterranean by the delicate *Dictymeniæ*, in which the surface of the leaf is composed of large cells; and, pursuing our course to warmer regions, this form gives place to *Amansia*, whose leaves are still more delicate, with their cells arranged in transverse lines, each cell exactly of the same length as its neighbour cell, and regularly twelve-sided. Such fronds resemble a fine piece of mosaic pavement, and exhibit the *areolated* structure in its greatest perfection. In several of the leafy genera, the leaves are nerveless, in others nerved, and in some traversed by a system of branching veinlets, that spread through the whole substance. In one or two they are thick and fleshy, containing large chambers filled with mucus. In many they are proliferous, the new leaves springing from the disks or margin of the old. The net-work fronded, such as *Claudea*, have been already noticed. The filiform kinds, to which belong nearly the whole of the British species, are either articulated, or furnished with an articulated axis coated with a stratum of small, irregularly formed, polygonal cells. They are all constructed on the same plan: there is a central, articulated filament, usually devoid of colouring matter, and round this filament is ranged a circle of elongated cells, of equal length, to which the name *siphons* or tubes has been given. These whorls of cells, placed one above the other, form the filiform frond; and the points of the connection of their ends, the joints, when the frond is articulated. When there is no visible articulation it exists in the centre of the frond, but is concealed from view by a coating of cells, of greater or less thickness, as in *Rhodomela*, or is partially visible, as in *Rytiphlæa*.

Many of the *Rhodomelaceæ* are of a brown-red, and some of them of a full brown colour, and nearly all become darker in drying. Some that are rose-coloured, as *Pol. byssoides*, when living, become quite dark after they have been dried, and others turn completely black, a peculiarity which has suggested the ordinal name (signifying red-black). Many discharge a quantity of dark coloured, offensive matter, when steeped in fresh water, and several will rapidly decompose when brought in contact with that medium. Others may be kept in it for days without injury, or even with advantage, for by this means the tendency to dry black is lessened. All, except some of the *Bostrychiæ*, are strictly marine, and generally grow near low-water mark. Our own *Bostrychia* *scorpioides* is amphibious, growing, sometimes in the sea and sometimes in ditches of brackish water, and a similar indifference to habitat was observed by Dr. Hooker in *B. vaga*, of Kerguelin's land.

SYNOPSIS OF THE BRITISH GENERA.

I. ODONTHALIA. *Frond* flattened, linear, with an obsolete midrib, pinnatifid, alternately inciso-dentate. [Plate 11, A.]

II. RHODOMELA. *Frond* cylindrical, inarticulate, opake. *Tetraspores* contained in pod-like receptacles (*stichidia*). [Plate 11, B.]

III. BOSTRYCHIA. *Frond* cylindrical, inarticulate, dotted; the surface cells quadrate. *Tetraspores* in terminal pods. [Plate 11, C.]

IV. RYTIPHLÆA. *Frond* cylindrical, inarticulate, transversely striate. *Tetraspores* in pod-like receptacles. [Plate 11, D.]

V. POLYSIPHONIA. *Frond* cylindrical, articulated, wholly or in part; the branches longitudinally striate. *Tetraspores* in distorted ramuli. [Plate 12, A.]

VI. DASYA. *Frond* cylindrical, the stem inarticulate; the ramuli articulated, composed of a single string of cells. *Tetraspores* in pod-like receptacles (*stichidia*), borne by the ramuli. [Plate 12, B.]

I. ODONTHALIA. Lyngb. [Plate 11, A.]

Frond plano-convex, two-edged, vinous-red, distichous, obsoletely ribbed, alternately toothed at the margin, cellular; central and surface-cellules minute, irregular. *Fructification* twofold, on distinct plants; 1, *ceramidia*, containing a tuft of pear-shaped spores; 2, lanceolate *pods* (*stichidia*) containing tetraspores in a double row. Name, ὀδους, a *tooth*, and θαλος, a *branch*.

1. O. *dentata*, L.; frond vaguely branched in an irregularly pinnate manner; branches linear-oblong, narrowed at base, pinnatifid; laciniæ alternate, sharply toothed at the truncate extremities; capsules clustered on branched peduncles. *Grev. Alg. Brit. p.* 101, *t.* 13; *Hook. Br. Fl.* ii. *p.* 293; *Harv. Phyc. Brit. t.* xxxiv. *Fucus dentatus, E. Bot. t.* 1241.

On rocks in the sea. Perennial. Fruiting from January to March. Frequent on the shores of Scotland, and of the north of England and Ireland.—*Fronds* rising from a hard disk, tufted, 3—12 inches long, much branched, furnished with an imperfect midrib toward the base, flat and membranaceous above; the main stem simple or forked, 2—4 lines wide, narrower at base, alternately toothed; branches issuing from the axils of the teeth of the main stem, attenuated at base, simple, or somewhat palmately divided, and either toothed or pinnatifid, the lobes in the latter case being toothed, and, as they become larger, pinnatifid. The frond preserves throughout nearly the same breadth, rarely exceeding 4 lines. *Fructification* borne along the margin on very slender pedicels, which are either simple or branched; *ceramidia* ovate, containing a cluster of pear-shaped spores, which are finally discharged through a terminal pore; *stichidia* lanceolate, containing a double row of ternate tetraspores. *Substance* cartilagineo-membranaceous, scarcely adhering to paper; *structure* densely cellular. *Colour* a deep vinous red, becoming darker in drying.

II. Rhodomela. Ag. [Plate 11, B.]

Frond filiform, solid, much branched, inarticulate, reticulated; the axis composed of concentric layers of oblong, hyaline cells; the periphery of several rows of minute, irregular, coloured cellules. *Fructification* twofold, on distinct plants; 1, *ceramidia*, containing a tuft of pear-shaped spores; 2, *tetraspores* contained in lanceolate *pods* (*stichidia*) or in swollen branchlets. Name, ῥοδεος *red* and μελας, *black;* because these plants become darker in drying.

1. R. *lycopodioides*, L.; frond elongate, mostly simple, densely beset with slender, finely divided branchlets, mixed with the short, rigid, bristle-like remains of a former series. *Grev. Alg. Brit. p.* 102; *Hook. Br. Fl.* ii. *p.* 294; *Harv. Phyc. Brit. t.* l. *Fucus lycopodioides, E. Bot. t.* 1163.

On the stems of *Laminaria digitata*. Perennial. Summer. Common on the shores of Scotland and of the north of England and Ireland.—*Fronds* 4—18 inches long, tufted, filiform, attenuated upwards, simple or subsimple, clothed, in its winter state, with short, rigid, simple or slightly branched ramuli, half an inch to an inch in length; in summer throwing out from these and the main stem numerous capillary, multifid, slender ramuli, usually 1 or 2 inches long, but which, in some magnificent specimens gathered by my friend *Mr. W. Thompson*, at Bangor, Co. Down, are lengthened into branches 6—14 inches long, and clothed at short distances with broad tufts of multifid ramuli, resembling those usually borne by the main stem. Some of these specimens seem almost intermediate with *R. subfusca*, and strikingly resemble *Polysiphonia Brodiæi* on a large scale. *Fructification* is plentifully produced by the summer ramuli. *Substance* cartilaginous, the summer branches adhering to paper. *Colour* purplish brown, becoming black in drying.

2. R. *subfusca*, Woodw.; frond filiform, much and irregularly branched; branches virgate, set with scattered, subulate, simple or pinnulated, alternate branchlets, often crowded towards the end of the branches. *Grev. Alg. Brit. p.* 103; *Hook. Br. Fl.* ii. *p.* 294; *Harv. Phyc. Brit. t.* cclxiv.; *Wyatt, Alg. Danm. No.* 111. *Fucus subfuscus, Woodw.*; *E. Bot. t.* 1164.

In the sea, on rocks and Algæ. Perennial. Summer. Frequent.—*Stem* 4—10 inches high, undivided or branched, set throughout with numerous, alternate, long branches, which bear a second or third series of alternately multifid ramuli. In winter these finely divided branches drop off, leaving the frond with the stunted remains of its branches rigid and broken; but early in the following spring a second series of ramuli arises from the branches, and on these the fructification is produced. *Substance* rigid in winter, cartilaginous and rather flaccid in summer, when the frond adheres to paper. *Colour* reddish or brownish, becoming darker in drying. An extremely variable plant in ramification, and in its summer and winter states presenting a startling contrast.

III. Bostrychia. Mont. [Plate 11, C.]

Frond dull purple, filiform, much branched, inarticulate, dotted; traversed by a jointed tube surrounded by one or more concentric layers of oblong coloured cells, which are gradually shorter towards the circumference; the surface cells cubical. *Fructification* twofold, on distinct plants; 1, *ceramidia*; 2, *tetraspores*, contained in terminal, lanceolate *pods*. Name, βοστρυχος, a *ringlet* or *curl of hair*.

1. B. *scorpioides*, Gm.; frond cylindrical, slender, attenuated, three or four times pinnated with horizontal branches, the uppermost involute at the extremity. *Grev. Alg. Brit. p.* 105; *Hook. Br. Fl.* ii. *p.* 294; *Wyatt, Alg. Danm. No.* 69; *Harv. Phyc. Brit. t.* xlviii. *Fucus amphibius, E. Bot. t.* 1428

On rocks in the sea, or in salt-water ditches. Annual? Summer. North Wales, *Rev. H. Davies.* Abundant at Shoreham, growing on *Atriplex portulacoides*, *Mr. Borrer.* Mouth of the river Dart, *Mrs. Griffiths.* Tydd Marsh, Cambridgeshire, *Mr. Skrimshire.* Shore of Blackwater at Maldon, *Mr. E. Forster, jun.* Selsea Marshes, *Martyn.* At Portstewart, North of Ireland, *Mr. D. Moore*, and elsewhere. — *Fronds* forming entangled tufts, very slender, cylindrical, excessively branched in a distichous manner, the branches very patent or divaricating, alternate, furnished with a second or third series of similar patent ramuli, the apices very much involute. *Capsules* unknown in this country; *receptacles* of granules forming pinnate tufts, either terminal or lateral. *Colour* pale purplish, becoming blackish in drying. *Substance* somewhat cartilaginous, tender. A very curious plant, forming, with some tropical, and several antarctic species, a distinctly marked little group—remarkable for their amphibious habits.

IV. Rytiphlæa, Ag. [Plate 11, D.]

Frond filiform or compressed, pinnate, transversely striate, reticulated; the axis articulated, composed of a circle of large, tubular, elongated cells (*siphons*) surrounding a central cell; the periphery of several rows of minute, irregular, coloured cellules. *Fructification* twofold, on distinct plants; 1, *ceramidia*, containing a tuft of pear-shaped spores; 2, *tetraspores*, contained in minute, lanceolate *pods* (*stichidia*), in a double row; or immersed in swollen ramuli. Name, ῥυτις, a *wrinkle*, and φλοιος, the *bark*, because the surface is transversely wrinkled (when dry).

1. R. *pinastroides*, Gm.; frond terete, irregularly branched; lesser branches pectinato-pinnate; the pinnæ secund, with their apices hooked inwards. *Rhodomela pinastroides, Grev. Alg. Brit. p.* 104, *t.* 13; *Hook. Br. Fl.* ii. *p.* 294; *Wyatt, Alg. Danm. No.* 112; *Harv. Phyc. Brit. t.* lxxxv. *Fucus pinastroides, E. Bot. t.* 1042.

On submarine rocks, near low-water mark. Perennial. Fruiting in winter. Southern shores of England, frequent.—*Frond* 4—8 inches high, cylindrical, subsimple at base, much branched above, the branches alternate or secund, long, spreading in a fan-like manner, much divided, the lesser ones set with secund, erect ramuli, about half an inch long, and either straight, or, more generally, hooked at the extremity. The whole plant marked, at short intervals, with transverse striæ, giving it a jointed appearance. *Capsules* minute, spherical, scattered on the ramuli; *tetraspores* imbedded in the ramuli of distinct plants. *Substance* cartilaginous. *Colour* a dull red, becoming black in drying.

2. R. *complanata*, Ag.; frond brown-red, compressed, pinnate or bi-tripinnate, the lower pinnæ short or abortive, the upper long, straight, erect, virgate, once or twice compounded; pinnules subulate or bifid, erect, closely set; the axils acute. *Harv. Phyc. Br. t.* clxx. *Pol. cristata, Harv. in Mack. Fl. Hib. part* 3, *p.* 205.

On the rocky beds of shallow tide-pools, exposed, at low-water mark, to full sunshine. Very rare. Perennial. Summer. South of England and West of Ireland.—*Stem* 2 or 3 inches high, erect, nearly simple below, decompound above, compressed, half a line in breadth, nearly equal throughout; branches erecto-patent, with acute axils, the uppermost becoming rather broader towards the apex, more or less regularly bipinnate; the lower pinnæ very short, with minute, subulate, simple pinnules, the upper much longer, with decompound or sometimes again pinnated pinnules; all the divisions very erect. *Colour* a dark brownish red. *Frond* reticulated with veins, and marked with arched, transverse striæ, or dark lines, at distances of about half the diameter apart; these indicate the joints of the internal axis, seen through the surface. *Fruit* has not been found in Britain.

3. R. *thuyoides*, Harv.; stems erect, rising from creeping fibres, terete; below simple and set with short, spine-like ramuli; above much branched; branches crowded, very erect, bipinnate; pinnæ pinnato-multifid; axils rounded. *Harv. in Mack. Fl. Hib.* iii. *p.* 205; *Wyatt, Alg. Danm. No.* 305; *Harv. Phyc. Brit. t.* cxxii.

On rocks in tide-pools, frequent. Perennial. Summer and autumn.—*Stems* 3 or 4 inches high, twice as thick as hog's bristles, cylindrical, erect, below either naked, or furnished with short, spine-like ramuli, or with broken remains of old branches; much branched above; branches long, crowded or fasciculate, quadrifarious or distichous, very erect (with a determinate oblong-lanceolate outline), bipinnate, middle and lower pinnæ pinnato-multifid, ultimate ones simple, or with the tips cloven. *Articulations* obscure, shorter than broad, scarcely obvious in the branches, more conspicuous in the ramuli, reticulated with veins. *Capsules* ovate, scattered or clustered, borne by the ramuli, very rare; *tetraspores* ternate, in distorted ramuli, frequent. *Antheridia* bright yellow, gelatinous, constantly produced in summer. *Colour* a dull brown or brownish yellow, becoming black in drying.

4. R. *fruticulosa*, Wulf.; stems diffuse, branched from the base; branches divaricating, pinnato-dichotomous, inarticulate, set in the lower part with short, horizontal, multifid ramuli; in the upper, more or less pinnated with larger, similarly divided branchlets; axils rounded; ramuli marked at short distances with transverse striæ, as if jointed; veins reticulated. *Harv. Phyc. Brit. t.* ccxx. *Pol. fruticulosa, Harv. in Mack. Fl. Hib.* iii. *p.* 205; *Hook. Br. Fl.* ii. *p.* 327, (*in part*). *Fucus fruticulosus, E. Bot. t.* 1686.

Between tide-marks, on sand-covered rocks. Perennial. Summer. Common.—*Fronds* 3—6 inches high, robust, cylindrical, much branched from the base, branches divaricating, with very patent axils, repeatedly divided in a pinnato-dichotomous manner, set in the lower part with short, alternate, horizontal, squarrose, multifid ramuli, about a line in length, in the upper distantly pinnated with similar but larger branchlets. *Articulations* scarcely obvious in the larger branches, very apparent in the ramuli, reticulated with veins; the transverse striæ or dissepiments opaque. *Capsules* ovate, sessile, very rare; *granules* ternate, in swollen ramuli, common. *Antheridia* frequently occur, imparting a yellowish colour to the plant. *Substance* cartilaginous. *Colour* dull reddish brown, or greenish yellow.

V. Polysiphonia. Grev. [Plate 12, A.]

Frond filamentous, partially or generally articulate; joints longitudinally striate, composed of numerous radiating cells (*siphons*) disposed round a central cavity. *Fructification* twofold, on distinct plants; 1, *ceramidia*, containing a tuft of pear-shaped spores; 2, *tetraspores* imbedded in swollen branchlets.—Name, *πολυς*, *many*, and *σιφων*, a *tube*. A vast genus, of which nearly 300 species, from all parts of the world, have been described; many, probably, more than once under different names.

Sub-genus I. Oligosiphonia. *Primary tubes four, rarely five.*

* *Frond articulated; the articulations distinctly visible to the base of the stem.*

1. P. *urceolata*, Sm.; threads rigid, setaceous, much branched, loosely entangled; branches dichotomous, erecto-patent, more or less furnished with short, patent, or recurved ramuli; joints bi-striated, those of the main branches 3—5 times longer than broad, of the ramuli very short; ceramidia pitcher-shaped, with a produced, contracted mouth, generally stalked. *Harv. Phyc. Brit. t.* clxvii.; *Hook. Br. Fl.* ii. *p.* 330; *Wyatt, Alg. Danm. No.* 133. *Conf. urceolata, E. Bot. t.* 2365.—*β. patens. P. patens, Grev. Hook. l. c. Conf. patens, Dillw. t. G.*

On rocks, and the larger Algæ, often covering the stems of *Laminaria digitata*. Annual. Summer.—*Stems* 3—9 inches high, dark red, as thick as horse-hair at the base, loosely entangled in large bundles, scarcely attenuated, rigid, not collapsing on removal from the water, and very imperfectly adhering to paper. *Articulations* very variable in length, in different parts of the plant; dissepiments broad and colourless. *β.* is less branched, with shorter joints, the branches beset throughout their length with short, recurved ramuli. It is the *P. patens* of authors, and of 'British Flora,' in which work I have expressed doubts whether it be specifically distinct from *P. urceolata*. A longer acquaintance with the subject induces me, unhesitatingly, to unite them. *β.* is generally found on the stems of *Laminaria digitata; a.* on rocks, but not invariably so.

2. P. *formosa*, Suhr.; threads exceedingly slender and flaccid, much divided; branches long, flexuous, bearing a second or third series; ramuli scattered, spreading; joints of the main branches many times longer than broad; ceramidia pitcher-shaped, with a produced contracted mouth. *P. formosa, Suhr.*; *Harv. Phyc. Brit. t.* clxviii. *P. gracilis, Grev. MSS.*; *Wyatt, Alg. Danm. No.* 216.

On rocks, &c., between tide-marks. Annual. Summer. Not uncommon.—*Filaments* 6—10 inches high, exceedingly slender and flaccid, much divided, with many long, slender, wavy branches, bearing a second or third series, and ultimately a few irregular, spreading, or erect ramuli. *Joints* of the main branches very long, those of the ramuli shorter, two-tubed. *Capsules* sessile or shortly stalked; *tetraspores* large, in the ramuli, often in beaded strings. This species has many points in common with *P. urceolata*, but is a much more slender and flaccid plant, and the capsules are different.

3. P. *stricta*, Dillw.; filaments densely tufted, setaceous, flaccid, bi-striated, dichotomous; branches and ramuli straight, erect; axils acute; upper articulations 4 or 5 times longer than broad; capsules ovate, sessile. *Hook. Br. Fl.* ii. *p.* 329. *Conf. stricta, Dillw. t.* 40.

In the sea, on sand-covered rocks. "Not uncommon;" *Dillw.*—*Filaments* 2—10 inches high, rising from a mass of creeping fibres. *Colour* dull red or purplish. A very ill-defined, confused species, which I do not understand, nor can it be determined without a careful examination of the original specimens, figured by Dillwyn. In herbaria we sometimes find *P. formosa*, sometimes *P. fibrata* under this name.

4. P. *pulvinata*, Ag.; filaments rising from a mass of creeping fibres, tufted and interwoven, short, very slender, flexuous, sparingly and irregularly dichotomous, more or less furnished with very patent or recurved, simple ramuli; articulations variable in length, bi-striated; ceramidia pitcher-shaped, very large, scattered. *Harv. Phyc. Brit. t.* cii. *P. macrocarpa, Harv. in Fl. Hib.* iii. *p.* 296; *Wyatt, Alg. Danm. No.* 215.

On rocks and Algæ between tide-marks. Annual. Summer. Not uncommon.—*Tufts* dense, intricate, about an inch in height, composed of very slender, capillary, flexuous filaments, variously branched. *Colour* a dull brownish-red or purplish. *Capsules* very large for the size of the plant, several times the diameter of the filament from which they spring. *Substance* soft and flaccid, soon decomposing in fresh water.

5. P. *fibrata*, Dillw.; stems setaceous, flaccid, gelatinous, simple or alternately branched, bearing at greater or less distances, dichotomously divided, more or less pencilled or tufted ramuli, whose tips are fibrilliferous; axils patent; articulations bi-striate, varying greatly in length; ceramidia ovate, generally stalked. *Harv. Phyc. Brit. t.* ccviii.; *Harv. in Hook. Br. Fl.* ii. *p.* 329; *Wyatt, Alg. Danm. No.* 39. *Conf. fibrata, Dillw.! Conf. Syn. p.* 84, *t. G.*

On rocks, stones, and Algæ, between tide-marks, not uncommon. Annual. Summer and Autumn.—*Stems* 2—10 inches long, densely tufted, dark red-brown, tender and gelatinous, decomposing rapidly in fresh water;

main thread alternately or sub-dichotomously branched, rather stouter than the branches, which are frequently long and much divided; *lesser* divisions more or less furnished with pencil-like tufts of dichotomously divided ramuli. *Joints* bi-striate, the striæ frequently crossing, those of the main thread sub-opaque, very short at base, becoming longer upwards, in the middle 4—8 times longer than broad, in the lesser ramuli 2 or 3 times. *Tips* of the ramuli truncate, bearing byssoid fibres and antheridia. *Capsules* ovate or globose, plentifully scattered over the ramuli; *granules* large, imbedded in the upper ramuli. Mrs. Griffiths finds at Ilfracombe, and Mr. D. Moore at Island Magee, Co. Antrim, a variety which differs from the common state in being less branched, the branches more distant, with much denser and more finely divided pencils of ramuli.

6. P. *spinulosa*, Grev.; "dark red; branches divaricate, somewhat rigid; the ramuli short, straight, subulate, divaricate; articulations about equal in length and breadth, three-tubed." *Grev. Crypt. Fl. t.* 90; *Hook. Br. Fl.* ii. *p.* 330.

In the sea; extremely rare. Annual? Appin, *Capt. Carmichael*, who only found one specimen.—*Frond* 1 or 2 inches in length, of a dark red colour, much branched, with a rigid and spinulose habit; main branches rather remote, irregular, much divaricated, somewhat flexuous; ultimate ramuli straight, subulate, almost thorn-like, divaricated like the rest, sometimes minutely divided at the apex, and each of the divisions terminated by a long, hyaline, jointed filament. *Articulations* about as long as broad, striated, with three internal tubes, of a pale brown-pink under the microscope. *Tubercles* (young) "very minute, quite sessile, round, dark red, scattered freely on the branches, and containing several dark granules." *Grev. l. c.* This is a very rare and little known plant, of which I have seen no specimen save the original one, found by Capt. Carmichael, and now preserved in the Hookerian Herbarium. Dr. Greville's figure is very characteristic. A transverse section of the stem exhibits four large siphons, with smaller secondary ones at their external angles. The Devonshire habitat, given on the authority of Mrs. Griffiths, in our first edition, belongs to *Pol. simulans*, a plant of very different structure, though very similar aspect.

7. P. *Richardsoni*, Hook.; stems cartilaginous, setaceous; branches alternate, elongated, divaricate, beset in the upper part with very patent, straight, sub-dichotomous ramuli; articulations of the stem and branches 2 or 3 times longer than broad, irregularly veined, of the ramuli shorter; ceramidia sessile, globose. *Hook. Br. Fl.* ii. *p.* 333; *Harv. Phyc. Brit. t.* x.

At Colvend, Dumfries, *Sir John Richardson*.—*Stems* 3 or 4 inches high, rigid, nearly as thick as a hog's bristle at base, branched throughout; branches alternate, often issuing at right angles. *Colour* a dull red, becoming darker in drying. *Main articulations* marked with numerous, anastomosing, irregular tubes, those of the lower branches 3—5 tubed, of the ramuli 2 or 3 tubed. *Capsules* sessile, scattered, subglobose, with a very wide aperture. *Siphons* five in the stem.—Of this species nothing is known beyond a single specimen preserved in the Hookerian Herbarium, and figured in Phycologia Britannica, as above quoted.

8. P. *Griffithsiana*, Harv.; stem rigid, attenuated, alternately branched; branches long, patent, sub-simple, furnished with numerous sub-dichotomous or alternate, slender, patent, flaccid ramuli; articulations of stem, branches and ramuli, about once and a half as long as broad, with straight veins; capsules broadly ovate, sessile. *Harv. Phyc. Brit. t.* ccxxviii.

Parasitical on *Polyides rotundus* at Torquay, *Mrs. Griffiths.* Isle of Portland, *Miss White.* Annual. Summer. Very rare. — *Stems* 3 or 4 inches high, as thick as a bristle, gradually attenuated upwards, alternately branched, the branches long, patent, simple or divided, furnished with numerous, sub-dichotomous or alternately divided, slender, patent ramuli, the ultimate ones often recurved, having a feathery character. *Articulations* of the stem visible to the base; they, as well as those of the branches and ramuli, about once and a half as long as broad, usually equal in all parts of the plant. *Substance* rather rigid in the stem and branches, imperfectly adhering to paper, flaccid in the ramuli, not decomposing, nor giving out colour in fresh water. *Colour*, below brownish, above rosy or pink. Nearly allied to *P. Richardsoni*, but in Mrs. Griffiths' opinion distinct. It is chiefly remarkable for the *equality* of its short joints, and for its property of resisting fresh water; "though kept long in fresh water it gave out neither colour nor smell, nor did it decompose as others would in the time." *Mrs. Griffiths in litt.*

9. P. *elongella*, Harv.; stems setaceous, rigid, sub-dichotomous; branches very patent, beset with flaccid, somewhat tufted, elongated, multifid ramuli, not tapering at base; joints of the branches about as long as broad, those of the ramuli rather longer, both marked with three parallel veins; dissepiments pellucid. *Harv. in Hook. Br. Fl.* ii. *p.* 334; *Wyatt, Alg. Danm. No.* 84; *Harv. Phyc. Brit. t.* cxlvi.

On rocks, &c., between tide-marks. Biennial. Spring. Rather rare; but generally distributed round the British shores.—*Stems* 2—4 inches high, in the lower part rigid, cartilaginous, and as thick as hogs' bristles, attenuated upwards to a capillary fineness; main branches distant, very patent or divaricated; ramuli more or less crowded, sometimes densely tufted, straight, dichotomous, somewhat tapering to the apex, not at all contracted at the base. *Articulations* distinctly visible in all the main branches, obscure towards the root; veins *all parallel*. *Colour* of the stems brownish, of the ramuli rose-red. *Ceramidia* large, ovate, scattered on the ramuli. This closely resembles small specimens of *P. elongata*, but is easily and clearly distinguished by the distinctly jointed branches, and the *parallel* (not *reticulated*) veins which they contain. It probably undergoes similar changes.

** *Frond partially inarticulate; the articulations of the stem and branches obsolete, or indistinct, the surface-cells being small and irregularly shaped.*

10. P. *elongata*, Huds.; stems robust, cartilaginous, irregularly branched, beset, especially towards the tips, with slender, tufted, multifid ramuli, which are attenuated at base; joints about as long as broad, those of the stem reticulated with veins. *Harv. in Hook. Br. Fl.* ii. *p.* 333; *Wyatt. Alg. Danm. No.* 40. *Conf. elongata, E. Bot. t.* 2429.—β. *denudata;* filaments nearly opaque, distorted, beset with wart-like excrescences and bare of ramuli. *Ceramium brachygonium, Lyngb. Hyd. Dan. t.* 36.—γ. *sanguinolenta;* ramuli forming broad, dense tufts, of a fine crimson, mostly at the tips of the branches. *Ag. Sp. Alg.* ii. *p.* 85. *P. rosea, Grev.! Fl. Edin. p.* 310.

In the sea, on stones, shells, corallines, &c. Biennial. Spring. β. and γ. are perhaps rather *states* of the plant than distinct varieties.—*Stems* 6—12 inches high, as thick as whip-cord, tapering to the base and apex, irregularly branched; the branches erect or spreading, producing the first season but few ramuli. In the winter these ramuli fall off, leaving the branches bare, and the tips broken: but early in spring, broad tufts of crimson, multifid ramuli, 1 or 2 inches or more in length, issue from the tips and upper part of the branches, and on these the fruit is borne. *Ceramidia* ovate, sessile, either in clusters or scattered; *granules* either imbedded in the ramuli, or borne in minute, pod-like processes of the branches. *Stems* scarcely adhering to paper; ramuli very flaccid, and closely adhering.

11. P. *Grevillii*, Harv.; stems inarticulate, marked with broken tubes, thick, cartilaginous, irregularly branched; branches subdivided, rather bare below, above densely clothed with long, irregularly dichotomous, very slender, pencilled, crimson ramuli; axils acute; articulations of the ramuli 3—6 times longer than broad, two-tubed. *P. Lyngbyæi, Harv. in Hook. Br. Fl.* ii. *p.* 328; *(not Hutchinsia Lyngbyæi of Agardh).*

Shores of Bute, on the larger Algæ, *Dr. Greville.*—*Frond* 6—10 inches high; *stem* as thick as that of *P. elongata*, cartilaginous, inarticulate, marked with short, flexuous veins, and wholly destitute of joints. Branches irregular, patent, sparingly divided, their lower part almost bare, the upper densely clothed with long, very slender, crimson ramuli, which spread in broad pencils, are much branched, straight, irregularly dichotomous, not in the least attenuated at base, their axils very acute; articulations marked with two striæ, rosy under the microscope, 2—4—6 times longer than broad; dissepiments pellucid.

12. P. *violacea*, Ag.; brownish-red or purple; stem inarticulate, marked with irregularly-broken tubes, rather robust, alternately branched; branches quadrifarious, several times

divided in an alternate manner, bushy or feathery, the ultimate ramuli exceedingly slender, fibrilliferous; articulations of the ramuli few-tubed, 2—4 times longer than broad. *Harv. Phyc. Brit. t.* ccix.; *Wyatt, Alg. Danm. No.* 176. *Hutchinsia violacea, Ag. Sp. Alg.* ii. *p.* 76.

On rocks and stones in the sea. Annual. Early summer. All round the coast. — *Frond* 6—8 inches high, with a principal stem, sometimes much more slender than a hog's bristle, set from top to bottom with long, alternate or irregular, quadrifarious branches of unequal length, but gradually diminishing upwards, which again bear a second, third or fourth series, gradually lessening in diameter and length, so that the plant has a singularly feathery or finely bushy character, the ultimate ramuli exceedingly slender, naked at base, with a few divisions near the summit, erecto-patent, the tips splitting into byssoid fibres. *Articulations* of the stem generally indistinct, irregularly tubed; of ramuli 2 or 3-tubed, twice or four times as long as broad. *Colour* a brownish red, often assuming a fine purple in drying. *Substance* tender, gelatinoso-cartilaginous, quickly decomposing in fresh water. *Capsules* ovate, sessile or shortly stalked; *tetraspores* large, binate or ternate, in the ramuli. The *P. violacea* of 'Brit. Flora,' is a purple variety of *P. nigrescens*.

13. P. *Carmichaeliana*, Harv.; filaments tufted, rigid, branched from the base; branches alternate, inarticulate, divaricating; ramuli sub-dichotomous, very patent, their articulations as long as broad. *Harv. in Hook. Br. Fl.* ii. *p.* 328. *P. divaricata, Carm. (not of Ag.)*

Parasitical on *Desmarestia aculeata* at Appin, *Capt. Carmichael.*— *Filaments* tufted, 4 inches high, rigid, thicker than hogs' bristles; branches scattered, issuing at right angles, ramuli sparingly divided, patent and divaricating. *Stem* and principal branches longitudinally striated, inarticulate, or towards the apex having an obscure appearance of joints; articulations of the ramuli 2—4 striate, somewhat swollen at the joints. *Colour* reddish brown, changing to black in drying, in which state it adheres very imperfectly to paper. Of this plant I have only seen the single specimen found by Capt. Carmichael, and preserved in Sir W. J. Hooker's herbarium.

14. P. *fibrillosa*, Dillw.; pale straw colour; stems inarticulate, robust, alternately branched; branches patent, resembling the stem, but somewhat jointed, sub-simple, thickly set with very slender, finely divided, short ramuli, whose tips are fibrilliferous; articulations of the ramuli 2 or 3 tubed, rather longer than broad. *Hook. Br. Fl.* ii. *p.* 334; *Wyatt, Alg. Danm. No.* 136.

On rocks and stones, and on Algæ between tide-marks. Annual. Summer. Common. — *Frond* 6—10 inches long. *Main stem* sometimes nearly half a line in diameter, always thicker than a bristle, attenuated upwards, furnished with several long, alternate or irregular, patent branches, of nearly its own thickness, which sometimes issue horizontally, sometimes are erecto-patent, but generally form considerable angles with the stem.

These branches are usually simple, in luxuriant specimens furnished with a second series, somewhat naked at base, in the upper part clothed with slender, finely divided, irregular ramuli, which are either short, and giving the branches a squarrose appearance, or elongated and divided, then giving them the feathery character of *P. violacea*. *Articulations* of the stem indistinct, of the branches somewhat nodose, many-striate, and about as long as broad, of the ramuli 2 or 3 tubed, rather longer than broad. *Apices* splitting into numerous byssoid fibres. *Colour* a pale straw or somewhat rosy when recent, becoming purplish in drying. *Substance* tender and gelatinous, very fragile and soon decomposing. *Capsules* generally stalked; *granules* in distorted ramuli.

SUB-GENUS 2. POLYSIPHONIA. *Primary tubes six or more.*

* *Frond partially inarticulate; the articulations of the stem and branches obsolete, the surface-cells being small and irregularly shaped. (Siphons seven).*

15. P. *Brodiæi*, Dillw.; stems inarticulate, robust, cartilaginous, alternately branched; branches virgate, clothed with spreading, pencilled, multifid, delicate, flaccid ramuli; articulations of the ramuli 3 or 4 tubed, rather longer than broad; siphons of the stem about seven; dissepiments transparent. *Harv. Phyc. Brit. t.* cxcv.; *Hook. Br. Fl.* ii. *p.* 328; *Wyatt, Alg. Danm. No.* 83. *Conf. Brodiæi, E. Bot. t.* 2589. — *β. subsimplex. Hutchinsia penicellata, Ag. Sp. Alg.* ii. *p.* 65.

On rocks and the larger Algæ, between tide-marks. Annual. Summer. Common on most of our shores; first noticed by the late *Mr. Brodie*, of Brodie, near Forres.—*Frond* 6—14 inches long, generally with an undivided, inarticulate, robust stem, furnished with numerous alternate branches, which are set at short distances with short, multifid, pencil-like ramuli, from half an inch to an inch long; the ramuli jointed, and repeatedly divided in an alternate manner. *Colour* a dark brownish purple. *Substance* gelatinous, instantly decomposing and giving out a disagreeable smell if immersed in fresh water. *β.*, which we have from Capt. Carmichael, who gathered his specimens at Staffa, differs from the usual state of the plant in being less branched, more rigid, of a darker colour and with more dense ramuli.

** *Frond articulated throughout; primary tubes six or seven.*

16. P. *variegata*, Ag.; filaments brownish purple, setaceous and rigid below, gradually attenuated upwards to a capillary fineness, dichotomous, the lower axils very patent; branches somewhat zigzag, elongated, much divided, set with lateral, capillary and very flaccid, multifid, purple ramuli; articulations near the base shorter than their breadth, in the principal branches twice as long as broad, in the ramuli short, marked with three broad, parallel, oblong tubes;

siphons six or rarely seven; ceramidia ovate, on short stalks. *Ag. Sp. Alg. vol. 2, p.* 81; *Harv. Phyc. Brit. t.* clv.

On mud-covered rocks in bays and estuaries, and on *Zostera*, &c. Annual. Summer and Autumn. Very local. Hitherto only found, in Britain, in the neighbourhood of Plymouth, but there abundant.—*Tufts* dense, 4—8—10 inches long, rigid below, very flaccid, and bright purple above. *Filaments* much branched, dichotomous, clearly articulated to the base. A distinct and beautiful species, and widely dispersed. It is abundant on the shores of France and Spain, in the Adriatic, and on the east coast of North America, in several places.

*** *Frond articulated throughout; primary tubes from eight to twenty.*

17. P. *obscura*, Ag.; tufts of small size, densely matted together; filaments creeping, throwing up erect, simple, secund branches, which are either naked or furnished with a few secund ramuli; articulations as long as broad, many tubed; siphons 12—13. *Ag. Sp. Alg. vol. 2, p.* 108; *Harv. Phyc. Brit. t.* cii. *A.*

On rocks, &c. at half-tide level. Jersey, *Miss White*. Sidmouth, *Rev. R. Cresswell*.—*Plant* spreading over the surface of rocks, in patches of six inches to a foot in diameter, covering the roots of *fuci*, &c. *Filaments* decumbent, attached by rootlets which issue from the lower surface, subsimple, furnished, along the upper surface, with erect, recurved branches, from a quarter to half an inch in length. *Articulations* visible in all parts of the frond. *Colour* a dark brown-red.

18. P. *simulans*, Harv.; filaments slender, bushy, branched from the base; branches alternate, patent, repeatedly (but irregularly) pinnate; the penultimate branches long and simple, set with short, distant, spine-like ramuli; articulations of the branches once and half as long as broad, of the ramuli shorter, many tubed; siphons about twelve; ceramidia globose. *Harv. Phyc. Brit. t.* cclxxviii. *P. spinulosa, of Herbaria, not of Grev.*

On rocks, &c., between tide-marks. Annual? Summer. Rare. Torquay, *Mrs. Griffiths*, 1831. Valentia, Kerry, *W. H. H.*, 1845. Orkney, *Rev. J. H. Pollexfen*. Jersey, *Miss White* and *Miss Turner*.—"*Colour* reddish. *Substance* stiff and brittle. *Stems* set with spines irregularly, which hold the plant together, so that it is difficult to disentangle." *Mrs. Griffiths*. The ceramidia are nearly spherical, with a wide mouth. This has the habit of *P. spinulosa*, with which it has been hitherto confounded, but it is really much more nearly related to *P. nigrescens*. It is, however, a smaller and more slender plant, more irregularly branched, and with much fewer siphons in the stem. Some of *Miss Turner's* specimens are closely pinnated, and have something the aspect of *Sphacelaria cirrhosa*; but usually the main branches are distant, and irregularly set.

19. P. *nigrescens*, Huds.; filaments robust, rigid, and generally rough with broken branches below, much branched

and bushy above; branches alternate, repeatedly divided in a pinnate manner; ramuli distant, elongated, awl-shaped, alternate, the upper ones sometimes having a few processes near the tips; lower articulations short; upper rather longer than broad; siphons about twenty; capsules ovate, sessile. *Harv. in Hook. Br. Fl.* ii. *p.* 332; *Harv. Phyc. Brit. t.* cclxxvii.; *Wyatt, Alg. Danm. No.* 135. *Conf. fucoides and Conf. nigrescens, E. Bot. t.* 1743 *and* 1717. *P. atro-purpurea, Moore.*

On rocks, &c. in the sea. Common. Perennial. Summer.—*Fronds* tufted, 6—8 inches high. *Stems* below rigid, subsimple, and either naked or rough with the remains of broken branches; above more or less soft and flaccid, much branched and bushy, the branches short or long, erect or spreading, repeatedly divided in a somewhat pinnate manner, the different series of ramuli gradually more slender; ramuli alternate, 2 or 3 lines long, erecto-patent, distant, the uppermost occasionally crowded, subulate, mostly simple. *Capsules* ovate, with a narrow aperture; *granules* ternate in the ultimate ramuli. *Colour* a dull brown, becoming darker in drying. Mrs. Griffiths finds an extraordinary plant at Larderham, Torbay, which, for the present, I consider a variety of this species. It is distichously branched, about triply pinnate, with the pinnæ and pinnulæ extremely patent, almost horizontal. The colour, when fresh, was "a pale straw," but becomes brownish when dried; the substance "stiff, and when recent resembled that of a *Sertularia;* the branches compressed." *Mrs. Griffiths. P. nigrescens* varies considerably in size, and in the comparative rigidity and greater or less division of the branchlets. I cannot distinguish *P. atropurpurea* from one of its common states.

20. P. *affinis*, Moore; filaments robust, elongated, cartilaginous below, flaccid above, irregularly divided; branches patent, naked at base, multifid and with an ovate outline above; ramuli very erect, simple or divided, acute; articulations multi-striate, the lower 2 or 3 times longer, the upper as long as broad; siphons about sixteen; ceramidia ovate, stalked. *Moore, in Ord. Surv. Londonderry, with a plate.*

On rocks, &c. in the sea. Carnlough, near Glenarm, *Dr. Drummond.* Cushendall, *Mr. Moore.*—*Fronds* 4—8 inches high, as thick as bristles, either divided in an irregular or subdichotomous manner, into a few principal branches, or alternately branched; branches patent, naked at base, multifid and with a fan-like outline above, the lesser branchlets all naked at base, furnished above with a few alternate or secund ramuli, very erect, the lowest longest, the apices somewhat fastigiate or corymbose, contracted at base, acute. *Substance* of the stem cartilaginous, adhering to paper; of the ramuli flaccid. *Articulations* of the stem 2 or 3 times longer; of ramuli as long as broad: those of the stem sometimes obscure. *Capsules* ovate or subglobose, stalked; *granules* large, in the ultimate ramuli. Described from *Mr. Moore's* specimens.

21. P. *subulifera*, Ag.; stems flexuous, cartilaginous, flaccid, irregularly branched; branches divaricating, furnished

with scattered, subulate, simple, patent ramuli; articulations as long as broad, multi-striate; siphons about thirteen. *Harv. in Hook. Journ. Bot. p.* 301; *Wyatt, Alg. Danm. No.* 178; *Harv. Phyc. Brit. t.* ccxxvii. *Hutchinsia subulifera, Ag. Sp. Alg.* ii. *p.* 97.—β. *Templetoni*; more slender, the joints 2 or 3 times longer than broad.

In deep water; very local. Annual. Summer. Torquay, *Mrs. Griffiths.* Weymouth, between tide-marks, *Miss White.* β. Belfast Bay, *Mr. Templeton* and *Mr. W. Thompson.* Carrickfergus and Roundstone Bay, *Mr. Mc'Calla.*—*Filaments* 4 or 5 inches long, as thick as hogs' bristles, attenuated upwards, subdichotomous or irregularly branched; branches divaricating, flexuous, long, subdivided, beset at distances of 1 or 2 lines with very short, scattered, spine-like, patent, acute, simple, or rarely subpinnated ramuli, the pinnulæ extremely short. *Articulations* of the branches as long as broad, 4—6 striate, the striæ straight and slender; of the ramuli shorter than broad; dissepiments opaque. *Substance* tender and flaccid. *Colour* purplish. β. which I find among the late Mr. Templeton's plants under the name of *Conf. spinifera*, and which I have also received from *Mr. Thompson*, differs from the Devonshire specimens in being more slender, the ramuli shorter, more patent and spine-like, with the joints 2 or 3 times longer than broad in the main stems, but variable in this respect. Mr. Thompson's specimens are more robust, and have shorter joints than Mr. Templeton's, thus approaching the Devonshire plant. Nearly related to the following, but with a more patent branching.

22. P. *atro-rubescens*, Dillw.; filaments sparingly or much branched, somewhat rigid, dark brownish-red; branches long, alternate, very erect, furnished with short, sub-fasciculate or scattered, subulate ramuli; articulations variable; the lower, 2 or 3 times,—the upper, once and a half as long as broad, marked with several spirally curved tubes; siphons about thirteen; ceramidia ovate, stalked or sessile. *Harv. in Hook. Br. Fl.* ii. *p.* 331; *Harv. Phyc. Brit. t.* clxxii. *Conf. atro-rubescens, Dillw. t.* 70. *Conf. nigra, E. Bot. t.* 2340. *P. Agardhiana, Grev. Crypt. t.* 210, *and Harv. l. c.*; *Wyatt, Alg. Danm. No.* 134. *Also P. badia and P. denudata, Grev. and Harv. l. c.*

On rocks in the sea; not uncommon. Perennial. Summer and autumn.—*Stems* densely tufted, or covering the rocks in wide patches, 2—6 inches high, thicker than horsehair, sub-simple, more or less furnished with long, alternate, erect, simple branches, which sometimes bear a second series, and are in greater or less abundance clothed with short, subulate, or spindle-shaped, erect ramuli. The joints vary considerably in length, but seldom exceed thrice their diameter. The *tubes* are very frequently, but not constantly, spirally curved. *Colour* deep red or brownish, becoming blackish in drying. *Substance* rigid, not adhering or but slightly to paper. *Capsules* with a very wide aperture, subglobose. With consent of Dr. Greville and Mrs. Griffiths, I gladly unite *P. Agardhiana*, *badia* and *denudata*, with the present species.

23. P. *furcellata*, Ag.; filaments elongated, tufted, entangled, flexuous, repeatedly and closely dichotomous; axils broad, rounded; ramuli erect, their points hooked in; middle articulations 3—5 times longer than broad; tubes about eight. *Harv. in Hook. Br. Fl.* ii. *p.* 332; *Harv. Phyc. Brit. t.* vii. *Hutchinsia furcellata, Ag. Sp. Alg.* ii. *p.* 91.

Floating in the sea, at Sidmouth; *Mrs. Griffiths* and *Miss Cutler.* Dredged in Torbay, *Mrs. Griffiths.* Carrickfergus, *Mr. M'Calla.* Roundstone, *W. H. H.*—*Filaments* slender, 5 or 6 inches long, much entangled, and excessively branched, flexuous, the divisions dichotomous, very close towards the extremities. *Articulations* with several slender striæ, which sometimes cross each other, variable in length; those of the larger branches 3—5 times, of the ramuli about twice as long as broad. *Colour*, when recent, "a bright brick-red" (*Mrs. Griffiths*), changing in the herbarium to a deep umber-brown. *Substance*, according to the same lady, "at first firm, but becoming flaccid immediately." *Capsules* unknown. A most distinct and beautiful species.

24. P. *fastigiata*, Roth.; filaments rigid, setaceous, of equal diameter throughout, forming globular tufts, many times dichotomous; axils patent; articulations shorter than their diameter, multi-striate; siphons sixteen to eighteen. *Hook. Br. Fl.* ii. *p.* 333; *Wyatt, Alg. Danm. No.* 177. *Conf. polymorpha, E. Bot. t.* 1764.

Parasitical on *Fucus nodosus* and *vesiculosus*, especially the former; very common.—*Filaments* 2—4 inches long, rigid, forming globose, dense, bushy tufts of a brown or yellowish colour. The above characters abundantly distinguish this from every other species.

25. P. *parasitica*, Huds.; slender, rigid, full-red, alternately branched, distichous; branches bi-tripinnate; pinnæ alternate, erect, awl-shaped; articulations about as long as broad, three-tubed; siphons eight; ceramidia ovate, on short stalks. *Hook. Br. Fl.* ii. *p.* 330; *Harv. Phyc. Brit. t.* cxlvii.; *Wyatt, Alg. Danm. No.* 175. *Conf. parasitica, E. Bot. t.* 1429.

On the larger Algæ, and (more frequently) on nullipores at the extreme limit of low-water, not uncommon on many of our coasts, but nowhere very abundant.—*Stems* half an inch to an inch and a half high, somewhat compressed, rigid, simple, distichously branched; branches alternate, short below, longer above, from two lines to three-fourths of an inch long, pinnated or bipinnated with awl-shaped, simple, acute, erecto-patent ramuli. *Articulations* of the branches about as long as broad, of the ramuli much shorter, marked with 3 or 4 broad tubes, with wide, transparent intervals. *Substance* cartilaginous, imperfectly adhering to paper. *Colour* rose-red, becoming brownish when dried.

26. P. *byssoides*, Good. and Woodw.; stems rigid, setaceous, cartilaginous, alternately or distichously branched;

decomposito-pinnate, patent; more or less densely clothed with minute, slender, dichotomous, single-tubed, byssoid ramuli; joints of the stem variable in length, 3 or 4 striate; the striæ parallel. *Harv. in Hook. Br. Fl.* ii. *p.* 334; *Wyatt, Alg. Danm. No.* 85; *Harv. Phyc. Brit. t.* cclxxxiv. *Conf. byssoides, E. Bot. t.* 547.

On rocks, &c., in the sea. Annual. Summer. Abundant on the eastern and southern shores of England and Ireland; rare in Scotland and the west of Ireland. Frith of Forth, *Dr. Richardson.* Ayrshire, *Mr. W. Thompson.* Bantry, *Miss Hutchins.* Malbay.—*Frond* 4—12 inches long; *stem* undivided, branched in a pinnate or bi-tripinnate manner; branches simple, attenuated, the lower ones longest, gradually diminishing upwards; the lesser divisions more or less densely clothed with slender, single tubed, once or twice forked, spreading, byssoid fibres or ramuli, which give the frond a beautifully feathery appearance. *Substance* sometimes rigid, and the byssoid ramuli squarrose; sometimes soft and flaccid. *Capsules* ovate, generally solitary. *Colour* a fine, clear red, which quickly becomes brown, on exposure to the air, or in drying.

VI. Dasya. Ag. [Plate 12, B.]

Frond filamentous; the stem and branches mostly opaque, irregularly cellular (rarely pellucid, longitudinally tubed), composed internally of numerous parallel tubes surrounding a central cavity; the ramuli jointed, single-tubed. *Fructification* twofold, on distinct plants; 1, *ceramidia,* containing a tuft of pear-shaped spores; 2, lanceolate *pods* (*stichidia*), containing *tetraspores* ranged in transverse bands.—Name, from δασυς, *hairy.*

1. D. *coccinea,* Huds.; stems robust, hairy, distichously branched; branches bipinnate; pinnulæ multifid, their articulations as long as broad. *Hook. Br. Fl.* ii. *p.* 335; *Wyatt, Alg. Danm. No.* 41; *Harv. Phyc. Brit. t.* ccliii. *Conf. coccinea, E. Bot. t.* 1055.—β. *tenuior*; more slender in all its parts. *Dillw.*—γ. *denudata;* branches naked, ramuli squarrose, minute, sub-simple. *Ceramium patens, Grev. Crypt. t.* 261.

On rocks, &c., near low-water mark. β. and γ. dredged in 4—15 fathom water. Annual. Summer. — *Stems* 6—8 inches high, as thick as small twine, rough with minute, hair-like fibres, a quarter of a line in length, generally undivided, set with alternate, distichous, bipinnated branches, which gradually become shorter upwards; pinnulæ multifid. Stem and branches inarticulate, the lesser pinnæ imperfectly jointed, composed of several tubes; ultimate ramuli subulate, acute, single-tubed, jointed, the joints short. *Capsules* at the base of the ramuli, ovate, slightly acuminate, containing a round mass of unequal spores. *Stichidia* oblong-acuminate, containing one or two rows of tetraspores. *Colour* a fine crimson, becoming scarlet. *Substance* cartilaginous, imperfectly adhering to paper.

2. D. *ocellata*, Gratel.; stems sub-simple, beset on all sides with long, erecto-patent, dichotomous, pencilled ramuli; articulations three or four times longer than broad; stichidia lanceolate, attenuated, marked with transverse bands of granules. *Harv. in Hook. Br. Fl.* ii. *p.* 335; *Wyatt, Alg. Danm. No.* 179; *Harv. Phyc. Brit. t.* xl. *Ceramium ocellatum, Grateloup. Dasya simpliciuscula, Ag. Sp.* ii. *p.* 122.

On mud-covered rocks near low-water mark, rare. Abundant on the Pier at Torquay, *Mrs. Griffiths.* Whitsand Bay, *Dr. Jacob.* Wicklow, *W. H. H.* Balbriggan, *Miss Gower.* Smerwick Harbour, *Mr. Andrews.*—*Stems* tufted, 1 or 2 inches high, simple or with 3 or 4 branches, setaceous, opaque, inarticulate, striate with veins, densely covered with ramuli, which are specially crowded round the tips of the branches, giving them a strikingly obtuse appearance. *Ramuli* 3—5 lines long, slender, erect, several times forked, the apices elongated. *Joints* of the ramuli long. *Colour* a brownish or bright purple. *Stichidia* lanceolate, acuminate, nearly as long as the ramuli, sessile or shortly stalked, containing dark purple granules, closely set in transverse bands. These receptacles are commonly produced; the *capsules* have not yet been found in this country.

3. D. *Arbuscula*, Dillw.; stems much and irregularly branched, beset on all sides with short, divaricating, dichotomous ramuli, whose articulations are about twice as long as broad; stichidia oblong, with a mucro. *Ag. Sp. Alg.* ii. *p.* 121; *Harv. Phyc. Brit. t.* ccxxiv. *Conf. Arbuscula, Dillw. t. G.* (*excl. syn. Brownii, and Dillw. t.* 85). *D. Hutchinsiæ, Harv. in Hook. Br. Fl.* ii. *p.* 335.

On rocks in the sea. Not uncommon on the shores of Ireland and Scotland. Remarkably fine at Bantry, *Miss Hutchins.*—*Stems* 2—4 inches high, tufted, much branched; branches alternate, bearing a second or third series, and densely clothed with dichotomous, divaricate ramuli, about a line in length, which give the plant a rounded appearaace; tips of the branches blunt. *Colour* generally a pale reddish brown, sometimes deep red; substance flaccid. *Capsules* ovate, with a much-produced, sub-cylindrical point, containing pear-shaped spores. *Receptacles* oblong, suddenly acuminate, or obtuse with a mucro, containing two or three rows of ternate granules. Very distinct from the last in habit and character.

4. D. *venusta*, Harv.; frond pyramidal, decompoundly pinnate; the branches clothed with exceedingly slender, flaccid, many times dichotomous, attenuated ramuli, whose articulations are five or six times as long as broad; stichidia pedicellate, ovoid, much acuminate; ceramidia ovate-urceolate, with a protruding mouth. *Harv. Phyc. Brit. t.* ccxxv.

Cast on shore, in summer. Annual? Very rare. Jersey, *Miss White* and *Miss Turner.*—*Stem* 3—4 inches high, as thick as a hog's bristle, undivided, furnished with numerous alternate, lateral branches, the lowest of which are longest, the rest gradually shorter upwards. *Branches* pinnated with a second or third series. *Stem* bare of ramuli, but all the branches and their divisions clothed with very slender, hair-like, dichotomous, single-tubed ramuli. *Colour* a fine rose-red. *Substance* very flaccid and tender, closely adhering to paper. A beautiful species, with the habit of *Seirospora Griffithsiana*, more than of any British species of Dasya.

Order VIII. LAURENCIACEÆ.*

Laurencieæ, *Hook. fil. and Harv. Lond. Journ. vol.* iv. *p.* 539. Chondrieæ, *J. Ag. Alg. Medit. p.* 67. *Harv. Ner. Austr. p.* 7. Lomentarieæ, *Endl. 3d Suppl. p.* 42. Chondrieæ (partly), Chondrosipheæ, Champieæ, *Kütz. Phyc. Gen. pp.* 435, 438, 439. Lomentareæ, *Lindl. Veg. King. p.* 25.

Diagnosis.—Rose-red or purple sea-weeds, with a cylindrical or compressed, rarely flat, linear, narrow, areolated, inarticulate or constricted and chambered, branching frond, composed of polygonal cells. *Fructification* double: 1, *conceptacles* (*ceramidia*) external, ovate, furnished with a terminal pore, and containing a tuft of pear-shaped spores; 2, *tetraspores* immersed in the branches and ramuli, scattered without order through the surface cells.

Natural Character.—*Root* sometimes a simple disk, but very frequently branching. *Frond* mostly cylindrical, rarely compressed, and still more rarely flattened, destitute of midrib, linear, usually preserving nearly the same breadth throughout, branching; the branches most generally pinnate, sometimes whorled, sometimes tufted, and sometimes (but very rarely) dichotomous. In the typical genera (such as *Laurencia* and *Bonnemaisonia*) the frond is solid, the whole substance composed of polygonal cells closely packed together, and there is no trace of articulation or regularly recurring constriction. But in some genera (as *Chylocladia*, *Champia*,

* This order is usually called *Chondrieæ*, a name objectionable on two grounds. First, the genus *Chondria*, Ag., is suppressed, being synonymous with *Laurencia*, L., the typical genus; and, secondly, the sound *Chondrieæ* or *Chondriaceæ* recalls *Chondrus*, which is a genus belonging to *Cryptonemiaceæ*. I therefore propose a name taken from the original, and most widely dispersed genus of the order.

&c.) the branches are usually hollow, and constricted at regular intervals into joint-like portions, furnished at each constriction with a diaphragm, which divides the cavity into separate chambers: these chambers are filled with mucous matter, through which a few vertical filaments, connecting the diaphragms, are dispersed. In other genera (as *Chrysymenia*) the frond is also hollow and full of mucus, with a few filaments dispersed through it; but in these there are neither constrictions nor diaphragm, but each branch constitutes a chamber. Such genera evidently connect the two extreme forms of the order.

The *ceramidia* are sometimes imperfectly organized, and reduced nearly to the structure of *coccidia*, the pore being indistinct. The contents, however, appear to be constantly pyriform spores, tufted as is normal in this kind of conceptacle. The *tetraspores* are sometimes collected near the tips of the ramuli, but very commonly they are dispersed through the branches in a very indefinite manner. On this dispersion is founded the chief technical character by which the order is distinguished from *Rhodomelaceæ*, but in habit there is between the two groups that difference which marks a natural family.

The colours of the *Laurenciaceæ* are often fugacious. In *Laurencia* itself, the prevalent colours are shades of purple, but in most other plants of the order they are pink or lake-red. When exposed to sunshine all become yellowish, and most lose their colour in fresh water. None turn black in drying.

The genera of this order, and many of the species, are remarkable for their wide dispersion, the same forms inhabiting the most distant countries. Thus, all of our *Laurenciæ* are natives also of the Southern Ocean; and *L. pinnatifida* is equally common in the Pacific and Atlantic basins, in both temperate and tropical climates.

SYNOPSIS OF THE BRITISH GENERA.

I. Bonnemaisonia. *Frond* solid, filiform, (rose-red), much branched; the branches margined with subulate, distichous cilia. [Plate 12, B.]

II. Laurencia. *Frond* solid, cylindrical or compressed, (purplish or yellowish), pinnatifid; the ramuli blunt. [Plate 12, C.]

III. CHRYSYMENIA. *Frond* hollow, filled with watery mucus, neither constricted nor chambered. [Plate 13, A.]

IV. CHYLOCLADIA. *Branches* hollow, filled with watery mucus, constricted at intervals, and chambered. [Plate 13, B.]

I. BONNEMAISONIA. Ag. [Plate 12, D.]

Frond filiform, inarticulate, compressed or plane, solid, much branched, the branches margined with distichous, awl-shaped, alternate cilia. *Fructification: ceramidia*, containing a tuft of pear-shaped spores. *Tetraspores* unknown.—Name, in honour of *M. Bonnemaison*, a French naturalist.

1. B. *asparagoides*, Woodw.; frond compressed or sub-terete; ceramidia stalked, opposite the cilia. *Grev. Alg. Brit. p.* 106, *t.* 13; *Hook. Br. Fl.* ii. *p.* 295; *Harv. Phyc. Brit. t.* li. *Fucus asparagoides*, *E. Bot. t.* 571. — *β. teres*; frond capillary, terete, cilia very long.

On rocks near low-water mark, and at a greater depth. Annual. Summer. β. at Wicklow, and in Kingstown Harbour, Dublin.—*Frond* 4—12 inches long, compressed or nearly cylindrical, varying in breadth from a capillary fineness to nearly a line, excessively branched; branches distichous, alternate, simple, or bearing a second series, gradually shorter upwards, set throughout at short distances with subulate, distichous ramuli, 1 or 2 lines long and extremely slender. *Capsules* ovate, with a short stalk, placed opposite to the cilia, containing a tuft of pear-shaped spores. Frequently the capsules are abortive, and then a minute process occupies their place. In a specimen communicated by *Mrs. Wyatt*, the place of capsules is occupied by a tuft of ramuli, which do not, however, produce *tetraspores*, but occasionally one of them, thicker than the rest, bears a capsule. *Colour*, a fine transparent crimson, darker in those from the west of Ireland, and in them becoming darker in drying, while in those from the east of Ireland and south of England the colour fades considerably in drying. *Substance* soft and flaccid.

II. LAURENCIA. Lamour. [Plate 12, C.]

Frond cylindrical or compressed, linear, pinnately branched, the apices obtuse; structure cellular, solid. *Fructification* of two kinds, on distinct individuals; 1, *ceramidia*, containing a tuft of pear-shaped spores; 2, triparted *tetraspores*, imbedded in the ramuli.—Name, in honour of *M. de la Laurencie*, a French naturalist.

1. L. *pinnatifida*, Gm.; frond compressed, cartilaginous, bi-tripinnatifid, divisions alternate, the ultimate ones obtuse, simple or lobed. *Grev. Alg. Brit. p.* 108, *t.* 14; *Hook. Br. Fl.* ii. *p.* 296; *Wyatt, Alg. Danm. No.* 113; *Harv. Phyc. Brit. t.* lv. *Fucus pinnatifidus, E. Bot. t.* 1202.—β. *Osmunda;* frond flat, generally undivided, ramuli short and multifid. *Hook. l. c.*—γ. *tenuissima;* frond flat, ramuli very thin and much branched, the branches divaricated. *Hook. l. c.*

On rocks, between tide-marks. Annual. June to September. α. and β. very common: γ. Devon and Cornwall, *Mrs. Griffiths.*—*Fronds* tufted, 1—12 inches high, compressed or subcylindrical, from half a line to 2 lines in breadth, alternately branched, the branches pinnatifid or bipinnatifid. *Substance* cartilaginous. *Colour* varying from a yellowish green to a dull purple or brownish red. *Capsules* broadly ovate, placed on the smaller branches; *tetraspores* imbedded in the ramuli. An extremely variable plant in size and general appearance. The taste is often hot and biting, whence it has obtained the name of *Pepper-dulse* in Scotland.

2. L. *cæspitosa*, Lamour.; frond cylindrical or sub-compressed, narrow, repeatedly pinnate, pyramidal; main branches often opposite, erecto-patent; ramuli irregularly scattered, distichous or spreading on all sides, often crowded, erect, slightly tapering to the base, truncate. *Mont. in Pl. Canar. p.* 154; *Harv. Phyc. Brit. t.* cclxxxvi. *L. hybrida, Lenorm. L. pinnatifida,* γ. *angusta, Hook. Br. Fl.*; *Wyatt, Alg. Danm. No.* 162.

On stones, &c., within tide-marks. Annual. Summer. Common.—*Fronds* 2—8 inches high, as thick as small twine, cylindrical or the main divisions slightly compressed, somewhat bare below, much branched above, with a pyramidal outline. *Branches* once or twice pinnate, erect or erecto-patent, irregularly set. *Ramuli* very irregular, often much crowded, simple or multifid, terete, tapering to the base and truncate. *Colour* either a very dark lurid purple, or (under the effects of sunlight) greenish yellow. Almost intermediate between the preceding and following; more cylindrical and narrower than *L. pinnatifida;* and very different in colour and in general habit from *L. obtusa.*

3. L. *obtusa*, Huds.; frond cylindrical, filiform, twice or thrice pinnate; ramuli mostly opposite, short, patent, wedge-shaped, obtuse. *Grev. Alg. Brit. p.* 111; *Hook. Br. Fl.* ii. *p.* 296; *Wyatt, Alg. Danm. No.* 21; *Harv. Phyc. Brit. t.* cxlviii. *Fucus obtusus, E. Bot. t.* 1201.

On the larger Algæ. Annual. Summer and autumn. Shores of England and Ireland, frequent. Rare in Scotland.—*Root* somewhat fibrous. *Fronds* generally tufted, 3—6 inches long, about half a line in diameter, cylindrical, filiform, repeatedly branched in a pinnate manner, the branches and ramuli mostly opposite, the latter 1 or 2 lines long, obtuse or truncate, somewhat narrowed at base, or nearly cylindrical. *Substance* tender and flaccid, soon decomposing. *Colour* a fine but fugitive pink, becoming yellowish and whitish in decay. *Ceramidia* ovate, on the smaller branches; *granules* ternate, immersed in the ramuli.

4. L. *dasyphylla*, Woodw.; frond filiform, terete, irregularly branched; ramuli short, club-shaped, obtuse, very much attenuate at base. *Grev. Alg. Brit. p.* 112; *Hook. Br. Fl.* ii. *p.* 296; *Wyatt, Alg. Danm. No.* 71; *Harv. Phyc. Brit. t.* clii. *Fucus dasyphyllus, E. Bot. t.* 847.

On rocks or stones between tide-marks. Annual. Summer. Frequent on the shores of England and Ireland.—*Root* fibrous. *Fronds* 4—12 inches high, cylindrical, half a line in diameter; *stem* generally undivided, set with more or less frequent opposite or alternate branches, the lower ones being longest, and frequently bearing a second series; all having numerous, linear club-shaped, obtuse ramuli, 1 or 2 lines in length, and very much attenuate at base, resembling the leaves of a *Sedum*: the whole frond marked, at short distances, with more or less distinct transverse striæ. *Substance* somewhat gelatinous, quickly decomposing. *Colour* a pale fugitive pink, or yellowish. *Ceramidia* ovate, on the lesser branches: *granules* ternate in the ramuli. Readily distinguished from the preceding by the ramuli tapering towards the base, and from the following by their being obtuse.

5. L. *tenuissima*, Good. and Woodw.; frond filiform, terete, irregularly branched; ramuli very slender, tapering to the base and apex. *Grev. Alg. Brit. p.* 113; *Hook. Br. Fl.* ii. *p.* 296; *Wyatt, Alg. Danm. No.* 22; *Harv. Phyc. Brit. t.* cxcviii. *Fucus tenuissimus, E. Bot. t.* 1882.

Between tide-marks, on rocks and other Algæ; very rare. Annual. Summer and autumn. Weymouth, *Goodenough* and *Woodward*. Isle of Wight, *Rev. G. R. Leathes*. Torquay, *Mrs. Griffiths*. Cornwall, *E. Bot.* Ballycotton, coast of Cork, *Miss Ball*.—*Root* fibrous. *Fronds* tufted, 6—8 inches long, half a line in diameter, cylindrical, much branched in an irregularly pinnate manner; the main stem generally undivided, having numerous, alternate, spreading branches, of unequal length, some of the longest bearing a second series; and all set, at the distance of one or two lines, with slender, bristle-like ramuli, 1—4 lines long, much attenuated at their insertion, and more or less tapering towards the point. *Substance* very tender, between gelatinous and cartilaginous. *Colour* a pale purplish or pinky red, fugitive, and becoming yellowish. *Ceramidia* ovate, borne by the ramuli, in which also the tetraspores are imbedded.

III. CHRYSYMENIA. J. Ag. [Plate 13, A.]

Frond tubular, continuous (not constricted or jointed), filled with a watery juice, and traversed by a few longitudinal filaments; its walls composed of several rows of cells, the innermost of which are distended and much elongated, the outer gradually smaller, and the superficial ones very minute. *Fructification*: 1, *ceramidia*, containing a very dense tuft of angular spores; 2, triparted *tetraspores*, immersed in the ramuli.—Name, from χρυσεος, *golden*, and υμην, a *membrane;* because the species assume golden tints if steeped for some time in fresh water.

1. C. *clavellosa*, Turn.; frond gelatinous, much branched in a pinnate manner, mostly distichous; ultimate ramuli lanceolate, distichous, or quadrifarious, attenuated at base; ceramidia conical. *Grev. Alg. Brit. p.* 115; *Hook. Br. Fl.* ii. *p.* 297; *Wyatt, Alg. Danm. No.* 23; *Harv. Phyc. Brit. t.* cxiv. *Fucus clavellosus, E. Bot. t.* 1283.—β. *sedifolius;* ramuli between oblong and oval, crowded, undivided. *Turn.*

On stones, between tide-marks. Annual. May to September. Various stations on the coasts of England, Scotland and Ireland, but nowhere very common. β. at Lossiemouth, *Mr. Brodie.*—*Fronds* tufted or solitary, 3—12 inches high, varying from a quarter of a line to more than a line in diameter, gradually widening from the base to the middle, and thence diminishing to the apex, much branched, repeatedly but irregularly pinnate, the branches patent, opposite or alternate, bearing one or more series of linear-lanceolate ramuli, 1—4 lines in length, and closely set; they, as well as the branches, usually distichous, but sometimes springing from all sides of the frond. *Ceramidia* conical, with a pore, containing a tuft of angular spores; *tetraspores* imbedded in the ramuli. *Substance* flaccid and slippery, closely adhering to paper. *Colour* a brilliant pink.

2. C. *Orcadensis*, Harv.; frond distichous, pinnate, the main stem and the pinnæ elliptic-oblong, compressed; pinnæ opposite.

At Skaill, Orkney, *Miss Watt.* The specimens yet seen of this supposed species are insufficient to establish its characters fully, but I am unwilling to omit altogether the recording of so remarkable a plant. My specimen, for which I am indebted to the *Rev. J. H. Pollexfen*, is evidently in a very young state. It is about an inch high; each frond elliptic oblong, fully a quarter of an inch broad, bearing three or four distant pairs of pinnæ, of similar form, but smaller dimensions. The colour is a clear pinky red. The parts of the frond are proportionally very much broader than in any state of *C. clavellosa* which I have seen; but in the absence of full-grown specimens I can form no judgment as to the validity of the species.

IV. Chylocladia. Grev. [Plate 13, B.]

Frond (at least the branches) tubular, constricted at regular intervals, and divided, by internal diaphragms, into chambers, filled with a watery juice and traversed by a few longitudinal filaments; periphery composed of small polygonal cells. *Fructification:* 1, spherical, ovate or conical *ceramidia*, containing a tuft of wedge-shaped spores; 2, tripartite *tetraspores*, immersed in the smaller branches and ramuli.—Name χυλος, *juice*, and κλαδος, a *branch*.

1. C. *ovalis*, Huds.; frond filiform, irregularly dichotomous, naked below, above beset with elliptical, simple (rarely elongated and constricted) ramuli, tapering at the base; capsules spherical. *Grev. Alg. Brit. p.* 116, *t.* 14; *Hook. Br. Fl.* ii. *p.* 297; *Wyatt, Alg. Danm. No.* 114; *Harv. Phyc. Brit. t.* cxviii. *Fucus ovalis, E. Bot. t.* 711.

In the sea, on rocks and Algæ. Annual. June to August. Frequent on the shores of England and Ireland. Little Isles of Jura, Papa Westra, *Lightfoot.*—*Fronds* tufted, 2—10 inches high, cylindrical, from half a line to a line in diameter, irregularly and somewhat distantly dichotomous, naked below; branches above more or less densely set with elliptical or lanceolate, clustered or scattered ramuli, 1—4 lines long, half a line to a line in diameter, much attenuated at base, either obtuse or somewhat tapering at apex, and either simple, or contracted at intervals as if jointed. *Substance* cartilaginous in the stem; tender in the ramuli, which are filled with a laxly gelatinous fluid. *Capsules* globose, with a pellucid limbus sessile on the ramuli; *tetraspores* imbedded in the ramuli.

2. C. *kaliformis*, Good. and Woodw.; frond sub-gelatinous, tubular, distantly constricted as if jointed, repeatedly pinnate; branches whorled at the constrictions with chain-like ramuli; capsules spherical, with a pellucid border. *Grev. Alg. Brit. p.* 117; *Hook. Br. Fl.* ii. *p.* 298; *Wyatt, Alg. Danm. No.* 24; *Harv. Phyc. Brit. t.* cxlv. *Fucus kaliformis, E. Bot. t.* 640.

In the sea, on rocks and other Algæ. Annual. June to September. Frequent on the coasts of England, Scotland and Ireland.—*Fronds* tufted, 4—12 or even 18 inches long, 1 or 2 lines in diameter; stem undivided, attenuated at each extremity, and contracted at intervals of half an inch or more. From the contractions spring long, simple, primary branches, similar to the stem, but more slender and more regularly contracted, opposite or in whorls, patent, and bearing at their contractions one or more series of lesser branches and ramuli, all of which taper at each end, and are more or less distinctly contracted, the contractions of the ramuli being very close together. *Substance* tender and gelatinous. *Colour* a fugitive pink or purplish red. *Capsules* spherical, placed on the young branches; *tetraspores* in the ramuli.

3. C. *reflexa*, Chauv.; frond membranaceous, purple; lower branches cylindrical, slender, arched, attaching themselves by short rooting processes; secondary branches simple, mostly secund, moniliform, spindle-shaped; ramuli few, scattered, patent or recurved. *Harv. Phyc. Brit. t.* xlii.

On rocks, near low-water mark. Annual. Summer. Very rare. Hagington, near Ilfracombe, *Miss Amelia Griffiths.*—*Frond* 2—3 inches high, branching irregularly from the base; the lower branches cylindrical, forming successive arcs, attached at intervals to other Algæ by short rootlets tipped with disks. Secondary branches spring from the arched ones, either two or three from one point, or else they are solitary and secund: these are regularly constricted into articulations about once and a half as long as broad. Nearly related to *C. kaliformis*, from which it is chiefly distinguished by its creeping habit and small size. The Irish station given in *Phyc. Brit.* is incorrect.

4. C. *parvula*. Ag.; frond sub-gelatinous, slender, branched in a straggling, sub-dichotomous manner; branches constricted at intervals of equal length and breadth; capsules ovate. *Grev. Alg. Brit. p.* 119; *Hook. Br. Fl.* ii. *p.* 298; *Wyatt, Alg. Danm. No.* 72; *Harv. Phyc. Brit. t.* ccx. *Chondria parvula, Grev. Crypt. t.* 346.

Parasitical on the smaller Algæ. Annual. Summer and autumn. Not uncommon.—*Fronds* rising from a mass of fibres, densely tufted, 2 or 3 inches long, half a line in diameter, excessively branched and entangled; branches irregular, opposite or alternate, of various lengths, with or without scattered ramuli, which are slightly attenuated at base; the tips obtuse; the whole frond marked, at distances of nearly equal length and breadth, with external constrictions, and furnished with internal septa. *Capsules* ovate, borne on the smaller branches, and containing a spherical mass of ovate seeds; *tetraspores* in the articulations of the branches. *Substance* soft and somewhat gelatinous. *Colour* a fine, but fugitive, pinky red. Well distinguished from *C. kaliformis* by the ramification, the uniformly short articulations, and the shape of the conceptacles.

5. C. *articulata*, Huds.; frond tubular, gelatinoso-membranaceous, strongly constricted throughout, as if jointed, much branched in a fasciculato-dichotomous manner; capsules obtusely conical. *Grev. Alg. Brit. p.* 120; *Hook. Br. Fl.* ii. *p.* 298; *Wyatt, Alg. Danm. No.* 73; *Harv. Phyc. Brit. t.* cclxxxiii. *Fucus articulatus, E. Bot. t.* 1574.

Between tide-marks, on rocks and the larger Algæ. Annual. Summer. *Fronds* springing from a mass of fibres, tufted, 1—6, or occasionally 12 inches long, excessively branched and bushy, constricted at regular intervals of 2—4 lines, irregularly divided; main stem somewhat dichotomous, bearing at its constrictions whorls of branches, which again divide dichotomously, and bear from their joints opposite or whorled, lanceolate ramuli. The tips of the branches are somewhat fastigiate and the plant has a rounded outline. *Capsules* conical; *tetraspores* in the joints of the ramuli. *Colour* a fine pinky red, less fugitive than in others of the genus. *Substance* membranaceous, filled with watery gelatine.

Order IX. CORALLINACEÆ.

Corallineæ, *Lamour. Cor. Class, p.* 244; *Dne. Class. p.* 63; *Endl.* 3d *Suppl. p.* 48; *Harv. Ner. Austr. ined.*; *Lindl. Veg. King. p.* 25. Corallineæ and Spongiteæ, *Kütz. Phyc. Gen. pp.* 387, 385. Corallinidæ and Nulliporidæ, *Johnst. Brit. Lith. p.* 205, &c.

Diagnosis.—Rigid, articulated or crustaceous, mostly calcareous sea-weeds, purple when recent, fading on exposure to milk-white, composed of closely packed, elongated cells or filaments, in which carbonate of lime is deposited in an organized form. *Tetraspores* tufted, contained in ovate or spherical *conceptacles* (*ceramidia*) furnished with a terminal pore.

Natural Character.—*Root*, where this organ is manifested, an expanded, crustaceous disk, often spreading widely. *Frond* almost always calcareous, effervescing strongly when thrown into acids, rarely destitute of lime, very variable in aspect and habit. The lowest forms of the order are simple incrustations, spreading, like the crustaceous lichens, over the surface of rocks or the fronds of the larger Algæ. In the smaller of these the crust is a mere film, as thin as paper, generally circular, and extending by means of small additions to the circumference; so that the frond becomes marked, as it advances, with concentric circles. In the larger, the crust is thick and stony, rising here and there into prominences, and sinking in depressions. Still further advance manifests itself by the crust assuming a branching habit; at first, papillæ rise from the surface; these thicken, and widen and lengthen, and at length throw out branches, till a shrubby frond, of stony hardness, but extremely brittle, is formed. All these changes in character take place within the limits of a single genus, *Melobesia*. Nearly related to this (and by many botanists considered identical) is *Mastophora*, a genus in which the frond is expanded into leafy lobes, usually fan-shaped, sessile or stalked, but not adnate to rocks, of a flexible substance, containing a smaller portion of carbonate of lime than in the former group. Some of these have the habit of *Padina*, but differs from that genus in being of a red colour. They are the most perfectly-organized of the leafy or frondose Corallines (*Nulliporeæ*).—The articulated, or true

Corallines, are filiform, either pinnated, or dichotomous, the branches formed of strings of calcareous articulations, truncated at the upper extremity and rounded at the lower, each articulation connected with that above and below it by a flexible joint, composed of cellular tissue, destitute of carbonate of lime. This joint in our British species is scarcely obvious till after maceration, but in many exotic species (of *Amphiroa*) it is so long as to interrupt the continuity of the articulations, and is either naked, or coated with wart-like, calcareous tubercles. The form of the articulations varies extremely, and often in the same species, or even in the same specimen, so that the determination of these plants is sometimes difficult. In many the articulations are cylindrical; in others oval and compressed; in some flat and irregularly shaped; but in the greater number they are heart-shaped or wedge-shaped, with the upper angles frequently prolonged with horns.

The fructification consists of hollow, external or immersed conceptacles, containing a tuft of oblong spores, divided at maturity, by three horizontal fissures, into four parts. They are therefore *tetraspores;* precisely similar to those of *Plocamium*, *Hypnea*, &c. The nature of the conceptacle varies, even in the same species. Thus, in *Corallina*, it is normally formed by the metamorphosis of the terminal articulation of the branches, which swells at the sides and becomes pierced at the apex. But in *C. squamata*, and even in *C. officinalis*, other articulations frequently bear numerous small, hemispherical conceptacles on their sides; and sometimes the whole surface is warted with such; and these irregular organs are equally furnished with tetraspores as the normal ones. These latter conceptacles, which are irregular in *Corallina*, are the normal fruit of *Amphiroa*, a genus chiefly from the Southern Ocean. In *Jania* the conceptacle is similar to that of *Corallina*, except that it generally bears a pair of ramuli (resembling the antennæ of an insect) from its upper angles.

The Corallines are found in all parts of the Ocean, but are much more numerous in warm than in cold countries, and some of the species of the tropical and sub-tropical ocean are among the most beautiful of marine vegetables. Until recently the plants of this order were, with other calcareous Algæ, confounded with the zoophytes, or polypiferous corals. They are, however, undoubtedly, of vegetable nature; and when the lime which they contain is removed by acid, the vegetable framework, concealed beneath it, is found to be of a similar structure to that of other Rhodosperms, to which group of Algæ they are further allied by their colour and the nature of their spores.

The Order consists of two, or, if Lithocystis be rightly placed in it, of three sub-orders, as follows :—

SYNOPSIS OF THE BRITISH GENERA.

Suborder 1. CORALLINEÆ. *Frond* filiform, articulated.

I. CORALLINA. (*Frond* pinnated). *Ceramidia* terminal, simple. [Plate 13, C.]

II. JANIA. (*Frond* dichotomous). *Ceramidia* tipped with two horn-like ramuli. [Plate 13, D.]

Suborder 2. NULLIPOREÆ. *Frond* crustaceous or foliaceous, opake, not articulated.

III. MELOBESIA. *Frond* stony, forming either a crustaceous expansion, or a foliaceous, or shrub-like body. [Plate 14, A.]

IV. HILDENBRANDTIA. *Frond* cartilaginous, not stony, forming a crustaceous expansion. [Plate 14, C.]

Suborder 3? LYTHOCYSTEÆ. *Frond* plane, hyaline, composed of cells radiating from a centre. *Fructification* unknown.

V. LYTHOCYSTIS. (*A minute parasite*). [Plate 14, B.]

Suborder 1. CORALLINEÆ. Frond filiform, articulated.

I. CORALLINA. Linn. [Plate 13, C.]

Frond filiform, articulated, branched (mostly pinnate), coated with a calcareous deposit. *Fructification*, turbinate or obovate, mostly terminal *ceramidia*, pierced at the apex by a minute pore, and containing a tuft of erect, pyriform, or club-shaped, transversely parted tetraspores. Name, from *Coralium*, *coral*, which these plants resemble in having a stony substance.

1. C. *officinalis*, Linn.; decompound-pinnate; lower articulations cylindrical, twice as long as broad; upper slightly obconical, round-edged, their upper angles blunt; ultimate ramuli cylindrical, obtuse. *Johnst. Brit. Lith. p.* 216; *Harv. Phyc. Brit. t.* ccxxii.

On rocks, &c. between tide-marks, extending from the limits of high, to the extremity of low-water mark. Perennial. Winter and spring. Very abundant on the British shores.—*Root* a widely-expanded, red crust. *Fronds* 2—6 inches high, tufted, much branched, bi-tripinnate; but varying greatly in luxuriance according to the depth at which it grows. The fructification varies in different specimens; normally the ceramidia are urn-shaped, formed by the transformation of the terminal articulation of the ramuli; but sometimes the other articulations produce lateral ovate capsules, sometimes two, sometimes more springing from the same articulation, and occasionally the whole frond becomes densely warted with this irregular fruit.

2. C. *elongata*, Ell. and Sol.; "the lateral shoots of the branches slender and subulate, with long, cylindrical articulations." *Johnst. Lith. p.* 221.

Coast of Cornwall, *Ellis*. Jersey, *Mr. Hassall*. "Coralline attached by a crustaceous base, rising to the height of 3 or 4 inches, very bushy, distinctly jointed, slender, the ultimate branchlets almost hair-like: articulations of the stem not much longer than their own diameter, somewhat compressed and wedge-shaped, the shoulders often produced into a spinule; articulations of the setiform pinnules cylindrical, from two to six times their diameter in length, often terminated with a graniferous tubercle, which frequently becomes axillary from little setaceous branches shooting up from each side." *Johnst.* l. c. I am not acquainted with this species.

3. C. *squamata*, Park.; decompound pinnate; lower articulations cylindrical, scarcely longer than their breadth; upper obconical or obcordate, compressed, two-edged, their upper angles sharp and prominent; ultimate ramuli very slender, acute. *Johnst. Brit. Lith. p.* 222; *Harv. Phyc. Brit. t.* cci.

On rocks, near low-water mark. Perennial. Summer. South of England, Jersey, and South and West of Ireland.—This has the habit of *C. officinalis*, but differs in the form of the upper articulations, which are here much compressed, with the angles sharp and prominent. Two abnormal states of fruit are figured in *Phyc. Brit.*, one of which resembles the normal fructification of *Jania* (section *Haliptilon*); the other that of *Amphiroa*. Such irregularities show how little dependance can be placed on characters derived from fructification in this family of plants: and I fear characters of ramification are equally treacherous.

II. Jania. Lamour. [Plate 13, D.]

Frond filiform, articulated, dichotomous, branched, coated with a calcareous deposit. *Fructification*, urn-shaped *ceramidia*, formed of the axillary articulation of the uppermost branches (mostly two-horned), pierced at the apex by a minute pore, and containing a tuft of erect, pyriform, transversely parted tetraspores. Named from *Janira*, one of the *Nereides*.

1. J. *rubens*, Linn.; articulations of the principal branches and ramuli cylindrical, about four times as long as broad. *Harv. Phyc. Brit. t.* cclii.

On the smaller Algæ between tide-marks. Perennial. Summer. On all parts of the British coast.—From half an inch to 1—2 inches high, densely tufted, dichotomous, many times forked, fastigiate, branches either erect or spreading, gradually tapering upwards. *Articulations* cylindrical in all parts of the frond, without prominent angles; those near the base very short, the upper ones gradually longer. *Ceramidia* subterminal, urn-shaped, with long horns, formed of from two to four articulations. *Colour* a pale red, with a purplish shade when quite fresh. A common plant on the shores of Europe, and perhaps throughout the temperate Atlantic.

2. J. *corniculata*, Linn.; articulations of the principal divisions obconical, compressed, their upper angles sharp and prominent; those of the uppermost ramuli cylindrical, filiform. *Harv. Phyc. Brit. t.* ccxxxiv.

On smaller Algæ between tide-marks. Southern shores of England and Ireland, Jersey.—Forms small dense tufts, 1—2 inches high, composed of slender, dichotomous fronds; branches fastigiate. *Articulations* of the principal branches 2—3 times as long as broad, tapering to the base, enlarged laterally upwards, compressed, their upper angles prolonged into a conical horn. *Colour* pale red. Known from the last by the different form of the articulations of the principal branches.

Suborder 2. Nulliporeæ. *Frond* crustaceous or foliaceous, opake, not articulated.

III. Melobesia. Lamour. [Plate 14, A.]

Frond attached or free, either flattened, orbicular, sinuated or irregularly lobed, or cylindrical and branched (never articulated), coated with a calcareous deposit. *Fructification:* conical, sessile *ceramidia*, scattered over the surface of the frond, and containing a tuft of transversely parted, oblong *tetraspores*.—Named from one of the sea-nymphs of Hesiod.

* *Frond thick, solid, stony, either shrub-like or encrusting.*

1. M. *polymorpha*, Linn.; frond attached to rocks, thick, stony, encrusting, or rising into short, clumsy branches, which are seldom much divided, and often merely rudimentary.

On rocks, stones, shells, &c. between tide-marks. Perennial. Common.—I suppose that most of the thick, difform, nulliporous crusts found between tide-marks would be referable to this species. Much remains to be done in working out the species of this genus. I do not pretend to understand them fully, not having sufficiently attended to their variations on the coast, and not possessing a sufficient suite of specimens to enable me to solve their difficulties in the cabinet.

2. M. *calcarea*, Ell. and Sol.; " is extremely white, solid and dichotomously branched; the little branches often unite together and become smaller at the ends." *Ellis and Sol. p.* 129, *t.* 23, *f.* 13; *Johnst. Brit. Lith. p.* 240, *t.* 24, *f.* 4, 5. *M. fragilis, M'Calla?*

Coasts of South of England and West of Scotland and Ireland. I have not seen any authentic specimen, but Ellis's figure is a faithful representation of the *M. fragilis* of M'Calla, which abounds on most of our coasts in 4—10 fathoms water. When recent it is a deep blood red, soon passing into brick-dust colour, and finally to a snowy whiteness. The branches are slender, divaricating, spreading in all directions, anastomosing below; free above and tapering to a blunt point. The ultimate ramuli are either simple or forked. On many parts of the coast this plant forms vast beds, extending for miles, in submarine strata; and is advantageously used as a manure on soils requiring the addition of lime. Here should also be mentioned *M. compressa* of M'Calla, which I have not yet had an opportunity of examining in a recent state. It differs from *M. calcarea* in having a compressed frond, with flat branches broader towards the tips, and is probably as good a species as any other of these variable forms.

3. M. *fasciculata*, Lam.; frond unattached, roundish or lobed, stony, much branched, fastigiate; branches solid, thick, crowded together, cylindrical or compressed; apices truncate, broad, somewhat concave. *Johnst. Brit. Lith. p.* 240; *Harv. Phyc. Brit. t.* lxxiv.

Lying at the sandy bottom of the sea in 4—5 fathoms water. Found on several parts of the coast.—*Fronds* 1—3 inches in diameter, roundish or irregularly lobed, composed of a stony central mass, from which issue several short lumpy branches. *Colour* a dark lurid purple, soon fading in the air.

** *Frond thin, foliated, free, or partially attached to rocks.*

4. M. *agariciformis*, Pall.; frond unattached, globular,

hollow; foliations delicate, papyro-crustaceous, dense, erect, much lobed and sinuated, fastigiate; margin thin, entire. *Johnst. Brit. Lith. p.* 241; *Harv. Phyc. Brit. t.* lxxiii.

Lying on the sandy bottom of quiet bays, in 2—3 fathoms water. Roundstone Bay, Cunnemara.—This forms globular masses 4—8 inches in diameter, hollow, from the central portion continually rotting away as the exterior foliations extend. The whole is composed of innumerable vertical leafy plates closely packed together, and variously twisted. It is of a pale flesh-colour when fresh.

5. M. *lichenoides*, Borl.; frond attached to rocks, free at the margins, foliaceous, lichenoid, variously lobed; foliations spreading, often imbricated; ceramidia large, conical, prominent.

On rocks and in tide-pools, near low-water mark. Not uncommon. Perennial?—Variable in habit, resembling one of the leafy Lichens, such as a *Peltidia*, spreading over rocks, or somewhat erect, the marginal lobes generally free. *Colour* pale. Some varieties of this plant closely resemble small specimens of *M. agariciformis*, and would lead us to infer that the difference in habit was caused by the different depths at which these plants vegetate.

*** *Frond minute, thin, parasitic on various Algæ, &c.*

6. M. *membranacea*, Lamour.; minute, dot-like, very thin, pale purple, circular, at length confluent, attached to other Algæ; ceramidia one or two, depressed.

Common on the leaves of *Zostera*, the fronds of *Chondrus crispus*, &c. Annual. Summer.—From half a line to a line in diameter, very thin, and almost membranous, dotting over the plant on which it grows. It very frequently is found in fruit, having two or more depressed ceramidia.

7. M. *farinosa*, Lamour.; minute, irregular in outline, rather thin, pallid, with two or three prominent *ceramidia*.

On various Algæ.—Rather larger and thicker than the preceding, with more prominent fruit, but to me it appears merely a stronger-grown variety. I depend, for the name, on a specimen from the Mediterranean, communicated by *M. Lenormand*.

8. M. *verrucata*, Lamour.; thin, expanded, irregularly lobed, pallid, dotted over with innumerable small, pimply *ceramidia*.

On *Phyllophora rubens*, &c.—Looks like a still more advanced state of *M. membranacea*.

9. M. *pustulata*, Lamour.; thick, dull purple or green, oblong or lobed, incrusting, smooth; *ceramidia* numerous, large, rather prominent, conical.

On *Phyllophora rubens*, *Chondrus crispus*, &c.—This is the largest and most developed of this parasitic section of the genus, and perhaps, without much violence, the three preceding species might be considered as merely younger and imperfect forms. Dr. Johnston goes much further, and refers the whole to *Corallina officinalis.* This plant, says he, "appears first in the guise of a thin, circular, calcareous patch of a purplish colour, and in this state is common on almost every object that grows between tide-marks. When developing on the leaves of *Zostera*, or in other unfavourable sites, these patches are usually pulverulent and ill-coloured, green or white, and never become large; but in suitable situations, they continue enlarging in concentric circles, each marked with a pale zone, until they ultimately cover a space of several inches in diameter. The resemblance which, in this condition, the crust has to some crustaceous fungi, more especially to *Polyporus versicolor*, is remarkably exact, and neither is it less variable than the fungus in its growth, the variations depending on the nature of the site from which it grows. If this is smooth and even, the foliaceous coralline is entirely adnate and also even, but if the surface of the site is uneven or knobbed, the coralline assumes the same character. If it grows from the edge of a rock, or on the frond of a narrow sea-weed, or from the branch of the perfect coralline, the basal laminæ spread beyond in overlapping imbrications of considerable neatness and beauty: they are semicircular, wavy, either smooth or studded with scattered granules, and these granules [*ceramidia*] may be either solid or perforated on the top. Such states of the coralline have been described as *Millepora lichenoides;* while its earlier states constitute Lamouroux's various species of *Melobesia.*"—*Johnst. Brit. Lith. p.* 220.

IV. Hildenbrandtia. Zanard. [Plate 14, C.]

Frond cartilagineo-membranaceous (not *stony*), crustaceous, suborbicular, adhering by its lower surface; composed of very slender, closely packed, vertical filaments. *Conceptacles* immersed in the frond, orbicular, depressed, pierced by a hole, and containing tetraspores and paraphyses at the base of the cavity.

1. H. *rubra*, Meneg.; *Mem. Rinn. Nat. Pador.* 1841, *p.* 10; *Harv. Phyc. Brit. t.* ccl. *Rhododermis Drummondii, Harv. in Ann. Nat. Hist. vol.* xiv. *p.* 27, *t.* 2.

On smooth stones and pebbles between tide-marks, and in deep water. Common.—Forms a thin, membranous crust, at first orbicular, and spreading concentrically, at last irregular in form, following the sinuosities of any body to which it may be attached. A small portion, viewed vertically under the microscope, shows minute cells, lying in clear jelly. When in fruit the surface is pitted with disk-like depressions, pierced by a hole which communicates with a chamber in which the spores lie. *Colour* variable; now a bright, now a dull red.

Sub-order 3? Lithocysteæ. *Frond* plane, hyaline, composed of cells radiating from a centre. *Fructification* unknown.

V. Lithocystis. Allm. [Plate 14, B.]

"Plant calcareous, consisting of a single plane of cellules, which are disposed in radiating, dichotomous series, forming an appressed, flabelliform frond."—*Allm.* Name, from λιθος, a *stone*, and κυτις, a *bladder;* because the cells have stony coats.

1. L. *Allmanni, Harv. Phyc. Brit. t.* clxvi.

Parasitical on *Chrysymenia clavellosa*, from an oyster bed, Malahide, Dublin, *Professor Allman.*—Forming minute, dot-like patches of a whitish colour on the fronds of the *Chrysymenia.* Each dot consists of one or several fan-shaped fronds, composed of quadrate cells, disposed in dichotomous series. The plant is brittle, colourless, and effervesces in acid.

Order X. DELESSERIACEÆ.

Delesserieæ, *J. Ag. Alg. Medit. p.* 116; *Endl. 3rd Suppl. p.* 52; *Lindl. Veg. King. p.* 25. Gasterocarpeæ (partim), *Dne. Class. p.* 65. Thamnophoreæ (partim), *Dne. l. c. p.* 63. Delesserieæ and Plocameæ, *Kütz. Phyc. Gen. pp.* 44, 449.

Diagnosis.—Rosy or purplish red, or blood-red sea-weeds, with a leafy, or rarely filiform, areolated, inarticulate frond, composed of polygonal cells. *Leaves* delicately membranaceous. *Fructification* double; 1, *Conceptacles* (*coccidia*) external or half immersed, hemispherical, usually imperforate, containing, beneath a membranous pericarp, a tuft of dichotomous filaments, whose articulations are finally changed into spores. 2, *Tetraspores* in distinctly defined *sori*, either scattered through the frond or placed in proper fruit-leaflets or *sporophylla*.

Natural Character. — *Root* usually a conical disk, in some *Plocamia* and in *Hymenena* much branched, composed of many clasping fibres; and occasionally the frond is attached at intervals by disk-like roots, which issue from the under side of the midribs, or from the tips of the leaves. *Frond* rarely (*Plocamium*) linear, very narrow or filiform, and much branched; usually leafy, or expanded: in many cases forming distinct leaves, of definite shape, with costa and lateral nerves, in others consisting of leaf-like membranes of irregular form, without distinct costa, and either homogeneous, or traversed by branching, obscure and vanishing nerves. The distinction of the frond into stem and leaves, although in some cases, as in *Delesseria sanguinea*, very obvious, is nowhere, to my knowledge, absolute; the stems having, at an early period of growth, been in all cases leaves, and having lost their leafy character by the destruction of the lateral membrane, which never grows again. The costa, continuing to vegetate, throws out from its sides new leafy fronds, and thus the branching often becomes very irregular. This power of the costa to originate new fronds from any part equally exists in such branching plants as *Del. alata*, which is often converted from a flat and perfectly distichous forked leaf into a dense, bushy tuft, composed of innumerable similar leaves, springing, without order, each from the midrib of an older leaf. In *Del. hypoglossum* and *D. ruscifolia* this proliferous habit is shown in perfection. In these species each frondlet is perfectly simple at all ages, and composition can only take place by new frondlets springing from the midribs of the old. Other species, as *D. alata* and *D. sinnosa*, have a double mode of enlargement; normally by division of the frond, and abnormally by proliferous development. The cells of which the frond is composed are rarely elongate. In most cases they are twelve-sided, about as long as broad, and heaped together without much order; but in some they are cubical, and disposed in regular rows, vertical with the surface when the frond is thick. But in no case do they cohere strongly by their ends, so as to form separable filaments. The surface cells are often, but not always, large and flattened, and thus the frond has an areolated appearance under a lens. The *coccidia* are produced on various parts of the frond, and are either formed by a metamorphosis of a leaf (as in *D. sanguinea*), in which case they are pedicellated; or they originate from the midrib, as is common in Delesseria; or they are scattered over the membrane, as in *Nitophyllum* and in *Delesseria Lyallii*. They are usually hemispherical, prominent on one or other side of the frond indifferently, having a membranous pericarp, usually as thick as the frond from which it is developed, and they contain, on a central, basal placenta a tuft of dichotomous threads, with moniliform articulations, whose apical cells, and sometimes all the cells of the filament, are converted into spores, acquiring a dark red colour and dense substance. The *tetraspores* are commonly triangularly parted, but in *Plocamium* they are transversely zoned. In all cases they form well-defined *sori* or spots, which either occupy a portion of the surface of the membranous frond, or are confined to spore-leaflets (*sporophylla*), which spring from some part of the frond. This order is chiefly known from the *Rhodymeniaceæ* by the definite arrangement of the tetraspores; but the plants of the latter family are of a coarser texture, and in many instances have a partially fibro-cellular structure.

The *Delesseriaceæ* are not numerous, but they are widely scattered through the temperate and colder latitudes of both hemispheres. Few are tropical, and those of small size. On the shores of northern Europe and of the antarctic lands the finest species occur, some having fronds several feet in length. Where soil and exposure are favourable, some of the British *Nitophylla*, especially *N. punctatum*, attain very large dimensions. Of *Plocamium* our common species is found in all cool waters, being equally common at the North Cape of Europe and at Cape Horn, and extending in both hemispheres to some 34° of the line; but it is the only one of the genus to which it belongs whose habits are equally pelagic. All the other species, and there are several, are natives of the southern hemisphere, chiefly of the shores of South Africa and New Holland.

SYNOPSIS OF THE BRITISH GENERA.

I. Delesseria. *Frond* leafy, of definite form, with a percurrent midrib. [Plate 15, A.]

II. Nitophyllum. *Frond* leafy, of indefinite form, without a midrib (sometimes traversed by vague, vanishing nerves). [Plate 15, B.]

III. Plocamium. *Frond* linear, or filiform, compressed, much branched, distichous; ramuli pectinate, secund. [Plate 15, C.]

I. Delesseria. Lamour. [Plate 15, A.]

Frond rose-red, flat, membranaceous, with a percurrent midrib. *Fructification* of two kinds, on distinct individuals: 1, hemispherical *tubercles (coccidia)*, mostly on the midrib, containing a tuft of filaments, bearing the *spores:* 2, *tetraspores* forming definite spots in the frond, or in distinct leaf-like processes. — Named in honour of *M. Benj. Delessert,* a distinguished French naturalist and patron of Botany.

1. D. *sanguinea,* Linn.; stem cylindrical, cartilaginous, branched, bearing oblong or obovate, transversely veined leaves, entire at the margin; midrib percurrent, strong; tubercles stalked, attached to the midrib. *Grev. Alg. Brit. p.* 72; *Hook. Br. Fl.* ii. *p.* 285; *Wyatt, Alg. Danm. No.* 13; *Harv. Phyc. Brit. t.* cli. *Fucus sanguineus, E. Bot. t.* 1041.

In the sea. Biennial. Fruiting in winter, after the decay of the leaves. Common.—*Stem* simple or slightly branched, thick, bearing numerous oblong or broadly obovate, obtuse, penninerved leaves, 2—8 inches long, 1—6 inches wide, of a splendid pinky-red colour and delicately membranous substance; the margin waved, but quite entire; the midrib and lateral veins prominent, the former occasionally giving rise to small proliferous leaves. Such is the summer state. In winter the membranaceous portion of the frond almost entirely decays, leaving little but the stems and midribs, which are then found fringed with fructification; the *tubercles* raised on little stalks about a line long; the *tetraspores* placed in little leafy processes.

2. D. *sinuosa,* Good. & Wood.; stem elongated, branched, beset with oblong or obovate, deeply sinuate or pinnatifid, toothed, penninerved leaves; nerves opposite. *Hook. Br. Fl.* ii. *p.* 285; *Wyatt, Alg. Danm. No.* 62; *Harv. Phyc. Brit. t.* cclix. *Fucus sinuosus, E. Bot. t.* 822.

On the larger Fuci, common. Biennial? Summer and autumn. *Stem* in young plants with a decurrent membrane (the remains of the simple leaf of which the plant at first consists); in old, naked and somewhat pinnatedly branched; the branches or *leaves* of an oblong or obovate form, deeply sinuate, or in many specimens pinnatifid, each lobe having a sinuous, jagged or serrated, sometimes ciliated margin; furnished with a strong midrib, and transverse opposite veins. *Colour* a fine rose-red, purplish when dry; much duller at all times than that of the preceding. *Fructification:* 1, *tubercles* imbedded in the midrib of the leafy lobes: 2, *tetraspores* placed in minute, slender processes, fringing the margin, and resembling cilia, formed out of a dissolved portion of the midrib.

3. D. *alata,* Huds.; stem excessively branched, somewhat dichotomous, linear, winged with membrane without distinct leaves; branches attenuate; margin entire. *Grev. Alg. Brit. p.* 73; *Hook. Br. Fl.* ii. *p.* 285; *Wyatt, Alg. Danm. No.* 14; *Harv. Phyc. Brit. t.* ccxlvii. *Fucus alatus, E. Bot. t.* 1387.

On the larger Algæ, common. Biennial? Summer. — *Frond* 3—8 inches high, 1 — 4 lines wide, much branched in a dichotomous manner, linear, the membrane decurrent along the branches, its margin quite entire, its surface marked, in luxuriant specimens, with evident transverse striæ. *Colour* a deep red. *Tubercles* spherical, attached to the midrib, generally near the ends of the branches; *tetraspores* imbedded in little leafy processes of the midrib, generally at or near the tips; sometimes in the tips themselves.

4. D. *angustissima*, Griff.; frond membranaceo-cartilaginous, compressed, very narrow, two-edged, much branched; branches alternate, distichous, of unequal length, much divided above, and furnished with numerous forked ramuli; tubercles imbedded either in the tips of the frond, or in small, axillary ramuli; tetraspores forming sori either in the inflated apices, or in axillary, lanceolate ramuli. *Harv. Phyc. Brit. t.* lxxxiii. *Del. alata, γ. angustissima, Grev. Alg. Brit. p.* 74. *Gelidium? rostratum, Griff. in Harv. Man.* 1*st ed. p.* 82.

On the stems of *Laminaria digitata*. Perennial. Winter and Spring. North of Scotland and east coast of England.—*Fronds* 4—8 inches long, not half a line in diameter, nearly cylindrical below, compressed and two-edged above, much branched. *Branches* distichous, alternate or dichotomous, or somewhat pinnate. *Colour* dark red. *Substance* cartilaginous. I admit this plant in deference to the opinion of Mrs. Griffiths, who considers it permanently distinct from the preceding, by the above characters. To me it appears merely an extreme variety of a variable plant.

5. D. *Hypoglossum*, Woodw.; frond much branched in a proliferous manner, composed of linear-lanceolate, midribbed leaves, tapering at each end, the younger series springing from the midribs of the older; tetraspores forming an oblong line at each side of the midrib, near the tips of the leaves. *Hook. Br. Fl.* ii. *p.* 286; *Wyatt, Alg. Danm. No.* 63; *Harv. Phyc. Brit. t.* ii.; *E. Bot. t.* 1396.

On rocks and other Algæ, not uncommon on the shores of England and Ireland; rare in Scotland. Annual. Summer.—*Fronds* several from the same base, at first forming a simple, linear-lanceolate leaf, furnished with a distinct midrib, and faintly marked by pellucid transverse veins; afterwards excessively branched, and forming globose tufts 4—6 inches in diameter; the branches or *leaves* springing from the midrib of those first formed, resembling them in outline, and bearing from their midribs a second and third series. *Colour* a fine pinky-red, soon given out to fresh water. *Tubercles* globose, seated on the midrib about the centre of the leaflet; *tetraspores* disposed in linear longitudinal lines or sori, at each side of the midrib, often near its end. Some of Miss Hutchins's specimens, gathered at Bantry Bay, are of very large size, the primary leaf being 6—8 inches long, and half an inch wide. In the common varieties the leaves are seldom more than two lines, but frequently only a line in breadth.

6. D. *ruscifolia*, Turn.; frond branched in a proliferous

manner, composed of linear-oblong, obtuse, midribbed leaves, scarcely tapered at base, the younger series springing from the midribs of the older; tetraspores forming an oblong line at each side of the midrib. *Grev. Alg. Brit. p.* 76; *Hook. Br. Fl.* ii. *p.* 286; *Wyatt, Alg. Danm. No.* 64; *Harv. Phyc. Brit. t.* xxvi; *E. Bot. t.* 1297.

On rocks and *Laminariæ*, &c.; rather rare. Annual. Summer and autumn. Shores of England and Ireland. — Originating, like the last, in a simple leaf, branched in a similar manner, and with a similar fructification. It differs chiefly in the form of the leaves, which are shorter, boader, obtuse at the apex and not tapering at the base; but specimens are occasionally found presenting intermediate appearances. The colour, too, is generally deeper, the substance rather firmer, and the reticulations smaller than in the last.

II. Nitophyllum. Grev. [Plate 15, B.]

Frond membranaceous, reticulated, rose-red (rarely purplish), veinless, or furnished with irregular veins towards the base. *Fructification:* 1, convex *tubercles* (*coccidia*) sessile on the frond, containing a tuft of filaments which bear the spores: 2, *tetraspores* forming distinct, scattered spots. —Name, from *nitor*, to *shine*, and φυλλον, a *leaf.* The absence of a nerve distinguishes this genus from *Delesseria*, as do the thinner, more reticulated substance, and *distinct* spots of tetraspores, from *Rhodymenia.*

1. N. *punctatum*, With.; frond very thin and delicate, destitute of nervures, either regularly dichotomous or cleft into two or three principal segments, whose margins are fringed with dichotomous lobes, the axils rounded; spots of tetraspores large, scattered over the whole frond or confined to its segments. *Grev. Alg. Brit. p.* 79, *t.* 12; *Hook. Br. Fl.* ii. *p.* 287. *Fucus punctatus, E. Bot. t.* 1575; *Harv. Phyc. Brit. t.* ccii. cciii.—β. *ocellatum;* frond with a roundish outline, cleft nearly to the base, the segments repeatedly dichotomous, linear. *N. ocellatum, Grev. Hook. Br. Fl.* ii. *p.* 286; *Wyatt, Alg. Danm. No.* 15. *Delesseria ocellata, Grev. Crypt. t.* 347.

Attached to various Algæ within and beyond the tidal limit. Annual. Summer. On the coasts of England, Ireland and Scotland, in many places; the Irish specimens of large size. β. coast of Moray, *Mr. Brodie.* Torquay and Sidmouth, *Mrs. Griffiths.* Bantry Bay, *Miss Hutchins.*—*Frond* primarily of a broadly wedge-shaped form, afterwards dichotomously divided, with rounded axils, the segments preserving their wedge shape, commonly from 4 to 12 inches long and about as broad, but in favourable situations much larger, and in some gigantic specimens gathered by *Mr.*

D. Moore, at Cushendall Bay, North of Ireland, 5 feet long and 3 feet wide! In some specimens the frond is nearly simple, with a few dichotomous lobes near the apex; in others it is once or twice forked, with the margin fringed with dichotomous lobes; and in others the whole frond is repeatedly and regularly dichotomous, the segments narrow and linear. This last state constitutes the *N. ocellatum* of authors, a plant which, in its typical form, appears distinct enough; but numerous specimens, kindly communicated to me by *Mrs. Griffiths*, exhibit such intermediate characters, that I no longer hesitate to unite it with *N. punctatum*: with which opinion, I am happy to add, *Dr. Greville* and *Mrs. Griffiths* coincide. In all its varieties the frond of this species is exceedingly thin and delicate, quite destitute of veins. The *tubercles* are globose, and thickly scattered over the surface; the spots of *tetraspores* large, 1 or 2 lines long, oblong, oval or linear, scattered over the whole surface or confined to a central portion of the frond.

2. N. *Hilliæ*, Grev.; frond thickish, but tender, faintly veined towards the base, roundish, but very irregular in figure, somewhat cuneate at base, variously cleft into oblong, more or less broad, rounded segments; spots of tetraspores very minute, scattered over nearly the whole frond. *Grev. Alg. Brit. p.* 80; *Harv. Phyc. Brit. t.* clxix. *N. ulvoideum, Harv. Man.* 1*st edit. p.* 57; *Hook. Br. Fl.* ii. *p.* 287; *Wyatt, Alg. Danm. No.* 16. *Del. Hilliæ, Grev. Crypt. t.* 351. *Fucus ulvoides, Turn. Hist. t.* 80, (*see Hook*).

On rocks, &c. near low-water mark; rare. Annual. July to October. South of England and Ireland, first found by the late *Miss Hill*, at Plymouth.—*Frond* 4—8 inches long, broadly flabelliform, slightly dichotomously cleft or lobed, the margin smooth and even, rising from a short, cartilaginous stem, obscurely veined at the base, and sometimes over the surface, of a thickish membranaceous substance "resembling soft kid-leather" (*Mrs. Griffiths*), and fine, rose-red colour, which becomes orange in fresh water. *Tubercles* large, globose, scattered over the surface; spots of *tetraspores* extremely minute, dot-like, abundantly scattered over the upper part of the lobes. *Smell*, when fresh, extremely disagreeable and peculiar. This species is well marked by its thick substance and the minute size of the spots of granules.

3. N. *Bonnemaisoni*, Ag.: frond shortly stalked, flabellate or palmate, variously cleft into numerous wedge-shaped segments, furnished near the base with irregular vanishing nerves; spots of tetraspores roundish, scattered over the frond. *Hook. Br. Fl.* ii. *p.* 287. *Del. Bonnemaisoni, Grev. Crypt. t.* 322.

On the stems of *Laminaria digitata*; rare. Annual. Summer. Orkney, *Rev. Mr. Clouston*. Bute, *Dr. Greville*. Larne, *Dr. Drummond*. Youghal, *Miss Ball*. Torquay and Ilfracombe, *Mrs. Griffiths*. Tramore, *Miss Taylor*. Miltown Malbay.—*Frond* with a short, cartilaginous stem, broadly fan-shaped, 2—4 inches long and about as broad, more or less deeply cleft in a dichotomous manner, the segments broadly wedge-shaped, about equal in length. *Substance* very thin and delicate, closely adhering to paper. *Tubercles* scattered over the frond; spots of *tetraspores* smaller than in *N. punctatum*, larger than in *N. Hilliæ*, scattered over the surface and segments.

4. N. *Gmelini*, Lamour.; frond with a short stalk, more or less fan-shaped, with a roundish outline, variously cleft into broadly wedge-shaped segments, waved, curled, and rather crisp, marked near the base (and sometimes over the surface) with vague vanishing nerves; spots of tetraspores linear, confined to the margin. *Grev. Alg. Brit. p.* 82; *Hook. Br. Fl.* ii. *p.* 288; *E. Bot. Suppl. t.* 2779; *Wyatt, Alg. Danm. No.* 65; *Harv. Phyc. Brit. t.* ccxxxv.

On rocks and *Laminariæ*, &c.; rare. Annual. Summer. Shores of England and Ireland.—*Stem* short, cartilaginous, expanding into a broadly fan-shaped or roundish frond, 2—4 inches, or in the Irish specimens 6 inches in breadth, more or less deeply cleft; its surface traversed by vague veins, which are very evident in some specimens, in others faint; the margin smooth and even. *Tubercles* scattered over the surface; spots of *tetraspores* confined to the margin, long and linear. *Substance* membranaceous, crisp, and somewhat rigid when first gathered. *Colour* a purplish red. Some specimens are scarcely cleft, others are divided nearly to the base into ribbon-like segments, but all preserve a roundish outline.

5. N. *laceratum*, Gmel.; frond sessile, much divided in a dichotomous manner, marked with flexuous veins; segments mostly linear, variously cleft, waved or fimbriate at the margin; spots of granules oblong, either marginal or borne on distinct leafy processes of the margin. *Grev. Alg. Brit. p.* 83; *Hook. Br. Fl.* ii. *p.* 288; *Wyatt, Alg. Danm. No.* 107; *Harv. Phyc. Brit. t.* cclxvii. *F. laceratus, E. Bot. t.* 1067.—β. *uncinatum;* fronds narrow, the lesser segments hooked.

Attached to Algæ, corallines, &c.; common. Annual. Summer.—*Fronds* 2—10 inches in length, much and dichotomously divided, marked in the lower part with vague, flexuous, branching veins; the segments of various lengths, linear wedge-shaped; the margin either smooth and even, or waved, crenate, or fringed with processes. *Tubercles* scattered; *tetraspores* either in marginal spots, or in leafy processes. β. is a much smaller state, having the ends of the branches hooked into the form of a sickle.

6. N. *versicolor*, Harv.: stem cartilaginous, elongated, simple or branched, suddenly expanding into a broadly fan-shaped, variously cleft frond, of a thickish-membranaceous, highly reticulate substance and rose-red colour, becoming golden-orange in fresh water: the segments rounded; the apices generally thickened into hard, expanded calli: fructification unknown. *Harv. Phyc. Brit. t.* ix.

Thrown up, probably from deep water. June to August. Ilfracombe, *Miss Hill* and *Mrs. Griffiths.* Youghal, *Miss Ball.*—*Root* unknown. *Stem* somewhat tuberous in its lower part, half an inch to an inch high, simple or branched; the branches suddenly expanding into broadly fan-shaped, more or less deeply cleft fronds; the segments rounded, generally entire, sometimes minutely ciliate; the tips and sometimes the margins of the segments much thickened, producing oblong or oval cartilaginous bodies, one or two lines in diameter, at first smooth, afterwards ciliate, and which, on being dissected, are found to contain innumerable minute granules. No fructification, except these bodies be such, has been detected. The substance is much thicker and the reticulation larger than in *N. Bonnemaisoni*, which it most resembles; and I agree with *Mrs. Griffiths* in regarding it as distinct from that species, although the differences are difficult to be expressed in words, and in the absence of fructification its true relations cannot be determined. In outline it very much resembles some states of *Rhodymenia Palmetta*, but the structure is totally dissimilar. *Mrs. Griffiths* has favoured me with the following remarks: "This plant was known to Mrs. Hare thirty years since, who called it *Fucus Halensis*, I have been told, but I do not think it ever was published. *Dr. Greville* described it in his *Crypt. Flora* as identical with *N. Bonnemaisoni*, which, after having known this plant upwards of twenty years, and the other nearly as long, I cannot allow. I have never seen any sort of fruit, except the large wart-like substance of the tips in mature age be such; they, when very old, appear to have a fringed margin. When wetted and cut through under a glass, they are full of minute grains which pour out and cloud the drop of water. The colour, when fresh, is rose-red, but fresh water turns it a most beautiful orange. The substance is thicker than in most, but the stem and branches are also striking. I never saw it growing, nor in plenty, but a few fragments may be found most tides thrown up. The *N. Bonnemaisoni* is sometimes found near it, but rarely." *Griff. in litt.*

III. Plocamium. Lamour. [Plate 15, C.]

Frond pinky-red, linear, compressed or flat, ribless, or faintly nerved, cellular, distichously much branched: the ramuli alternate or secund, acute. *Fructification* of two kinds: spherical *tubercles* (*coccidia*), sessile or stalked, marginal or axillary, containing a mass of angular spores: 2, lateral or axillary, simple or branched, *pods* (*stichidia*), containing a double or single row of transversely parted, oblong tetraspores.—Name, πλοκαμος, *intertwined hair;* alluding to the finely branched fronds.

1. P. *coccineum*, Huds.; frond narrow, cartilaginous, plano-compressed; branches irregularly alternate, patent; ramuli subulate, secund, three or four consecutively, pectinate on their inner edges; tubercles lateral, sessile; stichidia scattered, simple or branched. *Grev. Alg. Brit. p.* 98, *t.* 12;

Hook. Br. Fl. ii. *p.* 293; *Wyatt, Alg. Danm. No.* 20; *Harv. Phyc. Brit. t.* xliv. *Fucus coccineus, E. Bot. t.* 1342.

On rocks and Algæ, common everywhere. Perennial. Summer and autumn.—*Root* fibrous. *Fronds* tufted, 2—12 inches long, excessively branched and bushy, compressed, two-edged, very narrow, main stems half a line in diameter, irregularly divided, thickly set with patent alternate branches, which are throughout furnished with short distichous ramuli, which are either simple and subulate, or bearing a second and third series of similar subulate ramuli from their inner face, the compound ramuli resembling small combs. *Tubercles* solitary, sessile on the edge of the upper branches; *tetraspores* oblong, transversely divided into several joints, contained in little branching receptacles borne by the ramuli.

Order XI. RHODYMENIACEÆ.

Sphærococcoideæ, *J. Ag. Alg. Medit. p.* 148. *Endl.* 3*rd Suppl. p.* 55. Sphærococceæ, *Lindl. Veg. Kingd. p.* 25. Part of Gasterocarpeæ, Sphærococcoideæ, and Chondrieæ, *Dne. Class. p.* 64—65.

Diagnosis.—Purplish or blood-red sea-weeds, with an expanded or filiform, inarticulate frond, composed of polygonal cells; occasionally traversed by a fibrous axis. Superficial cells minute, irregularly packed, or *rarely* disposed in filamentous series. *Fructification* double: 1, *Conceptacles* (*coccidia*) external or half immersed, globose or hemispherical, imperforate, containing beneath a thick pericarp a mass of spores affixed to a central placenta: 2, *Tetraspores* either dispersed through the whole frond, or collected in indefinite, cloudy patches.

Natural Character.—*Root* disk-like or branched, sometimes much matted. *Frond* very variable in habit and colour, either leafy or filiform and much branched, never articulate; in some an intense scarlet, in some crimson, in others brown-red or purple, usually growing somewhat darker in drying. The leaf-like expansions of the frond are very rarely symmetrical; and never (except in *Stenogramme*, which is scarcely a real exception) furnished with well-defined midribs, but in several the central portion is somewhat thickened and traversed by a bundle of closely packed filaments which constitute an internal rib. Such a rib occurs in several of the filiform species, where it is only discoverable on dissection. The frond is commonly dichotomously or palmately cleft; it is rarely pinnatifid, and when so cleft the laciniæ are alternate. The lower part of the frond is frequently narrow and cylindrical, or contracted into a stipe, and the outline in such species, is often a segment of a circle, all the tips being of equal length. The substance is seldom delicately membranous: it is more commonly rather thick, composed of several strata of cells. The internal cellular structure is rather lax, the cells being of large size, frequently empty, though sometimes filled with granular matter, polygonal, about as long as broad, and either lying close together or separated by wide air-cells or passages. Towards the circumference the substance becomes gradually more dense; the cells smaller and more filled with colouring matter; and the cells of the outermost layers are always of very minute size. In some genera (as *Gracilaria*) the outer strata of cells which form the periphery, are arranged in lines, or filaments, perpendicular to the surface; and these genera indicate a passage into *Cryptonemiaceæ*, a group which touches the present order (as at present constituted) at many points. In the leafy species the *coccidia* are either confined to the margin or scattered over the surface. They are always prominent, very convex, and contain a mass of spores, various in character and in degree of perfection. Sometimes the spores are exceedingly minute and numerous, the whole substance of the nucleus breaking up into a powder; sometimes (as in *Rhod. ciliata*) they are formed from the terminal cells of radiating filaments. In the filiform species the coccidia are either lateral, or they are, more rarely, lodged in the centre of the branches, forming nodose swellings at intervals. The *tetraspores* are never collected into well-defined sori, and are most usually dispersed over the smaller branches of the frond. When sori exist they are spreading and cloud-like, without exact limit. In several species the *tetraspores* are transversely parted or zoned; a character which may, perhaps, be advantageously employed in defining genera, but which is not taken up in the present work. Zoned *tetraspores* exist in *Rhod. ciliata*, *R. jubata*, and *R. bifida;* in *Hypnea;* and in several others.

The *Rhodymeniaceæ* are widely dispersed; all our genera having representatives in very distant countries with very various climates. *Rhodymenia* is an ill-defined genus, as it stands at present, and will probably be eventually broken up into several. Its species are most numerous in temperate latitudes, between the parallels 40° and 50° at either side the line: and many, especially of the section *Calophyllis* (typified by *R. laciniata*) are among the most splendidly coloured of crimson and carmine Algæ. Others, as *R. Hombroniana*, are clothed in royal purple; while others, like the sober *dulse* of our coasts (*R. palmata*) have often nearly as much of brown as of purple in their attire. The "dulse," whose "crimson leaves" an American poet compares to

"a banner bathed in slaughter,"

is probably *R. laciniata*, a species by no means dulse (dulcis). *Stenogramme*, though with but two species, inhabits two great oceans; one of its species being a native of the shores of California, the other of Portugal and the South of England. *Sphærococcus* is equally scattered, if *S. crinitus*, a Kamtschatkan plant, is a congener with our *S. coronopifolius*. The *Gracilariæ* extend from high latitudes to the tropics, and our *G. conferroides* and *G. multipartita* are among the commonest tropical Algæ. *Hypnea*, typified by *H. musciformis*, is chiefly tropical, and is a very common form throughout the tropical oceans.

I have altered the name of this order, not merely for the sake of euphony, but because *Sphærococcus* does not correctly typify the structure of the great bulk of the plants composing the order. I have some doubts whether *Sphærococcus* should not be transferred to *Cryptonemiaceæ*, and placed near *Gelidium*, an affinity already suggested by M. Montagne. Both orders require a thorough revision, which would probably lead to the transfer of some genera from one to the other, and perhaps the establishment of one or more new orders.

Many of the *Rhodymeniaceæ* are valuable in an economic sense. On our own shores *R. palmata*, the Dulse of the Scotch and Dillisk of the Irish, is largely collected on many parts of the coast; and in the west of Ireland it forms an important item in the household condiments. It is frequently the only relish eaten with the potato, serving for salt and butter. It is even brought to market in the inland towns, forming a common article on the huckster's stall; and I remember to have heard it cried about the streets of Limerick, with the recommendation — bawled out in sonorous brogue, —"'Twill kill the worms and cure the ladies!" Many of the *Gracilariæ* are largely used in the East as ingredients in soups and jellies, and also as substitutes for glue. One of them (*G. spinosa*) is the Agar-Agar of the Chinese, and is largely collected both for culinary purposes and as a component part of some of the strongest Chinese glues. It has recently been imported into England, and is occasionally used instead of carrigeen, in making jellies and blancmanges. Any other species which would boil down into jelly may be used, as all are tasteless or nearly so, after having been cooked.

SYNOPSIS OF THE BRITISH GENERA.

* *Frond flat, expanded, leaf-like, dichotomous or palmate.*

I. Stenogramme. *Conceptacles* linear, rib-like. [Plate 15, D.]

II. Rhodymenia. *Conceptacles* hemispherical, scattered. [Plate 16, A.]

** *Frond compressed or terete, linear or filiform, much branched.*

III. Sphærococcus. *Frond* linear, compressed, two-edged, distichously branched, with an obscure midrib. [Plate 16, B.]

IV. Gracilaria. *Frond* filiform, compressed or flat, irregularly branched; the central cells very large. [Plate 16, C.]

V. Hypnea. *Frond* filiform, irregularly branched, traversed by a fibro-cellular axis. [Plate 16, D.]

I. Stenogramme. Harv. [Plate 15, D.]

Frond rose-red, leaf-like, nerveless, laciniate, cellular; the central cells large, transparent, in several rows, those next the surface minute, coloured, closely packed. *Fructification:* 1, linear, convex, longitudinal, (nerve-like) *conceptacles*, containing a dense mass of minute spores; 2, *tetraspores* (unknown).—Name, from στενος, *narrow* and γραμμη, *a line;* alluding to the linear fructification.

1. S. *interrupta*, Ag.; frond stipitate, membranaceous, flabelliform, more or less deeply laciniate; laciniæ repeatedly dichotomous, their apices obtuse; conceptacles forming a nerve-like line through the centre of each lacinia, and usually abruptly terminating opposite the fork. *Harv. Phyc. Brit. t.* clvii. *Delesseria interrupta, Ag. Spec. Alg. vol.* 1, *p.* 179.

Washed up from deep water. Annual. November. Very rare. Bovisand, and near Plymouth, *Dr. John Cocks* (1846). Mount Edgecombe, *Rev. W. S. Hore.* Minehead, Somerset, *Miss Gifford.* — *Root* discoid. *Frond* with a short stem, which soon becomes compressed, and rapidly expands into a fan-shaped membrane, 3—5 inches long, and about as wide. This membranous lamina is either cleft to its base into numerous, linear, dichotomous laciniæ; or the lower half of the lamina is undivided, the upper variously cloven. The margin is usually flat and very entire, but now and then sends out minute leafy lobules; and when the segments are injured at the apex they frequently sprout out into proliferous growth. Barren fronds are quite nerveless; *fertile* ones have the centre of each lacinia traversed by a slender, raised, nerve-like line, which commences just below one of the forkings and terminates nearly opposite to another fork: this is the commencement of fructification. It rarely happens that the whole line proves fertile; but portions varying from 1 to 4 lines in length become much thickened, raised, and of a dark red colour, and at maturity are filled with innumerable minute spores. *Substance* cartilagineo-membranaceous. *Colour* a fine, clear, pinky-red, very similar to that of *Rhod. Palmetta*, which this plant resembles in several of its external characters. For a fuller account see *Phyc. Brit. l. c.*

II. Rhodymenia. Grev. [Plate 16, A.]

Frond flat, membranaceous, or subcoriaceous, ribless, veinless, cellular; central cells of small size, those of the surface minute. *Fructification:* 1, convex *tubercles* (*coccidia*) having a thick, cellular pericarp, and containing a mass of minute *spores*: 2, *tetraspores*, either zoned or tripartite, imbedded among the cells of the surface, scattered, or forming cloudy patches.—Name, ῥοδεος, *red*, and ὑμην, a *membrane.*

1. R. *bifida*, Good. and Woodw.; frond thin and transparent, rose-red, dichotomously divided from the base; segments linear; the apices obtuse; tubercles generally confined to the margin, sessile. *Grev. Alg. Brit. p.* 85; *Hook. Br. Fl.* ii. *p.* 289; *Wyatt, Alg. Danm. No.* 66; *Harv. Phyc. Brit. t.* xxxii. *F. bifidus, E. Bot. t.* 773.—β. *ciliata;* frond somewhat thicker than usual, opaque, brownish-red, narrow, much divided; the margins fringed with leafy cilia.

On rocks and Algæ, in the sea. Annual. Summer. Frequent on the shores of England and Ireland; rare in Scotland. — *Fronds* thin and delicate, 1 or 2 inches high, tufted, irregularly dichotomous, the axils rounded; the segments linear or somewhat wedge-form, 1—3 lines wide; the apices rounded or truncate. The margin is either entire, or fringed with minute processes which sometimes become branches. *Tubercles* globose, either marginal, or rarely scattered over the surface of the terminal lobes. *Tetraspores* transversely zoned, forming cloudy spots on the upper segments, both marginal and scattered. *Colour* a fine rose-red; substance transparent and delicate, nearly as thin as in *Nitophyllum;* but the *cellules* are smaller and denser, and the fructification very different.

2. R. *laciniata,* Huds.; frond thickish or sub-cartilaginous, opaque, bright red, more or less palmate or flabelliform, cleft into numerous, broad, wedge-shaped segments, which are again divided in a sub-dichotomous manner; the apices obtuse; the margin, when in fructification, fringed with minute cilia, in which the tubercles are imbedded. *Grev. Alg. Brit. p.* 86; *Hook. Br. Fl.* ii. *p.* 289; *Wyatt, Alg. Danm. No.* 17; *Harv. Phyc. Brit. t.* cxxi. *F. laciniatus, E. Bot. t.* 1068.

On rocks and stones, in deep water. Biennial? In fruit from January to July.—*Fronds* rising from a disk, several from the same base, 3—10 inches long, with a short, flat stem, which soon expands into a deeply cleft frond, divided in a dichotomous manner, the segments all becoming broader upwards, varying in width from half an inch to 3 or 4 inches; the apices obtuse, but frequently lacerated. When bearing *tubercles* the margin is closely fringed with minute ciliary processes, in which the tubercles are placed. *Tetraspores,* tripartite or cruciate, forming cloudy spots along the margin, which is then smooth and entire. *Substance* soft, between cartilaginous and membranaceous, adhering to paper. *Colour* a fine blood red, glossy when dry.

3. R. *Palmetta,* Esper.; stem cylindrical, sub-simple, expanding into a fan-shaped, rose-red frond, which is more or less cleft in a dichotomous manner; the segments wedge-shaped; axils rounded; apices (according to the state of fructification), either erose or rounded; tubercles mostly terminal; spots of tetraspores in the expanded tips. *Grev. Alg. Brit. p.* 88, *t.* 12; *Hook. Br. Fl.* ii. *p.* 290; *Wyatt, Alg. Danm. No.* 109; *Harv. Phyc. Brit. t.* cxxxiv. *F. Palmetta, E. Bot. t.* 1120.

On rocks, or the stems of *Laminaria digitata.* Annual. Summer and autumn.—*Stem* cylindrical, filiform, becoming compressed upwards, half an inch to 2 inches long, simple, or with one or two branches, expanding into a fan-shaped frond, 1 or 2 inches across, deeply divided in a dichotomous manner. In specimens communicated by *Miss Cutler,* there is scarcely any stem, and the frond is simply forked, its segments linear and not a line in breadth; and in others from the same lady, once-forked, wedge-shaped fronds rise irregularly from a mass of entangled creeping stems. *Tubercles* sessile, on the disk or margin, generally near the tips of the frond. *Tetraspores* ternate, forming oval cloudy spots in the expanded tips of the segments. *Colour* a fine pinky-red. *Substance* of the stem cartilaginous, of the frond membranaceous, somewhat rigid, imperfectly adhering to paper.

4. R. *cristata*, L.; frond semicircular, membranaceous, sub-dichotomous, the segments somewhat dilated upwards, repeatedly subdivided, the divisions alternate, decurrent, laciniate at the ends; tubercles spherical, imbedded in the margin of the frond." *Grev.—Grev. Alg. Brit. p.* 89; *Hook. Br. Fl.* ii. *p.* 290. *Sphærococcus cristatus, Grev. Crypt. t.* 85.

Parasitical on the stems of *Laminaria digitata;* very rare. Annual. July. Sea-shore at Wick, Caithness, *Messrs. Borrer* and *Hooker*; Frith of Forth, *Dr. Greville*; Berwick, *Dr. Johnston*; Shetland, *Prof. Forbes*; Orkney, *Dr. M'Bain.*—" *Fronds* about an inch long, divided near the base into several main branches, flat and even, entire at the margin, linear or dilated upwards, about a line in width, the branches again dividing once or twice subdichotomously, and then bearing numerous other smaller segments in an alternately pinnatifid manner, decurrent and cleft or laciniated at the apices; every division has a tendency to dilate upwards, so that the circumference of the frond is extended and crowded. *Fructification:* sessile, spherical, dark red *tubercles*, half the size of poppy-seed, usually occurring towards the extremity of the branches. *Substance* membranaceous, or very slightly cartilaginous, adhering closely to paper in drying. *Colour* a rose red, nearly similar to that of *Delesseria alata*."—*Grev. Alg. Brit. p.* 90. Quite a northern species, and very rare on our coasts.

5. R. *ciliata*, L.; frond thick, sub-cartilaginous, full purplish-red, rising from a short stalk, lanceolate, irregularly pinnated with lanceolate or cleft segments, attenuated at base; margin (and often the disk) furnished with simple, subulate cilia, which bear the tubercles at their extremity; tetraspores zoned, forming cloud-like patches over the disk; root fibrous, creeping. *Grev. Alg. Brit. p.* 90; *Hook. Br. Fl.* ii. *p.* 291; *Wyatt, Alg. Danm. No.* 67; *Harv. Phyc. Brit. t.* cxxvii. *F. ciliatus, E. Bot. t.* 1069.

On rocks and stones near low-water mark, and at a greater depth. Annual. Producing fruit in winter.—*Root* creeping, fibrous. *Frond* at first a simple, oblong or lanceolate leaf, 2—4 inches long, serrate or jagged at the margins, afterwards, from the elongation of the cilia into branches, deeply pinnatifid or lobed, the lobes simple or forked, ciliate or foliiferous at the margins and over the surface, narrowed at base, acute at the apex, very variable in breadth. *Substance* thick and cartilaginous, somewhat rigid. *Colour* a full red, generally becoming darker in drying. *Tubercles* spherical, on the cilia; tetraspores transversely zoned, forming cloudy spots on various parts of the surface.

6. R. *jubata*, Good. and Woodw.; frond thickish, flaccid, sub-cartilaginous, dull red, linear-lanceolate, much attenuated or cirrhous at the apex, vaguely pinnated with segments of the same form; the margin (and often the disk) beset with subulate or filiform cilia, in which both tubercles and tetraspores are produced on distinct plants: root fibrous, creeping. *Grev. Alg. Brit. p.* 91; *Hook. Br. Fl.* ii. *p.* 291; *Wyatt, Alg. Danm. No.* 18; *Harv. Phyc. Brit. t.* clxxv. *Sph. jubatus, Grev. Crypt. t.* 359.

On rocky or gravelly shores in tide-pools. Annual. Producing fruit in summer. Frequent.—*Root* a mass of creeping fibres, from which spring several fronds. *Fronds* rising with a short cylindrical stem, linear-lanceolate, attenuate, vaguely pinnated, all the branches attenuated at base, and drawn out at the apex into long, filiform points, the margin and disk more or less densely clothed with linear, filiform cilia, which, in some varieties, are very much elongated and again branched, when the frond is resolved into a dense entangled mass of cylindrical fibres. *Substance* cartilaginous, soft and flaccid. *Colour* a dull pinky red. *Tubercles* hemispherical, placed on the cilia: tetraspores transversely zoned, confined to the cilia, minute. A very variable plant closely allied to the preceding, from which it differs in the softer and more flaccid substance, different colour, and especially in the granular fructification, and in producing its fruit at a different season.

7. R. *palmata*, L.; frond coriaceous or sub-membranaceous, purple, broadly wedge-shaped, much and irregularly cleft, segments sub-dichotomously divided; margin entire, (often winged with proliferous leaflets); tetraspores distributed over the whole frond in cloud-like spots. *Grev. Alg. Brit. p.* 93; *Hook. Br. Fl.* ii. *p.* 291; *Wyatt, Alg. Danm. No.* 110; *Harv. Phyc. Brit. t.* ccxvii.—ccxviii. *F. palmatus, E. Bot. t.* 1306.—β. *Sarniensis*; frond thinner, laciniated, the segments very narrow. *Grev.*—*F. Sarniensis, Mert. Turn. Hist. t.* 44.—γ. *Sobolifera*; frond stipitate, membranaceous, the branches very narrow below, much divided, expanding upwards into wedge-shaped, jagged and laciniate lobes. *Harv. Phyc. Brit. t.* ccxviii. *fig.* 2. *R. sobolifera, Grev. Alg. Brit. p.* 95; *Harv. Man. ed.* 1, *p.* 63; *E. Bot. t.* 2133.

In the sea, on rocks and the stems of *Laminariæ*, very common.—*Fronds* 2—20 inches long, tufted, of a broad wedge-shape, but very irregular in division, sometimes palmate, sometimes more or less dichotomous, and sometimes cleft into numerous jagged branches. *Substance*, when young, membranaceous, afterwards leathery. *Colour* a dull purplish or brownish red. This is the *Dulse* of the Scotch, *Dillisk* of the Irish, and is much eaten in both countries, as well as in most of the northern states of Europe, by the poor along the shores, and is transmitted as an article of humble luxury over most parts of the country. It is generally eaten raw, either fresh from the sea or after having been dried, but is sometimes cooked. That is preferred which grows on rocks near low-water mark, being shorter, sweeter, and less leathery than the larger varieties; this is frequently covered with young mussel-shells, whence it is called by the hawkers "*Shell-dillisk.*" Cattle, especially sheep, are fond of it; whence it has been called *Fucus ovinus* by Bishop Gunner.

III. SPHÆROCOCCUS. Stack. [Plate 16, B.]

Frond cartilaginous, compressed, two-edged, linear, distichously branched, with an internal rib, cellular; central cells fibrous; medial polygonal; those of the periphery minute, disposed in horizontal filaments. *Fructification*, spherical *tubercles (coccidia)* having a thick fibro-cellular pericarp, and containing a mass of minute *spores* on a central placenta. —Name, *σφαιρα*, a *sphere*, or *globe*, and *κοκκος*, *fruit*.

1. S. *coronopifolius*, Good. and Woodw.; frond cartilaginous, much branched in a distichous and alternate manner, compressed and two-edged below, nearly flat above; the branches acute; capsules spherical, mucronate, on little stalks, fringing the smaller branches. *Grev. Alg. Brit. p.* 138, *t.* 15; *Hook. Br. Fl.* ii. *p.* 304; *Wyatt, Alg. Danm. No.* 122; *Harv. Phyc. Brit. t.* lxi. *Fucus coronopifolius, E. Bot. t.* 1478.

On rocky shores, near low-water mark, and beyond the tidal limit. Biennial. Summer and autumn. Not uncommon on the southern shores of England, and the western and southern shores of Ireland. Belfast, *Mr. Templeton.* Very rare in Scotland. Bute, *Dr. Greville.*—*Fronds* 6—12 inches long or more, very much branched, distichous; the main stems compressed, two-edged, thickened in the centre, two lines broad, becoming narrower and flatter upwards, irregularly divided in a manner between dichotomous and alternate, the upper branches once or twice forked, the segments set with close, alternate branches, which often bear a second series, or branched in a regularly alternate manner; the branches all spreading, giving the plant a fan-like outline; the margin of the upper branches generally fringed with minute, ciliary processes, about half a line in length, in some of which capsules are imbedded. *Tubercles* spherical, imbedded in the cilia below the tip, which is slightly produced beyond them and bent, forming "an oblique mucro" to the capsules, the whole not unlike the head of a bird. *Colour* a fine scarlet-red, darker in the main stem. *Substance* cartilaginous, becoming horny in a dry state, and imperfectly adhering to paper under pressure.

IV. GRACILARIA. Grev. [Plate 16, C.]

Frond filiform, or rarely flat, carnoso-cartilaginous, continuous, cellular; the central cells large, empty, or full of granular matter; those of the surface minute, forming densely-packed horizontal filaments. *Fructification*: 1, convex *tubercles* (*coccidia*), having a thick pericarp composed of radiating filaments, containing a mass of minute spores on a central placenta; 2, *tetraspores* imbedded in the cells of the surface.—Name, from *gracilis*, slender.

1. *multipartita*, Clem.; frond cartilagineo-membranaceous, tender, semi-transparent, brittle, dull purplish-red, deeply cleft in an irregularly dichotomous or palmate manner; the branches linear-wedge-shaped; the apices acute; tubercles conical, prominent, scattered over the surface. *Harv. Phyc. Brit. t.* xv. *Rhodymenia polycarpa*, *Grev. Alg. Brit. p.* 87; *Hook. Br. Fl.* ii. *p.* 289; *Wyatt*, *Alg. Danm. No.* 108; *Sphærococcus polycarpus*, *Grev. Crypt. t.* 352.

On rocks and stones in the sea; very rare. Perennial? August and September. Shore under Tait's Hill, Plymouth, *Miss Hill*, abundantly, *Rev. W. S. Hore*, *Dr. Cocks*, &c. Whitsand Bay, *Dr. Jacob*. Salcombe Bay, *Mrs. Wyatt*.—*Root* a thin spreading disk. *Frond* 4—12 inches high, cleft nearly to the base in an irregularly dichotomous manner; sometimes vaguely or palmately divided; sometimes having the principal divisions cleft into numerous secund, jagged segments; the branches lineari-wedge-shaped; apices acute. *Capsules* large, spherical, prominent, abundantly scattered over the frond. *Granules* very minute, imbedded in the frond over its entire surface. *Substance*, according to Mrs. Griffiths, "when fresh, thick, cartilaginous and tender, semi-transparent and very brittle, and most nearly resembling that of *Lau. pinnatifida*;" when dry, it becomes tough and shrinks considerably. *Colour* a dull purple, becoming redder in fresh water, pinky towards the tips.

2. G. *compressa*, Ag.; frond succulent, brittle, somewhat compressed, alternately or sub-dichotomously branched; branches long and mostly simple, tapering to a fine point; tubercles ovato-globose, sessile, scattered over the branches. *Grev. Alg. Brit. p.* 125; *Hook. Br. Fl.* ii. *p.* 299; *Wyatt*, *Alg. Danm. No.* 25; *Harv. Phyc. Brit. t.* ccv. *Sphær. lichenoides*, *Grev. Crypt. t.* 341, *(not of Ag.)*

Thrown up from deep water; very rare. Annual. August. Sidmouth, *Mrs. Griffiths* and *Miss Cutler*.—*Fronds* several from the same disk-like base, 6—12 inches long, from half a line to a line and a half in diameter, cylindrical, or somewhat compressed, either rising with a simple stem, and set with long alternate branches, all of which are much attenuated at base and apex; or divided near the base in a more or less dichotomous manner, the chief divisions alternately branched, and either naked, or furnished with a series of long, subulate, alternate or secund ramuli; thus the frond is partly dichotomous, partly pinnate. *Tubercles* sessile, large and prominent, scattered plentifully over the branches. *Tetraspores* minute, imbedded in the branches of distinct plants, tripartite or cruciate.

Substance very tender and fragile, succulent, cartilagineo-gelatinous. *Colour* a transparent, dull red, becoming brighter in fresh water.

3. G. *conferroides*, L.; frond cartilaginous, cylindrical, filiform, irregularly (often very slightly) branched; branches long, sub-simple; ramuli scattered, attenuated at each end; tubercles external, roundish, scattered. *Grev. Alg. Brit. p.* 123; *Hook. Br. Fl.* ii. *p.* 299; *Wyatt, Alg. Danm. No.* 75; *Harv. Phyc. Brit. t.* lxv. *Fucus conferroides, E. Bot. t.* 1668.—β. *procerrima*; branches very long, generally simple and almost naked, *Turn.*—γ. *albida*; frond compressed, mostly dichotomous, ramuli subulate. *Turn.*—δ. *geniculata*; frond distorted and bent as if broken at the tubercles.

Sea-shores, not unfrequent. Perennial. Fruiting in summer and autumn.—*Fronds* 3—20 inches long, cylindrical, as thick as small twine, irregularly branched, generally forked or branched at base, the branches either long and simple or dichotomously divided, either naked, or more or less furnished with short ramuli; all tapering upwards. *Colour* a pale or deep red, becoming paler in decay. *Substance* rigid-cartilaginous, not adhering to paper. *Tubercles* large, sessile, abundantly scattered over the branches; *tetraspores* minute, imbedded in the branches of distinct plants.

4. G. *erecta*, Grev.; frond cylindrical, erect, sparingly dichotomous; branches sub-simple; tubercles globose, clustered round the apices; tetraspores in terminal, pod-like ramuli. *Grev. Alg. Brit. p.* 124, *t.* 14; *Hook. Br. Fl.* ii. *p.* 300; *Wyatt, Alg. Danm. No.* 115. *Sphærococcus erectus Grev. Crypt. t.* 357.

In the sea, on sand-covered rocks; very rare. Perennial. Fruiting in winter. Torquay and Sidmouth, *Mrs. Griffiths.* Belfast Bay. *Mr. W. Thompson.* Port Ballantrae, North of Ireland, *Mr. D. Moore.* Roundstone, *Mr. M'Calla.* Orkney, *Rev. J. H. Pollexfen*, &c.—*Fronds* numerous, rising from an expanded disk, erect, 1 or 2 inches high, simple or once or twice forked, the branches erect, destitute of ramuli. *Colour* pale or full red. *Substance* cartilaginous and rigid, not adhering to paper. *Tubercles* spherical, clustered about the tips of the branches; *tetraspores* oblong, zoned, imbedded in lanceolate, pod-like, terminal receptacles.

V. Hypnea, Lamour. [Plate 16, D.]

Frond filiform, cartilaginous, continuous, much branched, cellular, with a dense, fibrocellular axis surrounded by several rows of polygonal cells, the innermost of which are largest, the outer gradually smaller to the circumference. *Fructification:* 1, spherical *tubercles* (*coccidia*) sessile or immersed in the ramuli, containing a mass of small spores; 2, transversely parted *tetraspores* imbedded in the surface-cells.

—Name, an alteration of *Hypnum*, the name of a well-known genus of mosses, in allusion to the mossy habit of some of the original species. The type of the genus is *Fucus musciformis* of Wulfen.

1. H. *purpurascens*, Huds.; frond cylindrical, filiform, bushy, excessively and irregularly branched; ramuli setaceous, acute, scattered, containing immersed spherical tubercles. *Harv. Phyc. Brit. t.* cxvi. *Gracilaria purpurascens, Grev. Alg. Brit. p.* 122; *Hook. Br. Fl.* ii. *p.* 299; *Wyatt, Alg. Danm. No.* 74, *Fucus purpurascens, E. Bot. t.* 1243. *Cystoclonium purpurascens, Kütz.*

On rocks, stones and Algæ between tide-marks; very common. Annual. Summer.—*Root* fibrous; frond 6 inches to 2 feet high, about a line in diameter; stem generally undivided, naked below, but after the height of 1 or 2 inches, thickly clothed with alternate, patent branches, which are either simple or forked, and in turn bear a third or fourth set, the branches and ramuli exceedingly variable in length; the whole plant with a bushy character. *Tubercles* immersed in the ramuli; *tetraspores* imbedded in the lesser branches of distinct plants. *Colour* a pale purplish pink, becoming blackish in drying. *Substance* cartilaginous, imperfectly adhering to paper.

Order XII. CRYPTONEMIACEÆ.

Cryptonemieæ, *J. Ag. Alg. Medit. p.* 81. *Endl. 3d Suppl. p.* 36. *Dne. Class, p.* 63. Also Furcellarieæ, and part of Chondrieæ, Sphærococcoideæ and Gasterocarpeæ, *Id. pp.* 64—65.

Diagnosis.—*Purplish* or rose-red sea-weeds, with a filiform or (rarely) expanded, gelatinous or cartilaginous frond, composed, wholly or in part, of cylindrical cells connected together into filaments. *Axis* formed of vertical, periphery of horizontally radiating filaments. *Fructification*, 1, *Conceptacles* (*favellidia,*) globose masses of spores immersed in the frond or in swellings of the branches. 2, *tetraspores* variously dispersed.

Natural Character.—*Root* seldom much developed, most frequently discoid; in some cases (as in *Furcellaria*) composed of many clasping and creeping fibres. *Frond* differing much in external appearance, and in colour and substance, but always composed in great measure, or often altogether, of filiform strings of cells, or *articulated filaments*. The cells or *articulations* of these filaments are either long and cylindrical, or more and more ellipsoidal or spherical, in which latter case the filaments become moniliform. In the genera of simplest structure (*Crouania*, *Dudresnaia*) the substance of the frond is loosely gelatinous and the threads are separated from each other by interposed colourless gelatine or *mucus*. The frond in such cases is highly elastic. It appears to the naked eye to be inarticulate, but when placed under the microscope is resolved into bundles of coloured filaments, radiating from a transparent bed. In the next advance of structure (as in *Catenella* and *Halymenia*) the filaments composing the outer coat of the frond are closely compacted and formed into a sort of membrane, while those belonging to the axis form a lax net-work, surrounded by mucus. In still more perfect genera (*Gigartina*, *Gelidium*, &c.) the substance becomes more and more firm; the cells of the axis are closely entwined, and anastomosing, and those of the periphery very minute, and cohere strongly by their sides. Thus at last we have structures formed as close and hard as those built up of polygonal cells. But the loose and fibrous structure characteristic of Cryptonemiaceæ becomes apparent in such plants as the *Gigartinæ* when the frond is allowed to soak for some time in fresh water, or when plunged for an instant into boiling water. A piece of *Gigartina acicularis* thus treated will be changed into a body having the appearance, under the microscope, of a *Dudresnaia* or *Nemaleon*. The *habit* of the loosely gelatinous genera is generally filiform, and branching. That of more perfect genera often shows a disposition to form leafy membranes, and in the most perfect the leafy branches have imperfect midribs, as is the case in *Suhria* and some species of *Gelidium*, and *Phyllophora*. *Ginannia* is remarkable for having a cylindrical frond, with a dense rib-like axis, surrounded by a space of much laxer structure intervening between the axis and true periphery:—the axis is much more strongly developed in some specimens than in others, and often looks especially in dried specimens of broad fronds, like a true midrib. The leaf-like fronds in this order are rarely delicately membranaceous. They are more frequently thick and fleshy, as in our *Iridæa*, and in many exotic species of *Gigartina* with the external habit of *Iridæa*.—There is nearly as much variety in the appearance and disposition of the fruit in this order as there is in the substance of the frond. In the simplest and most characteristic forms the *favellidia* or masses of spores are immersed in the substance of the frond itself, either wholly concealed beneath the surface cells, or their place is indicated by a minute *pore* through which the spores are finally liberated. Such a fructification differs from the *coccidium* (the proper fruit of the two preceding orders) in the absence of any definite pericarp. But it is difficult to deny pericarps, in the same sense of that word, to *Gigartina* and *Gelidium*, or even to *Catenella*. Insensible gradations connect the properly immersed favellidia of *Halymenia* with the conceptacular fructification of *Gigartina*; and, in doubtful cases, plants of this order are to be known from Rhodymeniaceæ more by the fibroso-cellular structure of the frond than by difference in conceptacular fructification. The *tetraspores* are in the less organized genera attached to the threads of the periphery, and scattered over them;—in many others they are immersed among the peripheric threads, and appear to be formed from one of the cells of the thread. In others, several consecutive cells are so transmuted; and sometimes the periphery bulges out into warts of irregular size and shape, called *nemathecia*. When these warts first appear they consist wholly of vertical filaments in no respect different from those of other portions of the peripheric stratum, but after a time each thread is changed into a string of bead-like tetraspores, a structure beautifully shown in *Gymnogongrus Griffithsiæ*. The common form of the tetraspore is tripartite, but many species have cruciate tetraspores, and others have zoned ones.

This is the largest, as well as most multiform, order of Rhodosperms, and is, under one form or other, widely dispersed. Several of our genera are cosmopolitan, and even some of the species are dispersed through most parts of the temperate and tropical ocean. *Gelidium corneum* is found on all the shores of Europe, and at both sides of the American Continent, as well as in South Africa and New Holland; and *Grateloupia filicina*, which perhaps attains its northern limit in the South of England, is very widely scattered along the shores of the warmer parts of the Atlantic, and abounds in the Mediterranean and Indian Oceans. *Gigartina acicularis* and *G. pistillata* are both natives of the Southern Ocean; *G. mamillosa* has been brought from California. *Gymnogongrus plicatus* is equally widely dispersed. *Gigartina Teedii*, so rare with us, is a common plant in the south of

Europe, where it produces fruit abundantly, and where the branches are very much broader than they are in English specimens. This plant is very closely allied to *G. Chauvini* and *G. Chamissoi* of South America, species of larger size, some of whose forms are with difficulty distinguished from some broad states of *G. Teedii* from the Adriatic. Several of the southern *Gigartinæ* have flat fronds two or three feet long and or two feet broad, resembling gigantic *Iridææ*, but having a structure identical with that of the filiform kinds.

Many of the Cryptonemiaceæ may be used as food; and among others, the Carrageen (*Chondrus crispus*) has been largely employed both as an esculent, in the shape of jellies and blancmanges, and for the manufacture of size for calico printers. It has also been recommended for fattening calves, being boiled to a jelly and then mixed with milk. If boiled in water, and thickened with refuse potatoes or meal, it forms no bad provender for swine. It is nearly tasteless, and boils down to a strong jelly. *Gigartina mamillosa* has similar properties, and is often substituted for *Chondrus*. *Iridæa edulis*, notwithstanding its specific name, is much less frequently made use of, but in some parts of England and Scotland it is said to be eaten by the fishermen, either raw, or after having been pinched between hot irons or fried; and is said to taste like roasted oysters.

SYNOPSIS OF THE BRITISH GENERA.

Sub-order I. Coccocarpeæ. *Frond* solid, dense, cartilaginous or horny. *Favellidia* contained in semi-external or external tubercles, or swellings of the frond.

I. Grateloupia. *Frond* pinnated, flat, narrow, membranaceo-cartilaginous, of very dense structure. *Favellidia* immersed in the branches, communicating with the surface by a pore. *Tetraspores* scattered. [Plate 17, A.]

II. Gelidium. *Frond* pinnated, compressed, narrow, horny, of very dense structure. *Favellidia* immersed in swollen ramuli. *Tetraspores* forming subdefined sori in the ramuli. [Plate 17, B.]

III. Gigartina. *Frond* cartilaginous, cylindrical or compressed, its flesh composed of anastomosing filaments, lying apart in firm gelatine. *Favellidia* contained within external tubercles. *Tetraspores* massed together in dense sori, sunk in the frond. [Plate 17, C.]

Sub-order 2. SPONGIOCARPEÆ. *Frond* solid, dense, cartilaginous or horny. *Favellidia* of several imperfectly known. Wart-like swellings composed of filaments sometimes containing tetraspores, sometimes spores.

IV. CHONDRUS. *Frond* flabelliform, dichotomously cleft, cartilaginous, of very dense structure. *Tetraspores* collected into sori, immersed in the substance of the frond. [Plate 17, D.]

V. PHYLLOPHORA. *Frond* stipitate, rigid membranaceous, proliferous from the disk, of very dense structure. *Tetraspores* in distinct superficial sori, or in proper leaflets. [Plate 18, A.]

VI. PEYSSONELIA. *Frond* depressed, expanded, rooting by the under surface, concentrically zoned, membranaceous or coriaceous. *Tetraspores* contained in superficial warts. [Plate 14, D.]

VII. GYMNOGONGRUS. *Frond* filiform, dichotomous, horny, of very dense structure. *Tetraspores* strung together, contained in superficial wart-like sori. [Plate 18, B.]

VIII. POLYIDES. *Root* scutate. *Frond* cylindrical, dichotomous, cartilaginous. *Favellæ* contained in spongy, external warts. *Tetraspores* scattered through the peripheric stratum of the frond, cruciate. [Plate 18, D.]

IX. FURCELLARIA. *Root* branching. *Frond* cylindrical, dichotomous, cartilaginous. *Favellæ* unknown. *Tetraspores* deeply imbedded among the filaments of the periphery, in the swollen, pod-like, upper branches of the frond, transversely zoned. [Plate 18, C.]

Sub-order 3. GASTROCARPEÆ. *Frond* gelatinoso-membranaceous, or fleshy, often of lax structure internally. *Favellidia* immersed in the central substance of the frond, very numerous.

X. DUMONTIA. *Frond* cylindrical, tubular, membranaceous. Tufts of *spores* attached to the wall of the tube, on the inside. [Plate 20, A.]

XI. HALYMENIA. *Frond* compressed or flat, gelatinoso-membranaceous, the membranous surfaces separated by a few slender, anastomosing filaments. Masses of *spores* attached to the inner face of the membranous wall. [Plate 19, D.]

XII. GINANNIA. *Frond* cylindrical, dichotomous, traversed by a fibrous axis; the walls membranaceous. *Masses* of spores attached to the inner face of the membranous wall. [Plate 19, C.]

XIII. KALLYMENIA. *Frond* expanded, leaf-like, fleshy-membranous, solid, of dense structure. *Favellidia* like pimples, half immersed in the frond, and scattered over its surface. [Plate 19, B.]

XIV. IRIDÆA. *Frond* expanded, leaf-like, thick, carnoso-coriaceous, solid, of dense structure. *Favellidia* wholly immersed, densely crowded. [Plate 19, A.]

XV. CATENELLA. *Frond* filiform, branched, constricted at intervals into oblong articulations; the tube filled with lax filaments. [Plate 20, B.]

Sub-order 4. GLOIOCLADIEÆ. *Frond* loosely-gelatinous; the filaments of which it is composed lying apart from one another, surrounded by a copious gelatine. *Favellidia* immersed among the filaments of the periphery.

XVI. CRUORIA. *Frond* crustaceous, skin-like. [Plate 20, C.]

XVII. NACCARIA. *Frond* filiform, solid, cellular; the ramuli only composed of radiating, free filaments. [Plate 20, D.]

XVIII. GLOIOSIPHONIA. *Frond* tubular, hollow; the walls of the tube composed of radiating filaments. [Plate 21, A.]

XIX. NEMALEON. *Frond* filiform, solid, elastic, filamentous; the axis composed of closely packed filaments; the periphery of moniliform, free filaments. [Plate 21, B.]

XX. DUDRESNAIA. *Frond* filiform, solid, gelatinous, filamentous; the axis composed of a network of anastomosing filaments; the periphery of moniliform, free filaments. [Plate 21, C.]

XXI. CROUANIA. *Frond* filiform, consisting of a jointed filament, whorled at the joints with minute, multifid, gelatinous ramelli. [Plate 21, D.]

I. Grateloupia, Ag. [Plate 17, A.]

Frond flat, pinnate, membranaceous, flexible, solid, composed of densely interwoven, anastomosing, branching filaments; those of the periphery moniliform, short, and very strongly compacted together. *Fructification:* 1, globular masses of spores (*favellidia*) immersed beneath the peripheric stratum, and communicating with the surface by a pore; 2, cruciate *tetraspores*, vertically placed among the filaments of the periphery, in subdefined sori. — Named in honour of *Dr. Grateloup*, a French algologist.

1. G. *filicina*, Wulf.; frond linear, attenuated at each extremity, irregularly once or twice pinnated with branches contracted at the base, and tapering to the apex. *Grev. Alg. Brit. p.* 151, *t.* 16; *Hook. Br. Fl.* ii. *p.* 306; *Wyatt, Alg. Danm. No.* 123; *Harv. Phyc. Brit. t.* c. *Fucus filicinus, Turn. Hist. t.* 150.

On rocks and stones at half-tide level, frequently where a small streamlet runs into the sea; very rare. Perennial. October to December. Sidmouth and Ilfracombe, *Miss Cutler*. Land's End, *Mr. Ralfs*. Ilfracombe and Torbay, *Mrs. Griffiths*. Mount's Bay and Aberystwith, *Mr. Ralfs*. — *Fronds* tufted, rising from a minute disk, seldom more than two inches high in British specimens, (exotic ones are often 8—10 inches), from half a line to a line in breadth, with an undivided or once forked, flexuous stem, which tapers to the base and apex, naked at base, its upper half, and often its greater length, more or less set with opposite or alternate, distichous, flexuous branches or *pinnæ*, which are either simple, or clothed in the upper part with a second series of pinnulæ; all the branches and ramuli linear, attenuated at the apex, and more or less contracted at base. *Substance* membranaceous, more or less perfectly adhering to paper. *Colour* a dull, dark purple or greenish, very like that of *Dumontia filiformis*. *Favellidia* minute, immersed in the branches, with a pore; cruciate *tetraspores* in the smaller pinnules. This last sort of fruit I find in specimens communicated by *Mrs. Griffiths*, from Ilfracombe and Hagington, October, 1836.

II. Gelidium, Lamour. [Plate 17, B.]

Frond linear, compressed, pinnated, corneous, solid; its axis composed of densely interwoven, longitudinal, tenacious fibres; the periphery of small, polygonal cells. *Fructification:* 1, *tubercles* (*flavellidia*) immersed in swollen ramuli, containing a spherical mass of oblong spores; 2, *tetraspores* immersed in the ramuli, bipartite or tripartite.—Name, from *gelu*, frost; whence also *gelatine:* but none of the species of the restricted genus are gelatinous.

1. G. *corneum*, Huds.; frond between cartilaginous and horny, nearly flat, distichously branched; branches linear, attenuated at each end, pinnate and bipinnate; pinnules mostly opposite, patent, obtuse, bearing within their apices elliptical tubercles, *Grev. Alg. Brit. p.* 141, *t.* 15; *Hook. Br. Fl.* ii. *p.* 305; *Wyatt, Alg. Danm. No.* 30; *Harv. Phyc. Brit. t.* liii. *Fucus corneus, E. Bot. t.* 1970.

On rocky shores, very common. Perennial. Summer.—Of this most variable plant the following varieties are enumerated by Dr. Greville, in his excellent '*Algæ Britannicæ.*'

β. *sesquipedale;* frond 4—8 inches high, between compressed and flat, linear, tripinnate, pinnæ attenuated at their base, ramuli linear-oblong, short, obtuse.

Sidmouth, *Dr. Greville.*

γ. *pinnatum;* frond 2—6 inches high, narrow, tripinnate, the pinnæ patent, nearly linear, bluntish. *Turn.*

Coasts of Cornwall, Devonshire, &c., *Hudson.* Bute, *Dr. Greville.*

δ. *uniforme;* all the pinnæ patent, attenuated at the base, obtuse at the points and scattered. *Turn.*

Ilfracombe, *Goodenough.*

ε. *capillaceum;* frond 5 or 6 inches high, narrow, pinnæ clustered towards its summits, nearly setaceous and somewhat erect. *Turn.*

King's Cove, Cornwall, *Turner.* Sidmouth, *Dr. Greville.*

ζ. *latifolium;* frond 2 or 3 inches long, 1 or 2 lines broad, nearly flat, pinnæ linear-lanceolate, mostly simple, set with numerous, short, setaceous pinnulæ.

Trevone Bay, Cornwall; and Torbay, *Mrs. Griffiths.* Sidmouth, *Dr. Greville.* Malbay.

η. *confertum;* frond 2 or 3 inches high, compressed repeatedly pinnated, pinnæ and pinnulæ long, very thin, acute, and irregularly divided.

Devonshire, *Mrs. Griffiths.* Bute, *Dr. Greville.*

θ. *aculeatum;* frond 1 or 2 inches high, compressed, very thin, pinnated very irregularly, pinnæ divaricated, irregularly divided, and set with minute, divaricate, subulate ramuli, crowded toward the summit of the frond.

Mount's Bay, *Mrs. Griffiths.*

ι. *abnorme;* frond 2 inches high, compressed, irregularly branched, branches and pinnæ producing at their extremities little tufts of partly deflexed ramuli.

North of Cornwall, *Mrs. Griffiths.*

κ. *pulchellum;* frond capillary, compressed, tripinnate, pinnæ between linear and clavate, obtuse. *Turn.*

Bantry Bay, *Miss Hutchins.*

λ. *claviferum;* frond sub-cylindrical, capillary, irregularly divided, the ultimate ramuli or pinnulæ obovate, edged with minute, scattered teeth.

Bantry Bay, *Miss Hutchins.*

μ. *clavatum;* frond capillary, between cartilaginous and membranaceous, decumbent, creeping, ramuli in the form of inversely-lanceolate or ovate leaves, much attenuated at their insertion.

South of England, frequent. Frith of Forth, *Dr. Richardson.*

ν. *crinale;* frond setaceous, sub-cylindrical, somewhat dichotomously branched, sometimes three-forked at the top, and bearing a few elliptical-oblong ramuli attenuated at their insertion.

East and south of England. Belfast Lough, *Mr. Templeton.*

2. G. *cartilagineum*, L.; frond several times pinnated, the pinnæ horizontal, alternate; tubercles elliptical, mucronate, terminating the smaller pinnulæ. *Grev. Hook. Br. Fl.* ii. *p.* 304. *Fucus cartilagineus, E. Bot. t.* 1477.

On rocks in the sea. Perennial. A very doubtful native of our shores. It was once found by *Dr. Withering* at Freshwater Bay, Isle of Wight, where its presence was probably accidental.—*Frond* 12—18 inches long, rising from a mass of fibres; the stems naked at base, in the upper part bi-tripinnate, the pinnæ and pinnulæ alternate, gradually diminishing in size. *Colour* a fine, dark purple, becoming scarlet, orange, yellow, and finally greenish on exposure. *Substance* cartilaginous, horny when dry. This plant is a native of the Cape of Good Hope.

III. Gigartina. Lamour. [Plate 17, C.]

Frond cartilaginous (filiform, compressed, or flat), irregularly divided, purple or dark red; the central substance composed of rather lax, branching and anastomosing filaments; the periphery of dichotomous filaments distantly set in pellucid jelly their apices moniliform and strongly united together. *Fructification:* 1, external *tubercles* containing, on a central placenta, dense clusters of *spores (favellidia)* held together by a network of threads; 2, *tetraspores* scattered among the filaments of the periphery.—Name, from γιγαρτον, a *grapestone*, which the tubercles resemble. *G. pistillata* is not unlike the stalk of a bunch of raisins, from which the fruit has been removed, leaving the pedicels only.

1. G. *pistillata*, Gmel.; frond compressed, stipitate, flabellately branched; branches repeatedly forked, with wide, rounded axils, naked or pinnated with short, horizontal, subulate ramuli, which bear the tubercles at or near their tips. *Grev. Alg. Brit. p.* 146; *Hook. Br. Fl.* ii. *p.* 300. *Harv. Phyc. Brit. t.* ccxxxii. *Fucus gigartinus, E. Bot. t.* 908.

On rocks, near low-water mark; very rare. Perennial. Spring. Coast of Cornwall, in several places. Jersey.—*Root* an expanded disk. *Fronds* several from the same base, 3—6 inches long, compressed or subcylindrical, from half a line to a line in diameter, tapering at base, rising with a simple stem for an inch or two, then once or twice forked, the segments elongatad and again repeatedly forked towards the extremities; the apices acute, and branches erect, the upper branches, in fruit-bearing specimens, pinnated with short, horizontal, simple or forked, or sometimes with pinnated ramuli, from 2 lines to ½ an inch long. *Tubercles* seated on the sides or terminating the ramuli, spherical, depressed in the centre, of the colour of the frond, with a thick opaque coating, containing a mass composed of several distinct clusters of very minute spores. *Substance* cartilaginous when recent, horny when dry. *Colour* a dull purple, becoming darker in drying. The Irish station noticed in 'Mag. Nat. Hist.' vol. ix. p. 148, is incorrect.

2. G. *acicularis*, Wulf.; frond cylindrical, filiform, irregularly branched, between pinnated and dichotomous; branches divaricating, curved; ramuli few, scattered, very patent, subulate, often secund; tubercles spherical, scattered on the branches. *Grev. Alg. Brit. p.* 147, *t.* 16; *Hook. Br. Fl.* ii. *p.* 300; *Wyatt, Alg. Danm. No.* 26; *Harv. Phyc. Brit. t.* civ. *Fucus acicularis, E. Bot. t.* 2190.

On rocks, near low-water mark; rare. Annual? Winter. Several places on the coasts of Devon and Cornwall. At Torquay, in December, with tubercles very fine, *Mrs. Griffiths.* Belfast Bay, *Mr. Templeton,* (*Turner*).—*Fronds* tufted, 2—4 inches high, with a simple or forked, arched or wavy stem, set with patent or horizontal, alternate or secund branches of about equal length, and which are either naked or furnished with a second or third series; branches cylindrical, about half a line in diameter, acuminate; ramuli subulate, pinnate or secund, of unequal length. *Tubercles* spherical, sessile on the smaller branches, or occasionally terminating the ramuli, scattered or clustered. *Substance* cartilaginous. *Colour* a dull purple-red, darker when dry.

3. G. *Teedii*, Turn.; frond membranaceous, flaccid (horny when dry), flat, linear, acuminate, repeatedly pinnated with slender, horizontal, distichous, subulate ramuli; capsules

globose, on the ramuli. *Grev. Alg. Brit. p.* 96; *Hook. Br. Fl.* ii. *p.* 301; *Wyatt, Alg. Danm. No.* 28; *Harv. Phyc. Brit. t.* cclxvi. *Sph. Teedii, Grev. Crypt. t.* 356.

On rocks at extreme low water, very rare. Perennial. Elberry Cove and Tor Abbey Rocks, *Mrs. Griffiths.*—*Fronds* 2—5 inches high, from half a line to a line in width; *stem* cylindrical, soon becoming compressed, and finally flattened, either forked at the base or simple, set at intervals of about a line with long, horizontal, distichous branches, attenuated at each end, and pinnated with a second or third series of patent subulate ramuli; the whole forming a broadly ovate or fan-shaped frond. The ramuli are frequently very much lengthened out and filiform. *Tubercles* have not yet been found in this country; they occur on the ramuli. *Colour* purplish, becoming brighter in fresh water, and finally yellowish. *Substance* flaccid, but becoming horny when dry, and not adhering to paper.

4. G. *mamillosus*, Good. and Woodw.; frond thick, flabelliform, channelled, irregularly dichotomous; segments oblong-wedge-shaped; tubercles roundish or ovate, supported on little stalks, scattered over the disk of the frond. *Grev. Alg. Brit. p.* 127; *Hook. Br. Fl.* ii. *p.* 302; *Wyatt, Alg. Danm. No.* 117; *Harv. Phyc. Brit. t.* cxcix.; *E. Bot. t.* 1054.

On rocks and stones near low-water mark, common. Perennial. Autumn and winter.—*Fronds* 3—6 inches high, cylindrical at base, but gradually widening into a compressed, and finally flat, wedge-shaped frond, which is either once or twice forked or repeatedly dichotomous; the segments all wedge-shaped, from a line to half an inch in breadth; the apices acute. *Tubercles* roundish, borne on short, filiform processes, produced in great plenty by the surface of the upper segments, and which, in cases of imperfect fructification become leaflets. *Colour* a dark purple. *Substance* tough.

IV. Chondrus. [Plate 17, D.]

Frond cartilaginous, nerveless, compressed or flat, flabelliform, dichotomously cleft, formed internally of three strata; the *inner* of densely packed longitudinal fibres; the *medial* of small, roundish cells; the *outer* of vertical, coloured moniliform filaments. *Fructification*: 1, prominent *tubercles (nemathecia)* composed of radiating filaments, whose lower articulations are at length formed into spores (?); 2, *tetraspores* collected into sori, immersed in the substance of the frond; 3, *favellidia*, immersed in the frond, and scattered over its segments, containing minute spores.—Name, from χονδρος, *cartilage*.

1. C. *crispus*, L.; frond, thickish, cartilaginous, dichoto-

mous, flat or curled; segments wedge-shaped, very variable in breadth; apices truncate, sub-emarginate, or cloven, axils obtuse; sori concave on one side. *Grev. Alg. Brit. p.* 129, *t.* 15; *Hook. Br. Fl.* ii. *p.* 302; *Wyatt, Alg. Danm. Nos.* 118 and 119; *Harv. Phyc. Brit. t.* lxiii. *Fucus crispus, E. Bot. t.* 2285.

On rocky sea shores, very common. Perennial. Spring.—*Fronds* densely tufted, 2—10 inches high, narrow and sub-cylindrical at base, but soon becoming flat, repeatedly forked, very variable in breadth; segments from 1—4 lines wide, flat or curled; the axils generally rounded. *Sori* oval, imbedded in the frond, prominent on one side and concave on the other, containing minute cruciate tetraspores. *Colour*, various shades of purple or greenish; in shallow pools near high-water mark, generally yellow or pale green. *Substance* horny when dry. This is the *Carrigeen*, or *Irish Moss* of the shops.

2. C. *norvegicus*, Gunn.; frond linear, dichotomous, flat, the axils patent, the apices rounded; favellidia minute, imbedded in the substance; nemathecia prominent, sessile, scattered over both surfaces of the frond. *Grev. Alg. Brit. p.* 130; *Wyatt, Alg. Danm. No.* 120; *Harv. Phyc. Brit. t.* clxxxvii.; *E. Bot. t.* 1080.

Rocky shores near low-water mark, rare. Annual? September to March. Chiefly in the south of England and Ireland. Saltcoats, *Rev. D. Landsborough.*—*Fronds* 2—3 inches high, with a cylindrical stem from a quarter to half an inch long, thence flat, 1 or 2 lines wide, and repeatedly dichotomous. *Favellidia* (very rare, and hitherto only found by *Mrs. Griffiths*), about the size of poppy-seed, imbedded in the frond, containing a mass of minute spores. *Warts* or *nemathecia* common, roundish, nearly a line in diameter, scattered over the frond, composed of beaded filaments. *Substance* thinner than in *C. crispus*. *Colour* a deep, rather dull, blood-red.

V. Phyllophora. Grev. [Plate 18, A.]

Frond stipitate, rigid-membranaceous, proliferous, nerveless or with a vanishing nerve, cellular; cells minute, angular, gradually smaller towards the surface. *Fructification:* 1, *tubercles* (*favellidia*?) scattered over the frond, containing masses of minute spores; 2, *warts* (*nemathecia*) seated on the frond, composed of radiating, moniliform filaments, whose lower articulations are at length converted into spores; 3, *tetraspores*, collected into sori, either towards the apex of the frond, or in proper leaflets.—Name, from φυλλον, a *leaf*, and φορεω, *to bear*.

1. Ph. *rubens*, L.: stem very short, expanding into a sublinear, simple or forked, membranaceous, obscurely mid-

ribbed frond, which is repeatedly proliferous from the surface; tubercles sessile, wrinkled, or crested with sinuous folds; warts concealed under leafy processes. *Grev. Alg. Brit. p.* 135, *t.* 15; *Hook. Br. Fl.* ii. *p.* 303; *Wyatt, Alg. Danm. No.* 29; *Harv. Phyc. Brit. t.* cxxxi. *Fucus rubens, E. Bot. t.* 1053.

On rocks, &c. near low-water mark. Perennial. Winter. Not uncommon on the shores of England and Ireland; more rare in Scotland, and chiefly on the western shores.—*Fronds* tufted, 3—8 inches long, stem minute, cylindrical, gradually expanding into a linear-wedged-shaped, simple or forked frond, furnished at base with a faint midrib, and one or two inches long, from the surface of which, near the tips of the segments, springs a second frond similar to the primary, but generally more repeatedly dichotomous, and this bears from its apices new fronds in like manner; apices blunt. *Substance* membranaceous, rather rigid, not adhering to paper. *Colour* a fine, deep, blood-red. *Tubercles* minute, scattered over the frond, with a thick, opaque, wrinkled skin, containing a mass of minute spores. *Nemathecia* immersed in the bases of little leafy processes, plentifully borne by the surface of distinct plants.

2. Ph. *membranifolius*, Good. and Woodw.; stem cylindrical, filiform, branched; the branches expanding into broadly wedge-shaped, membranaceous, two-lobed or dichotomous segments; tubercles roundish, on short stalks arising from the stem. *Harv. Phyc. Brit. t.* clxiii.; *Grev. Alg. Brit. p.* 131; *Hook. Br. Fl.* ii. *p.* 302; *Wyatt, Alg. Danm. No.* 76. *Fucus membranifolius, E. Bot. t.* 1965.

On rocky sea shores between tide-marks, frequent. Perennial. October to March.—*Fronds* 3—12 inches high; stem cylindrical, filiform, irregularly branched, the branches expanding into wedge-shaped or fan-shaped, dichotomously cleft, flat, membranaceous *frondlets*, about an inch in length, and more or less divided. *Tubercles* borne on short stalks by the branches. *Nemathecia* also frequently occur on the frondlets, where they form long deep red spots, composed of beaded filaments. The substance of the stem is cartilaginous, of the frondlets membranaceous.

3. Ph. *Brodiæi*, Turn.; root a small disk; stem cylindrical, filiform, branched, the branches expanding into oblong, cuneiform, simple or forked, flat, membranaceous frondlets, which are proliferous from their extremity; nemathecia sessile on the tips of the segments. *Harv. Phyc. Brit. t.* xx. (excl. fig. 2, 3, 4); *Grev. Alg. Brit. p.* 133; *Hook. Br. Fl.* ii. *p.* 303. *Fucus Brodiæi, E. Bot. t.* 1966.

On rocks in the sea, rare. Perennial. Spring. Eastern coast of Scotland, frequent, *Mr. Brodie, Mr. Stewart, Dr. Greville, &c.* Mouth of the Bann, Co. Derry, *Mr. D. Moore.* Belfast Bay, *Mr. W. Thompson.*—*Frond* 1—8 inches high; *stem* cylindrical, variable in length, simple or branched, its branches expanding into oblong, flat, forked or simple, wedge-shaped leaves, varying in breadth from two to four lines, and in length from one to three inches; the segments somewhat truncate, often proliferous from the apex, the young shoot rising with a cylindrical stem, which soon expands into a frondlet resembling the primary one, and this, in its turn, gives birth to a second or third. *Nemathecia* large, globose, dark red, sessile on the tips of the frond, at length converted into moniliform strings of tetraspores, (*J. Ag.*)

4. Ph. *Palmettoides*, J. Ag.; root a widely-expanded disk; stem cylindrical, filiform, simple or branched, expanding into an oblong, narrow-obovate or cuneate, simple or but once forked, rose-coloured frond, which is sometimes proliferous; sorus solitary, transverse, elliptical, near the apex of the frond, immersed in its substance. *Chondrus Brodiæi β. simplex*, *Grev. Alg. Brit. p.* 133; *Wyatt, Alg. Danm. No.* 121; *Harv. Phyc. Brit. t.* xx. *fig.* 2, 3, 4.

On rocks, near low-water mark. Perennial. Winter and spring. Rare. Coasts of Devonshire and Cornwall.—*Root* a broad discoid expansion, an inch or more across, from which a large number of stems issue. *Stem* filiform, half an inch to an inch high, simple or branched, terminating in a rose-coloured, membranaceous, linear-obovate or cuneate, mostly simple leaf, one or two inches long. This leaf is sometimes forked, and sometimes bears small leaflets from its disk or apex. Towards the apex of the leaf, in fertile specimens, is a large transverse, elliptical sorus, immersed in the substance of the frond, composed of a multitude of minute tetraspores. No other fructification has been observed. Nearly allied to the preceding, but distinguished by the position of the sori, the brighter colour of the frond, and form of the root.

VI. Peyssonelia. Dne. [Plate 14, D.]

Frond brownish red, depressed, rooting by the under-surface, concentrically zoned, composed of several rows of cells, disposed obliquely in filamentous, vertical series. *Fructification*, warts scattered over the upper surface of the frond, formed of radiating filaments, and containing oblong, cruciately-divided tetraspores.—Name in honour of *J. A. Peyssonel*, an early and meritorious observer of marine plants.

P. *Dubyi*, Crouan; frond membranaceous, orbicular or lobed, attached by the whole of the under surface. *Harv. Phyc. Brit. t.* lxxi. (*colour much too pale.*)

Hab. On old shells, stones, &c. on scallop-banks, in 10—15 feet water. Shores of the British Islands, not uncommon.—*Frond* 1—2 inches across, at first orbicular, afterwards irregularly lobed, membranaceous, thin, adhering closely by its lower surface, which is clothed with short radicles, to the surface on which it grows. *Warts* of fructification scattered, containing a few large cruciate tetraspores, with very wide limbi. *Colour* dull brown-red. The figure in *Phyc. Brit.* is badly coloured.

VII. Gymnogongrus. Mart. [Plate 18, B.]

Frond cylindrical or compressed, horny, much branched, its substance composed of densely packed filaments, of which the innermost are longitudinal, the middle curving outwards, and the external stratum (or periphery) horizontal and moniliform. *Fructification* naked warts entirely composed of bead-like strings of cruciate tetraspores.—Name, from γυμνος, *naked*, and γογγρος, a word applied by Theophrastus to the wartlike excrescences often seen on trees.

1. G. *Griffithsiæ*, Turn.; frond filiform, flexuous, cartilaginous, stipitate, many times dichotomous, the apices fastigiate, forked, warts of fructification oblong, at length surrounding the stem. *Grev. Alg. Brit. p.* 149; *Hook. Br. Fl.* ii. *p.* 301; *Wyatt, Alg. Danm. No.* 28; *Harv. Phyc. Brit. t.* cviii. *Fucus Griffithsiæ, E. Bot. t.* 1926.

On rocks in the sea. Perennial. Autumn and winter. Coast of Devonshire, *Mrs. Griffiths.* Bantry Bay, *Miss Hutchins.* Balbriggan, *Dr. Scott.* Orkney.—*Fronds* tufted, entangled, 2—4 inches high, slender and filiform, many times dichotomous, the axils patent, the apices nearly of equal length, giving the plant a rounded outline; branches flexuous, of equal diameter throughout, obtuse. *Fructification*, so far as known, consisting of oblong warts, surrounding the stem, composed of articulated filaments, whose cells are afterwards changed into cruciate *tetraspores*, strung together like beads. Each tetraspore is brilliant as a ruby, and marked with a slender St. George's cross. *Substance* cartilaginous, somewhat horny when dry. *Colour* a dull purplish-red.

2. G.? *plicata*, Huds.; frond horny, cylindrical, filiform, very irregularly branched, entangled, wiry; branches subdichotomous; axils obtuse; ramuli often secund; fructification, oblong warts composed of obscurely jointed filaments. *Grev. Alg. Brit. p.* 150; *Hook. Br. Fl.* ii. *p.* 301; *Wyatt, Alg. Danm. No.* 116; *Harv. Phyc. Brit. t.* cclxxxviii. *Fucus plicatus, E. Bot. t.* 1089.

On rocky sea shores. Perennial.—*Fronds* 4—10 inches long, entangled, rigid and wiry, cylindrical, as thick as hogs' bristles, of equal diameter throughout, irregularly branched, dichotomous, with very rounded axils, more or less furnished with horizontal ramuli, which sometimes spread in all directions. *Fruit*, as far as known, oblong warts embracing the stem, and composed of very slender jointed threads; but I have never succeeded in finding spores or tetraspores. The structure in this plant is very much more dense than in *G. Griffithsiæ*, and the filaments of which it is composed much more slender. *Colour* a blackish purple, whitish in decay.

VIII. Polyides. Ag. [Plate 18, D.]

Root an expanded disk. *Frond* cylindrical, dichotomous, cartilaginous, solid; the axis consisting of densely-packed, longitudinal, interlacing and anastomosing filaments; the periphery of coloured, horizontal, dichotomous filaments, whose lower half is composed of large, elliptical cells, their upper half of much smaller, submoniliform cellules. *Fructification:* 1, oblong, irregular, spongy warts, composed of dichotomous filaments, through which are scattered ellipsoidal *favellæ*, having a broad, pellucid limbus; 2, cruciate *tetraspores* immersed among the filaments of the periphery of the frond.—Name from πολυ, *many*, and ιδεα, *form* or *appearance*.

1. P. *rotundus*, Gmel.; *Grev. Alg. Brit. p.* 70, *t.* 11; *Hook. Br. Fl.* ii. *p.* 284; *Wyatt, Alg. Danm. No.* 161; *Harv. Phyc. Brit. t.* xcv. *Fucus rotundus, E. Bot. t.* 1738.

On rocks and stones in the sea. Perennial. Autumn and winter. Southern and Eastern shores of England and Ireland. Rather rare in Scotland.—*Root* an expanded disk. *Fronds* 4—6 inches high, as thick as whip-cord, of a dark purplish brown colour, terete, repeatedly dichotomous, the tips fastigiate, giving the plant a rounded outline when displayed; the axils rounded. *Fructification:* " spongy pale or pink warts on the sides of the upper branches, at first roundish or oblong and scattered, but at length 2—4 lines long and 1 or 2 lines thick, sometimes creeping all round the frond, and occasionally several, becoming confluent, extend for nearly an inch along the branches. The warts are naked or destitute of any epidermis, composed of white articulate filaments, radiating horizontally from the frond, and containing numerous imbedded clusters of spores (*favellæ*), each cluster surrounded by a pellucid limbus." *Grev.* Besides this fructification, *Mrs. Griffiths* communicates specimens from Sidmouth having the upper ramuli slightly swollen and containing imbedded *tetraspores*, of a narrow shape, with the endochrome parted crosswise into 4 sporules. In habit this plant closely resembles the following, and can scarcely be distinguished when out of fruit, except by the root and the rounded axils of the branches.

IX. Furcellaria. Lamou. [Plate 18, C.]

Root branching. *Frond* cylindrical, dichotomous, cartilaginous, solid; the axis consisting of densely packed, longitudinal, interlacing and anastomosing filaments; the *periphery* of coloured, horizontal, dichotomous filaments, whose lower half is composed of large ellipsoidal cells; their upper half of much smaller cylindrical cellules. *Fructification* oblong, transversely parted or zoned *tetraspores*, deeply imbedded among the filaments of the periphery, in the swollen apices of the frond. Conceptacular fruit unknown.—Name, from *furcula* or *furcilla*, a little fork. The analysis of the frond given in *Phyc. Brit. figs.* 3 and 4, is incorrect.

1. F. *fastigiata*, Huds.; *Grev. Alg. Brit. p.* 67, *t.* 11; *Hook. Br. Fl.* ii. *p.* 283; *Wyatt, Alg. Danm. No.* 106; *Harv. Phyc. Brit. t.* xciv. (figs. 3 and 4 incorrect). *Fucus lumbricalis, E. Bot. t.* 894.

Rocks and stones between tide-marks, common. Perennial. Bearing fruit in winter.—*Root* a mass of stout fibres. *Frond* 6—12 inches high, terete, simple at base, repeatedly dichotomous upwards, the apices fastigiate, the axils acute. *Substance* between fleshy and cartilaginous. *Colour* brownish purple, becoming much darker in drying. When in fruit the branches, in the upper part, are swollen into a lanceolate pod-like figure, and are found on dissection to contain beneath their surface a dense stratum of dark brownish-purple, pear-shaped tetraspores, divided transversely into four joints or sporules. The *receptacles* when ripe fall off, leaving the branches truncated. In a state of the plant constituting Turner's var. β., the tips of the branches bear short, ovato-lanceolate, transparent, soft, pod-like bodies, which appear to be imperfect attempts at fructification. These Dr. Greville has sometimes observed to lengthen into healthy branches.

X. Dumontia. Lamour. [Plate 20, A.]

Frond cylindrical, filled with watery gelatine, tubular; its walls membranaceous, composed externally of minute, roundish cells, internally of elongated cells, forming longitudinal filaments. *Fructification:* 1, clusters of obovate *spores* attached to the inner surface of the membrane of the frond: 2, roundish *tetraspores*, among the surface cells. — Name, in honour of M. *Dumont*, a French naturalist.

1. D. *filiformis*, Fl. Dan.; frond tender, membranaceous, cylindrical, pinnated with long, simple branches, which are attenuated at each extremity. *Grev. Alg. Brit. p.* 165, *t.* 17; *Hook. Br. Fl.* ii. *p.* 308; *Wyatt, Alg. Danm. No.* 31; *Harv. Phyc. Brit. t.* lix. *Ulva purpurascens, E. Bot. t.* 641. — β. *crispata;* frond compressed, waved, curled or twisted. *Grev. Crypt. t.* 240.

Rocks and stones between tide-marks, common. Annual. Summer. β. in places exposed to tidal streams or currents.—*Frond* generally undivided, narrowed at each end, bearing numerous, alternate, simple or rarely forked branches, similar to the primary; of a membrano-gelatinous substance, and yellowish, greenish, or dull purple colour, with intermediate shades. A most variable plant. In some individuals the main stem is 8—18 inches long, a line to half an inch in diameter, bearing numerous filiform branches, 4 or 5 inches long. In others the stem is very short, 2 or 3 inches; the branches 10—14 inches long, and of twice the diameter of the stem. In others there is scarcely any stem, but 4 or 5 branches rise from a point near the root, and these are 10 or 12 inches long and an inch in diameter. Other varieties are but two or three inches high, both stem and branches filiform. β. is remarkable for compressed stems, from half an inch to an inch wide, crisped and curled. Conceptacular fruit or *favellæ* abundantly scattered over the whole frond, giving it a dotted appearance. I have never seen the tetraspores.

XI. Halymenia. Ag. [Plate 19, D.]

Frond compressed or flat, gelatinoso-membranaceous, consisting of a double membrane, separated by a very lax network of articulated filaments; cells of the membrane minute, coloured. *Fructification:* spherical masses of *spores (favellidia)* immersed in the frond, attached to the inner surface of the membranous periphery.—Name, from ἁλς, *the sea*, and ὑμην, a *membrane*.

1. H. *ligulata*, Woodw.; frond compressed or flat, irregularly dichotomous or palmate, the segments attenuated, often proliferous at the margin. *Grev. Alg. Brit. p.* 162, *t.* 17; *Hook. Br. Fl.* ii. *p.* 308; *Wyatt, Alg. Danm. No.* 125; *Harv. Phyc. Brit. t.* cxii. *Ulva ligulata, E. Bot. t.* 429.

On rocks and stones in the sea, chiefly along the southern shores of England and Ireland. Annual. Summer.—*Frond* extremely variable in form and ramification, and in substance, but resolvable into three principal varieties. 1, *dichotoma*; frond 6—8 inches long, half a line to 1 or 2 lines broad, compressed, very gelatinous, many times divided in an irregularly dichotomous manner, the divisions nearly of equal breadth, becoming gradually narrower towards the extremities, which are tapering and acuminate. 2, *ramentacea;* frond 12—14 inches long, compressed, divided into three or four principal lobes or branches, from half an inch to an inch in breadth, and from 1—4 inches long, attenuated at base, thence cylindrical till near the apex, when they again slightly taper. In substance this closely resembles the first variety, containing a great quantity of gelatine, the external membrane being very thin, and of a pale rose-colour. 3, *latifolia;* frond 12—20 inches long, 2—4 inches wide in the widest part, rising from a minute stem, wedge-form, either simple or forked, or once or twice irregularly cleft in a palmate manner, the segments 1 or 2 inches broad, destitute of ramuli; of a dark red colour, and soft, but not very gelatinous substance (very similar in feel to *Rhodymenia reniformis*), perfectly flat, the stratum of gelatine interposed between the membranes being very thin. The fructification is abundantly scattered over every part of the frond, and, to the naked eye, resembles minute dark red dots.

XII. Ginannia. Mont. [Plate 19, C.]

Frond terete, dichotomous, membranaceo-gelatinous, traversed by a fibrous axis, from which slender, dichotomous, horizontal filaments radiate towards the membranous periphery; surface cellules hexagonal. *Fructification:* spherical masses immersed in the frond, affixed to the inner coating of the periphery, composed of radiating filaments, whose cells are at length converted into spores.—Name in honour of *Count G. Ginanni*, author of an early work on the productions of the Adriatic.

1. G. *furcellata*, Turn.; frond tender, cylindrical, uniformly dichotomous, the segments obtuse. *Grev. Alg. Brit. p.* 163; *Hook. Br. Fl.* ii. *p.* 308; *Wyatt, Alg. Danm. No.* 79; *Harv. Phyc. Brit. t.* lxix. *Ulva furcellata, E. Bot. t.* 1881.

On rocks and stones in the sea, rare. Annual. Summer. On the Eastern and Southern shores of England. All round the Irish coast, but nowhere common.—*Frond* 2—6 inches long, cylindrical, from a line to nearly half an inch in diameter, repeatedly and regularly dichotomous, of a fine pinky red colour, and either firmly or laxly gelatinous substance. Irish specimens are much larger than the English ones. Some are remarkable for possessing a very distinct midrib. The branches (particularly in the broader specimens) are frequently constricted, as if tied, when the frond assumes a jointed appearance. In a specimen communicated by *Mrs. Griffiths*, the apices are truncate as if broken off, with the margins thickened into a disk or ring, from the centre of which spring one or two little ramuli, showing an evident attempt at prolonging the frond after injury. This species seems widely distributed; I have gathered it at the Cape of Good Hope, and possess specimens from New Zealand.

XIII. Kallymenia. J. Ag. [Plate 19, B.]

Frond blood-red, ribless, expanded, carnoso-membranaceous, formed internally of three strata; the *inner* of interlacing filaments; the medial of large round cells; the outer of minute cells, arranged in vertical strings. *Fructification:* 1, spherical masses of spores (*favellidia*) semi-immersed in the frond; 2, triangularly parted, scattered tetraspores.—Name from καλλος *beauty*, and ὑμην, a *membrane*.

1. K. *reniformis*, Turn.; stem short, cylindrical, simple or branched, suddenly expanding into a roundish, sub-simple, or irregularly cleft (occasionally producing new fronds at the margin), somewhat lobed frond; favellidia and tetraspores scattered over the surface. *Harv. Phyc. Brit. t.* xiii. *Rhodomenia reniformis, Hook. Br. Fl.* ii. *p.* 292; *Wyatt, Alg. Danm. No.* 19. *Iridæa reniformis, Grev. Alg. Brit. p.* 160. *Fucus reniformis, E. Bot. t.* 2116.

On rocks, &c. in deep pools, near low-water mark; rather rare. Perennial. Summer and Autumn. Found from Orkney to Cornwall, and on the Irish coasts, but nowhere common.—*Stem* minute, cylindrical, suddenly expanding into a roundish or reniform, undivided (or accidentally cleft) frond, of a soft, thickish, membranaceous substance, becoming thinner in drying, of a fine blood-red colour, and either simple, or bearing along its margin lobes of a shape similar to the frond. The fronds vary in diameter from 1 inch to 6, 8, and even 14 inches. *Favellidia* of small size, thickly scattered over the surface of the frond; *tetraspores* very minute, ternate, imbedded in the frond over which they are dispersed.

2. K. *Dubyi*, Chauv.; stem compressed, gradually expanding into an obovate, simple, dull-red frond, wedge-shaped at the base; favellidia very minute, densely scattered over the surface. *Harv. Phyc. Brit. t.* cxxiii.

On rocks, &c. within tide-marks, chiefly in land-locked bays. Annual. Spring and early summer. Discovered at Falmouth by *Miss Warren.* Plymouth *Rev. W. S. Hore.* West of Ireland.—*Fronds* 6—12 inches long, cuneate at base, obovate, at first quite simple, afterwards often torn. *Colour* a dull, brownish red, becoming pale and yellow in old age. In form this greatly resembles *Iridæa edulis*, while in structure and substance it more nearly agrees with *Kal. reniformis.*

XIV. Iridæa. Bory. [Plate 19, A.]

Frond flat, carnoso-cartilaginous, dull red; the central substance composed of densely interwoven, longitudinal fibres; the periphery of closely-packed horizontal, moniliform filaments. *Fructification:* 1, spherical masses of spores (*favellidia*) immersed in the frond; 2, *tetraspores* forming a stratum at the base of the filaments of the periphery.—Name from *Iris*, the *rainbow*, because some species reflect prismatic colours when growing under water.

1. I. *edulis*, Stackh.; frond simple, obovate or wedge-shaped, rounded at the apex, gradually narrowing towards the base into a short stem. *Grev. Alg. Brit. p.* 158, *t.* 17; *Hook. Br. Fl.* ii. *p.* 308; *Wyatt, Alg. Danm. No.* 78; *Harv. Phyc. Brit. t.* xcvii. *Fucus edulis, E. Bot. t.* 1307.

On rocks and stones in the sea, common. Perennial. Autumn and winter.—*Root* an expanded disk, from which spring numerous, obovate, obtuse, thick, cartilagineo-carnose or somewhat leathery fronds, 4—18 inches long, 2—8 inches wide, which gradually taper towards the base into a short, linear stem; undivided, but frequently cleft by the action of the waves; the margin smooth and even. The colour is a fine deep red, becoming much darker, frequently blackish when dried. Conceptacular *fructification* near the extremity, in wide patches, frequently spreading over a large portion of the frond, composed of globules of minute spores imbedded in the substance. *Tetraspores* forming dense band-like sori, immersed in the substance of the frond beneath the periphery. The frond of this species is occasionally eaten by the poor, either raw or cooked in the frying-pan.

XV. Catenella. Grev. [Plate 20, B.]

Frond dull purple, membranaceous, filiform, constricted at intervals; its axis composed of a lax net-work of anastomosing, longitudinal filaments. *Fructification:* 1, spherical masses of spores (*favellidia*) contained in external, capsular bodies; 2, oblong, transversely parted *tetraspores*, immersed among the filaments of the periphery.—Name a diminutive of *catena*, a *chain*.

1. C. *Opuntia*, Good. and Woodw. *Grev. Alg. Brit. p.* 166, *t.* 17; *Hook. Br. Fl.* ii. *p.* 309; *Wyatt, Alg. Danm. No.* 126; *Harv. Phyc. Brit. t.* lxxxviii. *Rivularia Opuntia, E. Bot. t.* 1868.

Marine rocks near high-water mark, not uncommon.—*Fronds* densely matted together, half an inch to an inch high, rising from a mass of creeping fibres; branches erect, simple, or slightly branched in an irregular manner, contracted at intervals as if jointed; the *internodes* or spaces between the contractions narrow at base, gradually swelling upwards. *Colour* a dull, dark purple. *Substance* membranaceous, tender and soft, more or less full of moisture, imperfectly adhering to paper.

XVI. Cruoria. Fries. [Plate 20, C.]

Frond gelatinoso-coriaceous, forming a skin on the surface of rocks, composed of vertical, tufted, simple, articulated filaments, set in a firmly gelatinous matrix; one of the joints of each filament larger than the rest. *Fructification:* tetraspores lying at the base of the filaments.—Name, from *cruor, blood;* because the plant looks like a blood-stain on the rock.

1. C. *pellita*, Lyngb. *Harv. Phyc. Brit. t.* cxvii. *Chætophora pellita, Lyngb. Hyd. Dan. p.* 193, *t.* 66; *Harv. in Hook. Br. Fl.* ii. *p.* 390; *Harv. Man.* 1*st ed. p.* 123.

On smooth exposed rocks and stones, between tide-marks. Perennial. Fruiting in February, *Carm.* Common on most of the rocky shores of Britain.—*Fronds* forming smooth, glossy patches of 2—3 inches in diameter, on the surface of smooth rocks, at first circular, afterwards irregularly shaped, between gelatinous and leathery, wholly composed of vertical, coloured filaments set in a colourless jelly. *Filaments* tufted, perfectly simple, dull purple.

XVII. Naccaria. Endl. [Plate 20, D.]

Frond cylindrical or compressed, filiform, solid, rose-red; central cells large, empty, those of the surface minute. *Ramuli* composed of jointed, dichotomous, whorled filaments, surrounded by free gelatine. *Fructification:* spores, attached to the whorled filaments of the (swollen) ramuli. — Name, in honour of *F. L. Naccari*, an Italian Algologist.

1. N. *Wigghii*, Turn. *Harr. Phyc. Brit. t.* xxxviii. *Chætospora Wigghii, Grev. Alg. Brit. p.* 153, *t.* 16; *Hook. Br. Fl.* ii. *p.* 306; *E. Bot. t.* 1165; *Wyatt, Alg. Danm. No.* 124.

Sea shores, very rare. Summer. Annual. Yarmouth, *Mr. Lilly Wigg.* Eastern and southern shores of England and Ireland, and west of Ireland. Usually thrown up from deep water. — *Frond* 6—12 inches high, cylindrical, filiform, much branched; main stem about half a line in diameter, attenuated upwards, repeatedly divided with alternate branches spreading quadrifariously, the branches thickly set with minute, slender ramuli, tapering to both ends, and from about half a line to a line and a half in length. *Structure* of stem and branches cellular; the ramuli composed of minute, dichotomous, gelatinous filaments, radiating from the centre. *Colour* a fine rose-red, given out to fresh water. *Substance* tender and gelatinous, adhering to paper. *Fructification* situated in the centre of the ramuli, which are then much swollen; consisting of numerous minute red spores, attached to the whorled filaments of the branchlet.

XVIII. Gloiosiphonia. Carm. [Plate 21, A.]

Frond cylindrical, filiform, tubular, somewhat gelatinous; the periphery composed of radiating, coloured, branched, jointed filaments. *Fructification:* globules of red spores *(favellidia)* imbedded in the filaments of the periphery, to which they are attached. — Name, γλοιος, *viscid*, and σιφων, a *tube;* from the gelatinous, tubed frond. This genus, founded on the *Fucus capillaris* of Turner, was originally proposed by the late Capt. Carmichael, in his unpublished *Algæ Appinenses*, and has been adopted by Mr. Berkeley. Except in the tubular frond it does not differ from *Mesogloia*.

1. G. *capillaris*, Huds. *Berk. Gl. of Br. Alg. t.* 17, *f.* 3; *Harv. Phyc. Brit. t.* lvii. *Fucus capillaris, Turn. Hist. t.* 31; *E. Bot. t.* 1219. *Mesogloia capillaris, Ag.; Harv. in Hook. Br. Fl.* ii. *p.* 386.

In tide-pools, near low-water mark, very rare. Annual. Summer. Shores of England, Ireland and Scotland in several places, but nowhere common.—*Frond* 3—12 inches high, fine rose-red, of a lanceolate outline, much branched in a repeatedly pinnate manner, the main branches often a line in diameter, ramuli very slender; the branches and ramuli generally opposite, much attenuated at base and apex. Axis, according to Capt. Carmichael, tubular, the walls of the tube composed of jointed, longitudinal, interwoven fibres; the surface of extremely minute, dichotomous, radiating filaments. *Fructification:* large dense masses of spores, scattered among the filaments of the periphery.

XIX. Nemaleon. Targioni. [Plate 21, B.]

Frond cylindrical, gelatinoso-cartilaginous, elastic, solid; the axis columnar, dense, composed of closely packed, longitudinal, interlaced filaments; the periphery of elongated, horizontal, dichotomous filaments, whose ultimate ramuli are moniliform and coloured. *Fructification:* globular masses of spores *(favellidia)* attached to the filaments of the periphery.—Name, from νημα, a *thread*, and λήιον, a *crop;* crop of threads.

1. N. *multifidum*, Web. & Mohr; frond dichotomous, slightly branched; dull purple, elastic; the axils rounded. *Harv. Phyc. Brit. t.* xxxvi. *Mesogloia multifida, Hook. Br. Fl.* ii. *p.* 385; *Berk. Alg. t.* 16, *f.* 1; *Wyatt, Alg. Danm. No.* 98.

On shells and stones near low-water mark, not unfrequent. All round the coast. *Fronds* of a dull purplish brown colour, 3—6 inches high, 1—2 lines in diameter, sub-simple or once or twice dichotomous, sometimes irregularly branched, very elastic. *Axis* much denser than in the following, not clearly filamentous, but rather, as Capt. Carmichael expresses it, "a medullary cord."

2. N. *purpureum*, Harv.; stem undivided, attenuated at base and apex, set with numerous alternate, distichous, elongated, simple, attenuated branches, which are nearly destitute of ramuli. *Harv. Phyc. Brit. t.* clxi. *Mesogloia purpurea, Harv. in Hook. Br. Fl.* ii. *p.* 386; *Wyatt, Alg. Danm. No.* 47.

On stones, &c., in the sea, at extreme low-water mark, very rare. Sidmouth and Torbay, *Mrs. Griffiths* and *Miss Cutler.* West of Ireland, *W. H. H.*—*Fronds* from a foot to 2½ feet high, the main stem 2 or 3 lines in diameter, undivided, alternately branched; the branches patent, sub-horizontal, long, flexuous, simple, either bare of ramuli or furnished with a second series similar to themselves, all much attenuated towards the extremity and somewhat tapering at base. *Colour* a fine purple red, which is given out to fresh water; substance tender and gelatinous, slippery to the touch. Axis composed of laxly interwoven, colourless, branching, longitudinal threads, which throw out on all sides to the circumference horizontal, dichotomous, coloured, moniliform filaments. Under the microscope the apical cells of these filaments cause the branches of the frond to appear as if studded with red beads set in transparent glass. *Fructification:* very dense, roundish masses of sporules, deeply seated among the radiant fibres. In habit this remarkable plant a good deal resembles the granuliferous state of *Gracilaria compressa*, while the substance is more that of *Halymenia ligulata*.

XX. Dudresnaia. Bonnem. [Plate 21, C.]

Frond cylindrical, gelatinous, elastic; the axis composed of a lax network of anastomosing filaments, coated with a stratum of closely combined, longitudinal fibres; the periphery of horizontal, dichotomous, moniliform filaments. *Fructification:* 1, globular masses of spores attached to the filaments of the periphery; 2, external *tetraspores*, borne by the filaments of the periphery, and generally terminating a ramulus.—Name, in honour of *M. Dudresnay*, a French naturalist.

1. D. *coccinea*, Ag.; frond fine rose-red, tender and gelatinous, much and irregularly branched; branches alternate, flexuous, moniliform, attenuated towards the apex; ramuli more or less numerous. *Harv. Phyc. Brit. t.* ccxliv. *Mesogloia coccinea*, *Hook. Br. Fl.* ii. *p.* 386; *Wyatt, Alg. Danm. No.* 148. *Rivularia verticillata, E. Bot. t.* 2466.

Southern shores of England and Ireland, very rare. Summer. Brighton, *Mr. Borrer*. Bantry Bay, *Miss Hutchins*. Sidmouth and Torquay, *Mrs. Griffiths* and *Miss Cutler*.—*Frond* 4—8 inches high, of a fine rose-red colour, very tender and gelatinous, from a quarter of a line to a line in diameter at base, gradually attenuated upwards; much and irregularly branched, the smaller branches somewhat pinnated, moniliform, each series becoming narrower. Under the microscope the branches appear composed of numerous jointed, colourless, longitudinal fibres, set at close intervals with dense tufts of rose-coloured, dichotomous filaments, which cause the beaded appearance. The fruit is of two kinds, on distinct individuals: 1st, large dark red masses of minute spores (*favellidia*); 2nd, elliptic-oblong or club-shaped tetraspores, with pellucid pericarps, borne abundantly on the ramuli of the radiating filaments, generally terminating a ramulus.

2. D. *Hudsoni*, Ag.; frond much branched, filiform, pale reddish; branches mostly opposite, horizontal, once or twice pinnate; ramuli numerous, irregular, obtuse. *Harv. Phyc. Brit. t.* cx.; *Hook. Br. Fl.* ii. *p.* 386; *Wyatt, Alg. Danm. No.* 99. *Ulva rubens, Huds. Fl. Angl. p.* 571.

On stones and shells between tide-marks, not uncommon. Summer.—*Frond* excessively branched, slender, filiform, of a pale red or reddish brown colour; branches once or twice pinnated, with a lanceolate outline; ramuli abundant, 1—4 lines long, patent or divaricated, obtuse. The substance tender and gelatinous. "The structure is very remarkable; the frond appears to be made up of tufts of fibres radiating from a centre, each tuft, when separated in water under a glass, resembling a double aster or sea-anemone. In the centre of the petal-like fibres are masses of purplish grains."—*Mrs. Griffiths.*

XXI. Crouania. J. Ag.

Frond gelatinous, filiform, consisting of a jointed, single-tubed filament, whose joints are clothed with dense whorls of minute, multifid ramelli. *Fructification:* 1, *favellidia* "subsolitary near the apex of the ramuli, affixed to the base of the whorled ramelli and covered by them, containing, within a hyaline membranaceous perispore, a sub-globose mass of minute spores;" 2, obovate *tetraspores* of large size, affixed to the bases of the ramelli.—Name, in honour of the brothers *Crouan*, of Brest, celebrated among French Algologists.

1. C. *attenuata*, Ag.; frond capillary, brownish red, gelatinous, moniliform, much branched; main divisions sub-dichotomous, with wide axils; branches alternate, more or less furnished with ramuli. *Harv. Phyc. Brit. t.* cvi. *Mesogloia moniliformis, Griff. in Wyatt, Alg. Danm. No.* 197. *M. attenuata, Ag. Syst. p.* 51. *Griffithsia nodulosa, Ag. Sp. Alg.* ii. *p.* 136.

Very rare. Parasitical on *Cladostephus spongiosus*, at Salcombe, Devon, *Mrs. Wyatt.* Land's End, *Mr. Ralfs.*—*Fronds* 1 or 2 inches high, of a brownish or purplish red colour, excessively slender and gelatinous, much branched, all the branches moniliform or resembling strings of minute beads. The branches consist of a single-tubed, jointed filament or *axis*, from whose joints issue very dense, globular whorls of dichotomously multifid fibres. The joints of the main thread are sometimes short, sometimes of considerable length; in the former case the globular whorls (or *beads*) conceal the main thread altogether; in the latter they are widely separated, and then the plant, under a low power of the microscope, something resembles *Ceramium diaphanum*. *Fructification:* large *tetraspores* with pellucid pericarps, resembling those of *Callithamnion*, seated on the whorled filaments, either in pairs, or placed round the branch. I have never seen the *favellidia* above described, which are given on the authority of Professor Agardh.

ORDER XIII. CERAMIACEÆ.

Ceramieæ, *J. Ag. Alg. Medit. p.* 69. *Endl. 3rd Suppl. p.* 34. *Dne. Class. p.* 62 (in part). Callithamnieæ and Ceramieæ, *Kütz. Phyc. Gen. pp.* 370, 378. Cerameæ, *Lindl. Veg. Kingd. p.* 25.

Diagnosis.—Rose-red or purple sea-weeds, with a filiform frond, consisting of an articulated, branching filament, composed of a single string of cells, sometimes coated with a stratum of small cells. *Fructification:* 1, *favellæ;* berry-like receptacles, with a membranous coat, containing numerous angular spores; 2, *tetraspores* attached to the ramuli, or more or less immersed in the substance of the branches, scattered.

Natural Character.—Root small and discoid, sometimes creeping. *Frond* of small or mediocre size, almost always filamentous, generally filiform and cylindrical, rarely compressed or flat (in some species of *Ptilota*), narrow, much branched and mostly pinnate: in some cases dichotomously divided. In the simplest forms of this order (as *Callithamnion*) the frond consists of a single string of cylindrical cells, one growing from the apex of another, and forming branches by cells budding from points just below the apex of the previously formed cell. This structure prevails through the whole frond of the smaller *Callithamnia*, but in the larger species, the lower part of the branches and the whole of the stem are strengthened with numerous internal filaments traversing the frond; and in the shrubby species the stems are quite opake, and seem composed of a multitude of longitudinal filaments closely packed together. But even in these compound structures the frond has at first been organized as a simple string of cells, and will always be found to be traversed by an articulated filament, which is the original branch or stem, round which the longitudinal, secondary threads have been subsequently developed. These secondary or strengthening strings of cells appear to be formed at the bases of the upper branches, and to extend downwards, in a manner perfectly analogous to the formation of wood-bundles in a vascular plant. In such species as *Cal. tetragonum* and *C. brachiatum* the gradual introduction of such strengthening filaments may readily be traced by selecting specimens of different ages. In the young plants the branches and stem will be found to be nearly destitute of these secondary fibres, while old specimens are rendered almost opake by the large number of them. In *Callithamnion* the coating cells appear to be introduced into the walls of the original filament, but in more compound forms, as in *Microcladia* and *Ptilota*, the coating of the primary or axial filament is formed by the addition of one or more strata of small, mostly polygonal cells. Such fronds then appear to be inarticulate or cellular, all traces of joints being concealed by the incumbent cells. The tissue of which the *Ceramiaceæ* are composed is tender and delicate, and the frond usually adheres strongly to paper in drying, and soon decomposes if left in fresh water. Decomposition instantly shows itself by the colour changing from the clear, pinky red natural to the order to a bright orange; and this change of colour is accompanied by a disagreeable odour and the sudden breaking up of the branches into their component cells. In *Griffithsia* the disruption of the membrane is accompanied by a crackling noise, convulsive shrinkings, and the sudden discharge of all the colouring matter. This matter, in many of the genus, stains paper in a durable manner with a brilliant crimson, and might doubtless be applied as a pigment.

There is considerable uniformity in the fructification of the plants of this order. The conceptacular fruit, which is called a *favella*, is a metamorphosis of a secondary branch. In some it is formed with great regularity, while in others it has a diseased appearance. In *Callithamnion* the favellæ are naked, berry-like masses, terminating truncated branches, and are formed by the sudden stoppage of the branch, and the conversion of its apex into a mass of spores. These spores are at first attached to filaments within the favella, but eventually become free. In *Griffithsia*, *Ceramium*, and most other genera, the favellæ are protected by a whorl of short ramuli standing round them like the involucre to a flower. In *Ceramium* the favellæ are sessile, and either naked or (more commonly) involucrate. The *tetraspores* are rarely aggregated, being usually scattered along the lesser branches and ramuli. In *Callithamnion* and *Griffithsia* they are external, attached by a point at the base to the ramulus on which they sit; in *Seirospora* they are formed at the expense of the cells of the ramulus, each cell becoming transformed into a tetraspore; and in *Ceramium* and *Ptilota* they are either wholly immersed among the peripheric cells, from some of which they are formed, or they project beyond the surface, like little pimples. In most cases they are tripartite, in a few cruciate, but I do not remember any transversely-zoned tetraspores among the plants of this order.

In several exotic genera the frond assumes the appearance of a network, owing to the branches and ramuli continually growing into each other, or anastomosing. Some of these network genera (as *Halophlegma*) have no certain form, but resemble crimson sponges, variously lobed and sinuated; others (as *Thuretia*) are perfectly symmetrical, their branches and ramuli arranging themselves like the costæ and nerves of a skeleton leaf, and growing into perfectly defined fronds. One of these network ceramioid genera is found in the Adriatic, and may yet be discovered by some fortunate dredger in the south of England; the rest are natives either of the tropics or of Australia.

Most of the British genera, and several of the species, are widely dispersed. *Ceramium rubrum* grows almost wherever marine plants will grow, from high arctic to high antarctic latitudes; and *Spyridia filamentosa* is dispersed through all the warmer parts of the sea, and in Britain finds its northern limit. None of this order have been employed in the arts, unless the composition of sea-weed pictures, for which purpose they are great favourites, be considered to entitle them to the honour due to useful plants.

SYNOPSIS OF THE BRITISH GENERA.

I. PTILOTA. *Frond* compressed, inarticulate, distichous, pectinato-pinnate. *Favellæ* pedunculate, involucrate. [Plate 22, A.]

II. MICROCLADIA. *Frond* filiform, inarticulate, dichotomous. *Favellæ* sessile, involucrate. [Plate 22, B.]

III. CERAMIUM. *Frond* filiform, articulate, dichotomous; the joints opake. *Favellæ* sessile, mostly involucrate. *Tetraspores* mostly immersed. [Plate 22, C.]

IV. SPYRIDIA. *Frond* filiform, inarticulate; the branches clothed with minute, setiform, articulated ramelli. *Favellæ* pedunculate, involucrate. *Tetraspores* sessile on the ramelli. [Plate 22, D.]

V. GRIFFITHSIA. *Frond* articulated, dichotomous, or clothed with whorled, dichotomous ramelli, rose-red. *Favellæ* involucrated, sessile or pedunculate. *Tetraspores* sessile, on whorled ramelli. [Plate 23, B.]

VI. WRANGELIA. *Frond* articulated, pinnate. *Favellæ* terminal, involucrated, containing tufts of pear-shaped spores. *Tetraspores* sessile, scattered in the ramelli. [Plate 23, D.]

VII. SEIROSPORA. *Frond* articulated. *Tetraspores* disposed in terminal, moniliform strings. [Plate 23, C.]

VIII. CALLITHAMNION. *Frond*, at least the branches and ramuli, articulated, mostly pinnated. *Favellæ* terminal or lateral, sessile, without involucre (except in *C. Turneri*). *Tetraspores* sessile or pedicellate, scattered. [Plate 23, A.]

I. PTILOTA. Ag. [Plate 22, A.]

Frond inarticulate, linear, compressed or flat, distichous, pectinato-pinnate; the pinnules sometimes articulate. *Fructification:* 1, roundish, clustered *favellæ* surrounded by an involucre of short ramuli; 2, *tetraspores* attached to or immersed in the ultimate pinnules. Name, πτιλωτος, *pinnated;* from the delicately pinnated frond.

1. P. *plumosa*, L.; frond cartilaginous, decompound; secondary branches bi-tripinnate, elongate; pinnæ and pinnules exactly opposite, the latter subulate, cellular, traversed by a narrow, immersed, articulated filament; tetraspores on short pedicels, fringing the margin of the pinnules; favellæ pedunculate, with an involucre of 6—8 subulate ramuli. *Harv. Phyc. Brit. t.* lxxx.; *Grev. Alg. Brit. p.* 155, *t.* 16; *Hook. Br. Fl.* ii. *p.* 307. *Fucus plumosus, E. Bot. t.* 1308.

On the stalks of *Laminariæ*. Perennial. Summer and autumn. Northern and western coasts of Great Britain and Ireland.—*Fronds* 3—14 inches long, much and irregularly branched; branches from a quarter to half a line in width, attenuated upwards, patent, opposite or alternate, closely set with opposite, distichous, pinnated, lanceolate ramuli, from one to four lines in length, the pinnules acute, narrow-lanceolate, simple, or, in luxuriant specimens, again pinnated. *Favellæ* clustered, surrounded by an involucre, terminating the ultimate pinnules, the involucre composed of several subulate ramuli. *Substance* cartilaginous. *Colour* a fine dark red.

2. P. *sericea*, Gmel.; frond flaccid, excessively branched; secondary branches bi-tripinnate; pinnæ and pinnules exactly opposite, the latter linear, composed of a single row of cells; tetraspores on short processes of the pinnules; favellæ pedunculate, binate, naked, or surrounded with a few irregular ramuli. *Harv. Phyc. Brit. t.* cxci. *P. plumosa, β. capillaris, Harv. in Man. Ed.* 1, *p.* 84; *Wyatt, Alg. Danm. No. 77.*

On perpendicular rocks, between tide-marks, common; rarely on the stems of *Fucus serratus*. Perennial. Summer and autumn. All round the British coast.—*Fronds* tufted, 2—6 inches long, excessively branched, sometimes very dense, flaccid and soft to the touch, repeatedly pinnate. Ultimate pinnules very closely set, distinctly articulated, composed of a single row of coloured cells. *Colour* rarely a brilliant, usually a dull brownish red. A smaller and more delicate plant than the preceding, of much darker colour and more flaccid substance, and readily distinguished by the articulated pinnules. This species is the only *Ptilota* found on the south coast of England.

II. Microcladia. Grev. [Plate 22, B.]

Frond filiform, compressed, distichously branched, traversed by a wide articulated tube surrounded by numerous, large, coloured, angular, radiating cells, the outer coat formed of minute cells. *Fructification:* 1, sessile, roundish, involucrated *favellæ;* 2, *tetraspores* immersed in the ramuli.—Name, *μικρος, small,* and *κλαδος,* a *branch.*

1. M. *glandulosa*, Soland. *Grev. Alg. Brit. p.* 99, *t.* 13; *Hook. Br. Fl.* ii. *p.* 293; *Wyatt, Alg. Danm. No.* 68; *Harv. Phyc. Brit. t.* xxix. *Fucus glandulosus, E. Bot. t.* 2135.

In the sea, on other Algæ; very rare. Annual. Producing fruit in September and October. South of England, and East coast of Ireland. At Bray, *Mr. Sanders;* Kingstown, *Mr. Andrews.*—*Fronds* tufted, 1 or 2 inches high, about a quarter of a line in width, compressed, much branched from the base in an alternate or irregularly dichotomous manner, forming roundish fastigiate tufts; branches distichous, with patent axils, preserving nearly an equal breadth throughout, repeatedly divided, the ultimate ramuli short, and either subulate or bifid at the apex, in which case the points are forcipate. Under a low power of the microscope the branches appear marked with large, hexagonal, transverse areolæ, about three of which form the breadth of the frond, an appearance caused by the large cellules of the central part of the frond being seen through those of the surface, which latter, on increasing the magnifying power, are found to be exceedingly small and close. *Colour* a fine rose red. *Substance* cartilagineo-membranaceous, adhering to paper. *Favellæ* sessile on the margin of the branches, surrounded by two or three short subulate ramuli; *tetraspores* imbedded in the tips of the branches. This genus is scarcely sufficiently distinct from *Ceramium*, of which it has the habit, and from which it chiefly differs in the more opake frond. The structure is very similar.

III. Ceramium. Roth. [Plate 22, C.]

Frond filiform, one-tubed, articulated; the dissepiments coated with a stratum of coloured cellules, which sometimes extend over the surface of the articulation. *Fructification:* 1, sessile, roundish *favellæ*, having a pellucid limbus, containing minute, angular spores, and subtended by one or more short, involucral ramuli: 2, *tetraspores* either immersed in the ramuli, or more or less external.—Name, from κεραμος, a *pitcher*; but the fruit is not pitcher-shaped.

Section 1. Rubra. Smooth; the whole surface of the articulation covered with coloured cells.

1. C. *rubrum*, Huds.; filaments robust, gradually attenuated, irregularly dichotomous, having lateral, forked or multifid ramuli, the apices hooked inwards; articulations coated with coloured cellules, unarmed, the lowermost twice as long as broad, the upper shorter than their breadth; dissepiments constricted; tetraspores immersed in the articulations, whorled; favellæ globose, mostly borne on the lateral branchlets, subtended by three or four involucral ramuli. *Harv. Phyc. Brit. t.* clxxxi.; *Hook. Br. Fl.* ii *p.* 336; *Wyatt, Alg. Danm. No.* 42. *Conferva rubra, E. Bot. t.* 1166.

On rocks, stones, and Algæ in tide-pools; also dredged in 4—5 fathoms. Annual. Summer and Autumn. Very abundant on the British coasts.—*Frond* 2—12 inches long, robust, very variable in ramification; when growing in favourable situations of a clear red colour, but often much faded, brownish or yellow. Sometimes the lateral ramuli are all secund; sometimes there are scarcely any, and sometimes they are very numerous.

2. C. *botryocarpum*, Griff.; filaments crooked at the base, robust, gradually attenuated, irregularly dichotomous, having numerous lateral, mostly simple ramuli, the apices straight; articulations coated with coloured cellules, unarmed, the lowermost twice as long as broad, the upper shorter than their breadth; dissepiments constricted; tetraspores immersed in the articulations, whorled; favellæ globose, of small size, heaped together in irregular clusters, borne on the

lateral branchlets, destitute of involucral ramuli. *Harv. Phyc. Brit. t.* ccxv.

On rocks and Algæ, between tide-marks. Annual. Summer. Preston rocks, Torquay, *Miss Amelia E. Griffiths*; Ardrossan, *Rev. D. Landsborough*.—*Stems* sharply hooked or curved at the base. A smaller plant than the preceding, with the apices of the branches straight; the ramuli very numerous, and above all, the favellæ heaped together like clusters of small shot. *Colour* a lurid purplish red, often fading to green and yellow.

Section 2. DIAPHANA. Smooth; the surface of the articulation either altogether denuded, or but partially covered with coloured cellules, leaving a colourless space in the centre.

3. C. *decurrens*, Kütz.; frond robust, gradually attenuated upwards, dichotomous, with few lateral branchlets, the apices hooked inwards; articulations partially coated with coloured cellules which extend from the dissepiment at each end, but leave a colourless, pellucid space in the centre of the articulation; lowermost articulations twice as long as broad, upper very short. *Harv. Phyc. Brit. t.* cclxxvi.

On rocks, in tide pools. Annual. August. Torquay, on the Harbrick, *Mrs. Griffiths*.—*Filaments* thicker than hogs' bristles, 6—8 inches long, gradually attenuated, distantly forked, naked or furnished with a few scattered ramuli. *Articulations* somewhat moniliform, pellucid in the middle, but coated with coloured cells for a considerable space at each end. This plant seems almost exactly intermediate between *C. rubrum* and *C. diaphanum*. It has the size, and general habit of the former, but the partially hyaline articulations connect it with the latter. I have not seen any fructification. A specimen which I communicated to Professor Kutzing was returned to me by that author, named *C. decurrens*, *β. majus*, Kütz.

4. C. *Deslongchampii*, Chauv.; filaments subsetaceous, attenuated upwards, rigid, irregularly dichotomous, with or without lateral ramuli; the apices straight, spreading; articulations colourless, those of the main stems about thrice as long as broad, of the branches and ramuli much shorter; dissepiments opake, scarcely swollen; tetraspores whorled round the joints, prominent; favellæ heaped together, bursting irregularly from the sides of the branches destitute of involucral ramuli. *Harv. Phyc. Brit. t.* ccxix.; *Wyatt, Alg. Danm. No.* 218. *Cer. Agardhianum, Griff. in Harv. Man. ed.* i. *p.* 99.

On rocks in the sea, between tide-marks.—*Stems* 3 or 4 inches high, much branched in an irregularly dichotomous manner, the branches more or less furnished with simple or forked, slender ramuli, about one-third the diameter of the part from which they spring; the tips spreading, not hooked in. The whole frond variegated with dark purple; the joints transparent. To the naked eye the tuft has a blackish look: the substance is rigid, cartilaginous, and it adheres pretty fully to paper. *Favellæ* very irregular in form and size, having a distorted appearance, usually lobed, bursting from the stems over which they are thickly seattered, destitute of involucral ramuli; *tetraspores* large and very prominent, seated in the joints, *often of the same plant which bears "favellæ*."

5. C, *diaphanum*, Ag.; frond setaceous, attenuated upwards, rather flaccid, irregularly dichotomous, the lower forkings distant, the upper close together; branches set with short, lateral, dichotomous ramuli; articulations colourless, those of the main stems 3 or 4 times as long as broad, of the ramuli short; dissepiments swollen, opake; apices hooked inwards; favellæ near the tips of the branches, subtended by ramuli; tetraspores whorled in the joints, depressed. *Hook. Br. Fl.* ii. *p.* 336; *Wyatt, Alg. Danm. No.* 87; *Harv. Phyc. Brit. t.* cxciii. *Conf. diaphana, E. Bot. t.* 1742.

On the smaller Algæ in tide-pools. Winter and summer.—*Stems* tufted, 2—6 inches high, the thickness of hogs' bristles, irregularly or sub-dichotomously branched, the branches set at greater or less intervals with short or long dichotomous ramuli, two lines to half an inch long, which are constantly greatly more slender than the branches from which they spring, generally not more than a quarter their diameter; the tips generally hooked inwards. The whole frond is distinctly jointed, the dissepiments darkly coloured, the intervals pellucid, giving the filament a beautifully variegated appearance. *Favellæ* near the tips of the branches, roundish or somewhat lobed, generally subtended with one or two short ramuli; *tetraspores* prominent, large, with a pellucid case, seated in the coloured portion of the joints.

6. C. *gracillimum*, Kütz.; frond excessively slender, of nearly equal diameter throughout, very flaccid and gelatinous, dichotomous; the branches set with minute, flabelliform, dichotomous ramuli; articulations colourless, those of the branches five or six times as long as broad, those of the ramuli very short; dissepiments opake, purple; favellæ borne on the lateral ramuli, with a spreading, many-rayed involucre. *Harv. Phyc. Brit. t.* ccvi.

On mussel-shells, and on *Corallina officinalis* and other small Algæ, between tide-marks. Annual. Summer and autumn. West of Ireland, and South of England, in several places.—*Filaments* 2—3 inches long, much more slender than a human hair, flaccid and tender, irregularly divided, set with minute, many-forked ramuli of fan-like outline. *Colour* a dark, reddish purple.

7. C. *strictum*, Kütz.; frond capillary, nearly equal, membranaceous, irregularly dichotomous, the lower forkings

distant, the upper closer, all the divisions erect and straight, with narrow, acute angles; the apices straight, or slightly hooked inwards; articulations colourless, those of the stem and branches three to four times as long as broad, of the ramuli short; dissepiments opake, purple; favellæ near the tips of the branches, involucrate; tetraspores erumpent, bursting from the dissepiments of the larger branches. *Gongroceras strictum, Kütz. Phyc. Gen.*

On mussel-shells &c. in tide-pools. Annual. Summer. Torquay, *Mrs. Griffiths;* Dingle, *W. H. H.;* Roundstone, *Mr. M'Calla.*—*Filaments* as fine as human hair, densely tufted, not regularly dichotomous nor forming fastigiate tufts, distantly branched below, more frequently divided above. Articulations long in the middle of the filament. *Colour* of the tufts, when strong, dark livid purple, paler and yellower in sunny situations. *Substance* membranous, not very firmly adhering to paper. I sent one of my Dingle specimens to Prof. Kutzing, who returned it with the above name, It appears to be identical both with the Roundstone and Torquay plants. The frond is more slender than in *C. diaphanum*, and much more robust than in *C. gracillimum.*

8. C. *nodosum*, Kütz.; frond capillary, of equal diameter throughout, rigid, dichotomous, excessively divided, fastigiate; the axils very patent; articulations pellucid, those of the middle of the stem from four to six times as long as broad, the upper gradually shorter; dissepiments swollen; tetraspores erumpent, two or three together on the outer edge of short, accessory ramuli; favellæ at the apex of accessory ramuli. *Harv. Phyc. Brit. t.* xc.

On sandy shores, often at the roots of Zostera. Annual. Summer. Generally distributed.—*Fronds* 3—6 inches long, as fine as human hair or more slender, forming globular, fastigiate tufts, repeatedly dichotomous with very patent axils, of nearly equal diameter throughout. Dissepiments swollen, dark coloured; articulations colourless. *Substance* rigid and harsh to the touch when recent. In drying this plant imperfectly adheres to paper.

9. C. *fastigiatum*, Harv.; filaments capillary, equal throughout, dichotomous, level-topped; dissepiments opake; lower articulations colourless, 3 or 4 times longer than broad, upper coloured, short. *Harv. in Hook. Journ. Bot. vol.* i. *p.* 303; *Wyatt, Alg. Danm. No.* 87; *Harv. Phyc. Brit. t.* cclv.

On rocks, &c., in tide-pools, rare. Torquay, &c. *Mrs. Griffiths;* Plymouth, *Rev. W. S. Hore.* Frith of Forth, *Dr. Greville.*—*Filaments* 4 or 5 inches high, very slender, nearly of equal diameter throughout, regularly dichotomous from the base; the lower axils distant, the upper very close, many times forked; the apices fastigiate and hooked inwards. *Lower articulations* generally 3 or 4 times as long as broad, colourless; upper very short, rosy; dissepiments opake, swollen, purple. *Substance* tender and flaccid. *Colour* of the tuft, pinky-purple.

Section 3. CILIATA; frond armed, at the dissepiments, with one or more prickles, or bristle-like hairs.

10. C. *flabelligerum*, J. Ag.; frond subsetaceous, attenuated upwards, rigid, flabellately branched, irregularly dichotomous, with lateral, forked ramuli, the apices acute, patent or somewhat incurved; articulations coated with coloured cellules, those of the lower branches about twice as long as broad, of the upper equal in length and breadth, each armed on the outer edge with a single, minute, subulate, coloured, three-jointed prickle; tetraspores erumpent, whorled round the joint; favellæ 2—3 lobed, berry-like, subtended by several, patent, subulate ramuli. *Harv. Phyc. Brit. t.* cxliv.

On the smaller Algæ, between tide-marks. Annual. Summer and autumn. Rare. Torbay, *Mrs. Griffiths*; Jersey, *Miss White;* Blue Anchor Bay, *Miss Gifford;* Downshire Coast, *Rev. W. Edwards.—Frond* 2—3 inches high, as thick as hogs' bristle, gradually attenuated, somewhat flabellately branched. *Articulations* entirely covered with small cells. This plant resembles a small variety of *C. rubrum* for which it may readily be mistaken, if attention be not directed to the solitary thorn with which the joints are armed.

11. C. *echionotum*, J. Ag.; frond slender, of nearly equal diameter throughout, rigid, repeatedly dichotomous, frequently with lateral forked branchlets, fastigiate, the apices more or less involute; articulations pellucid, those of the middle of the stem three or four times longer than broad, the upper gradually shorter, the uppermost extremely short; dissepiments coloured, armed with numerous, slender, irregularly-inserted, subulate, colourless, one-jointed bristles; tetraspores mostly solitary in each joint, erumpent, along the outer margin of the filament; favellæ mostly bi-lobed, lateral, subtended by numerous, strongly incurved ramuli. *Harv. Phyc. Brit. t.* cxli.

On rocks, stones, and the smaller Algæ, between-tide-marks. Annual. Summer and Autumn. Not uncommon. Forming very dense, fastigiate, dark red or purple, somewhat rigid tufts. This species is at once recognised by the numerous *scattered* and *very slender* bristles which clothe the joints, so different from the *whorled*, robust prickles which distinguish *Cer. ciliatum.*

12. C. *acanthonotum*, Carm.; frond slender, of nearly equal diameter throughout, rigid, repeatedly dichotomous, fastigiate, the apices strongly involute; articulations pellu-

cid, those of the middle of the stem several times longer than broad, the upper gradually shorter; dissepiments coloured, armed on the outer edge with a single robust, broadly subulate, coloured, three-jointed prickle; tetraspores erumpent, whorled round the joint; favellæ roundish, subtended by a solitary, incurved ramulus. *Harv. Phyc. Brit. t.* cxl. *C. ciliatum β. acanthonotum, Harv. Man. ed.* 1, *p.* 100.

On exposed rocks, near low-water mark, and on the smaller Algæ. Annual. Summer and autumn. Not uncommon.—Very densely tufted, 2—6 inches high, matted when old, fastigiate when young, of a very dark purple colour, rigid and harsh to the touch. Known from *C. flabelligerum* by its different habit, and hyaline articulations; and from both the other species of this section by its solitary spine.

13. C. *ciliatum*, Ellis; frond slender, of nearly equal diameter throughout, rigid, repeatedly dichotomous, with or without lateral branchlets, fastigiate, the apices strongly involute; articulations pellucid, those of the middle of the stem from three to four times as long as broad, the upper gradually shorter; dissepiments coloured, furnished with a whorl of robust, subulate, three-jointed prickles; tetraspores alternating with the prickles; favellæ subtended by two or three ramuli. *Harv. Phyc. Brit. t.* cxxxix; *Harv. in Hook. Br. Fl.* ii. *p.* 336; *Wyatt, Alg. Danm. No.* 180. *Conf. ciliata, Ellis. E. Bot. t.* 2428.

On rocks and stones, and on the smaller Algæ in tide-pools. Annual. Summer. Not uncommon. Forming dense, fastigiate tufts of a paler shade of purple than in *C. acanthonotum*, from which this species is at once known by having *numerous, whorled* prickles on each joint. A beautiful object under a low power of the microscope.

IV. Spyridia. Harv. [Plate 22, D.]

Frond filiform, cylindrical, much branched, traversed by a wide, articulated tube, whose walls are composed of small angular cells; ramuli setiform, simple, jointed. *Fructification:* 1, stalked, gelatinous, lobed *favellæ*, involucred by short ramuli, and containing two or three distinct masses of roundish spores; 2, external *tetraspores*, with colourless borders, attached to the ramuli.—Name, Σπυρις, a *basket;* in allusion to the appearance of the receptacles.

1. S. *filamentosa*, Wulf; frond irregularly branched, subopake; branches tapering at the base, more or less densely clothed with setaceous ramuli; articulations of the stem very

short, of the ramuli once and half as long as broad. *Harv. Phyc. Brit. t.* xlvi.; *Harv. in Hook. Br. Fl.* ii. *p.* 337; *Wyatt, Alg. Danm. No.* 88. *Conf. Griffithsiana, E. Bot. t.* 2312.

On rocks between tide-marks. Southern shores of England. Holyhead, *Mr. Ralfs.*—*Stems* tufted, many rising from a broadly expanded disk, thick, 2—8 inches high, irregularly branched, cartilaginous, densely cellular, with an obscure appearance of articulation; branches beset with short, hair-like, simple or subdivided, scattered ramuli. *Colour* a dull red, fading to brownish. A curious plant, and extensively distributed over the world. It is found in the Indian and Pacific Oceans, and in the Mediterranean.

V. Griffithsia. Ag. [Plate 23, B.]

Frond rose-red, filamentous; *filaments* articulated throughout, mostly dichotomous; ramuli single-tubed, often whorled; dissepiments hyaline. *Fructification* double: 1, roundish, gelatinous, involucrated *receptacles* (*favellæ*), including minute granules; 2, *tetraspores* affixed to whorled ramelli.—Named in honour of *Mrs. Griffiths*, of Torquay, Devonshire, the "*facile Regina*" of British algologists.

* *Branches set with short ramelli.*

1. G. *equisetifolia*, Lightf.; stems robust, cartilaginous, whorled throughout with closely imbricated, incurved, many times dichotomous ramelli. *Hook. Br. Fl.* ii. *p.* 337; *Wyatt, Alg. Danm. No.* 181; *Harv. Phyc. Brit. t.* lxvii. *Conf. equisetifolia, E. Bot. t.* 1479.

On the shores of England and the west of Ireland. Frequent. Rare in Scotland. Frith of Forth, very rare, *Mr. Yalden.* Perennial. Summer.—*Stems* 3—8 inches high, a quarter of a line to nearly a line in diameter, inarticulate, much and irregularly branched; the chief divisions more or less beset with shorter branches, of half an inch to an inch in length, simple, and (including their ramelli) fusiform, tapering to the apex and base; the whole frond beset at distances of about half a line with incurved, dichotomous, jointed ramelli, about a line long and overlapping each other. The joints of these ramelli about 4 times as long as broad, swollen upwards. *Colour* a fine rose-red, sometimes brownish. The fructification remains imperfectly known.

2. G. *simplicifilum*, Ag.; stems slender, irregularly branched, whorled with imbricated, straight, once-forked ramelli. *Harv. in Mack. Fl. Hib. pt.* iii. *p.* 212; *Harv. Phyc. Brit. t.* cclxxxvii.

On rocks in the sea, very rare. On rocks near Black Castle, Wicklow, and among *rejectamenta* at Ardinairy Point, Co. Wicklow. Coast of Norfolk, *Rev. W. S. Hore.*—*Stems* 4—8 inches long, cartilaginous, more slender than those of G. *equisetifolia*, irregularly branched; branches long and mostly simple, much attenuated at the point, densely clothed with short, straight, overlapping, jointed ramelli, 1 or 2 lines long, and once-forked near the base. Occasionally the branches bear, together with these ramelli, jointed, slender branchlets, of the thickness of *G. setacea*, and either naked or beset near the summit with forked ramelli; and in other specimens the principal branches are covered with short rudimentary branches, resembling the larger ones. *Colour* a fine pinky red, very much brighter than in *G. equisetifolia*. *Fructification* unknown. I fear this is only an attenuated variety of the preceding.

3. G. *barbata*, Sm.; filaments dichotomous, slender; articulations slightly pyriform, 5 to 8 times as long as broad, the uppermost emitting long, opposite or whorled, multifid, byssoid ramelli on which the tetraspores are borne. *Harv. Phyc. Brit. t.* cclxxxi.; *Hook. Br. Fl.* ii. *p.* 338. *Conf. barbata, E. Bot. t.* 1814.

Thrown up by the sea, extremely rare. Beach at Brighton, *Mr. Borrer*, who, I believe, only found it once, and who has had the kindness to send me a portion of his specimen on talc. Jersey, growing on Algæ in rock pools, *Miss Turner.*—*Frond* 2—3 inches high, slender, gelatinous, many times forked, fastigiate, the lower branches naked, the last few articulations of the upper furnished with opposite or whorled very slender ramelli, resembling the byssoid fibres of a *Polysiphonia*. *Tetraspores* globose, borne on the ramelli. *Favellæ* stalked, involucrate. A much slenderer plant than *G. corallina*.

** *Stems dichotomous, naked.*

4. G. *Devoniensis*, Harv.; filaments very slender, gelatinous, flaccid, dichotomous, the lower axils patent, the upper acute; articulations cylindrical, 7—8 times as long as broad; dissepiments constricted; involucres of tetraspores whorled round the dissepiments of the branches. *Harv. Phyc. Brit. t.* xvi.

On rocks, &c. near low-water mark. Annual (?) Plymouth, not uncommon, *Rev. W. S. Hore*, &c.; Salcombe, *Mrs. Wyatt.*—*Filaments* 2—3 inches high, densely tufted, slender, dichotomous, fastigiate, the lower branches often throwing out root-like fibres which connect the filaments together toward the base. *Colour* a fine rosy red. *Articulations* many times longer than broad, cylindrical. A much more slender and densely tufted plant than *G. corallina*. Some of its more robust forms bear a greater resemblance to slender plants of *G. setacea*, but when in fruit the differently arranged tetraspores at once distinguish it.

5. G. *corallina*, Linn.; filaments dichotomous, incrassated, gelatinous; axils patent; articulations 2—4 times longer than broad, swollen upwards; involucres of tetraspores whorled

round the dissepiments of the branches. *Harv. Phyc. Brit. t.* ccxiv.; *Hook. Br. Fl.* ii. *p.* 338; *Wyatt, Alg. Danm. No.* 89. *Conf. corallina, E. Bot. t.* 1815.

On rocks, &c., between tide-marks, rather rare. On all our coasts.—*Stems* 2—4 inches high, tender and gelatinous, repeatedly and nearly regularly dichotomous, thicker than bristles, sometimes nearly half a line in diameter, jointed, the articulations 2 or 3 times longer than broad, swollen upwards, contracted below, giving the frond the beaded appearance of a coralline. *Fruit:* minute, densely aggregated *tetraspores* with wide borders, forming a band or whorl round the joints, near the tips of the branches; and roundish *favellæ*, disposed laterally on the ramuli.

6. G. *secundiflora*, J. Ag.; filaments ultra-setaceous, somewhat gelatinous but firm, irregularly dichotomous, the lesser divisions flabellate; axils acute; branchlets fastigiate, obtuse, not tapering to a point; articulations cylindrical, two to four times as long as broad, with a very wide border; "involucres on very short, lateral peduncles." *Harv. Phyc. Brit. t.* clxxxv.

On rocks, near low-water mark, very rare. Perennial? Discovered at Bovisand, near Plymouth, by *Rev. W. S. Hore.*—*Filaments* densely tufted, 4—8 inches high, thicker than hogs' bristles, not much attenuated, of a fine, rich crimson-red, repeatedly forked; all the axils acute, and the branchlets very erect. *Apices* not tapering. *Fruit* has not yet been seen in Britain.

7. G. *setacea*, Ellis; filaments dichotomous, setaceous, rigid, straight; the lesser branches sometimes opposite, attenuated to a point; axils acute; joints cylindrical, 5 or 6 times longer than broad; involucres, of both kinds pedunculate, lateral. *Hook. Br. Fl.* ii. *p.* 338; *Wyatt, Alg. Danm. No.* 137; *Harv. Phyc. Brit. t.* clxxxiv. *Conf. setacea, E. Bot. t.* 1689.

On rocks, &c. between tide-marks; not uncommon near low-water mark. Perennial.—*Stems* 3—6 inches long, setaceous, rather rigid, irregularly dichotomous, jointed; joints cylindrical, 3—6 times longer than broad, either bare of ramuli, or, rarely, throwing out from the joints simple, horizontal, root-like fibres. *Colour* a fine transparent crimson, which is instantly given out with a crackling noise, occasioned by the bursting of the membrane, on coming in contact with fresh water. It stains paper of a fine carmine, which keeps unaltered for many years in the herbarium. *Involucres* raised on lateral, club-shaped stalks, 2 or 3 lines long; their ramelli simple or forked, bearing on the inner faces, minute, spherical, crowded, *tetraspores. Favellæ* mostly binate, likewise attached to involucral ramelli, with very wide borders.

VI. Wrangelia. Ag. [Plate 23, D.]

Frond purplish or rose-red, filamentous, jointed; filaments single tubed. *Fructification:* 1, gelatinous *receptacles* (*fa-*

vellæ) terminating the branches, surrounded by an involucre and containing several clusters of pear-shaped spores compacted together; 2, *tetraspores* affixed to the ramuli, scattered.—Name, in honour of Baron von Wrangel, a Swedish naturalist. Nearly related to *Griffithsia*, from which this genus chiefly differs in having scattered tetraspores.

1. W. *multifida*, Huds.; stems setaceous, pinnate or bipinnate, articulated, each joint bearing a pair of opposite, slender, pinnato-multifid, incurved ramelli, or whorled with numerous forked ramelli; joints of the stem many times longer than broad. *Harv. Phyc. Brit. t.* xxvii. *Griffithsia multifida, Hook. Br. Fl.* ii. *p.* 338; *Wyatt, Alg. Danm. No.* 43. *Conf. multifida, E. Bot. t.* 1816.—β. *pilifera:* ramelli very long, sub-simple and hair-like.

On perpendicular rocks, near low-water mark. Frequent on the south coasts of England. West of Ireland. Belfast Bay, *Mr. W. Thompson.* Rare in Scotland, Saltcoats, *Miss Margaret Landsborough.* β. Torquay, *Mrs. Griffiths*—*Stems* 4—6 inches long, as thick as bristles, undivided, pinnated or bipinnated with one or two series of long, simple, distichous, patent branches, articulated; the joints very variable in length in different specimens, 5—10 times longer than broad, single-tubed, each bearing an opposite pair of slender, pinnato-multifid or sub-dichotomous ramelli, 1 or 2 lines long, which in β. are much drawn out, half an inch long, and either simple or pinnate. *Colour* a fine transparent rose-red, perishing quickly in the air or in fresh water. *Tetraspores* minute, elliptical, with a wide border, sessile on the lower part of the ramelli, opposite or secund, occasionally tufted. *Favellæ* roundish, stalked and involucrated, containing clusters of pear-shaped spores. The ramelli are generally described as dichotomous, but they are only so by abortion; the true mode of branching is pinnate, They are sometimes whorled, but more usually opposite.

VII. Seirospora. Harv. [Plate 23, C.]

Frond rosy, filamentous; stem articulated, one-tubed, the articulations traversed by jointed filaments; branches jointed. *Fructification:* 1, *Favellæ* (unknown); 2, oval *tetraspores* disposed in terminal, moniliform strings.—Name, σειρα, a *chain*, and σπορος, a *seed*.

1. S. *Griffithsiana*, Harv. *Phyc. Brit. t.* xxi. *Callith. seirospermum, Griff. in Harv. Man. ed.* 1, *p.* 113. *Cal. versicolor* β. *seirospermum. Harv. in Hook. Journ. Bot. vol.* i. *p.* 302; *Wyatt, Alg. Danm. No.* 19.

On rocks and Algæ, in 4—5 fathom water. Very rare. Torquay, *Mrs. Griffiths;* Salcombe, *Mrs. Wyatt*; Torpoint, Plymouth, *Rev. W. S. Hore;* Portaferry, *Mr. Thompson;* Roundstone, *W. H. H.;* Arran, *Rev. D.*

Landsborough ; Kirkwall Bay, *Rev. J. H. Pollexfen*.—*Stem* 2 or 6 inches high, setaceous, generally undivided, more or less opake and veiny, set with numerous, sub-distichous, long, simple, alternate, patent branches, the lowest of which are longest, giving the plant, when displayed, a broadly-ovate outline ; the largest frequently bearing a second set of similar branches. All are more or less furnished with sub-dichotomo-multifid, level-topped ramuli, of a narrow obovate outline. *Tetraspores* globose, in beaded strings at the tips of the branchlets, several strings generally tufted at each tip. This beautiful plant has the aspect, and many of the microscopic characters of strong specimens of *Cal. corymbosum*, but is at once distinguished by the fructification; the tetraspores in *Seirospora* being formed out of the terminal ramuli themselves, the whole ramulus becoming converted into a string of bead-like tetraspores.

VIII. Callithamnion. Lyngb. [Plate 23, A.]

Frond rosy or brownish red, filamentous; stem either opake and cellular, or translucent and jointed; branches jointed, one-tubed, mostly pinnate (rarely dichotomous or irregular); dissepiments hyaline. *Fructification*: 1, roundish or lobed, berry-like *receptacles (favellæ)* seated on the main branches, and containing numerous, angular spores: 2, external *tetraspores*, scattered along the ultimate branchlets or borne on little stalks.—Name, from καλλος, *beautiful*, and θαμνιον, *a little shrub*.

Section 1. Cruciata: *ramuli opposite*. (Sp. 1—7).

1. C. *plumula*, Ellis ; stems distichously branched, subdichotomous, articulated ; each joint bearing a pair of short, recurved plumules pectinated on their upper margin. *Hook. Br. Fl.* ii. *p.* 339 ; *Wyatt, Alg. Danm. No.* 138 ; *Harv. Phyc. Brit. t.* ccxlii. *Conf. plumula, Dillw. t.* 50. *C. Turneri, E. Bot. t.* 1637, (*not t.* 2336).—β. smaller in every part.

In the sea from Orkney to Devon, not uncommon. β. Devonshire, *Mrs. Griffiths.* Dublin Bay.—*Fronds* 2—5 inches long, distichously branched ; the branches alternate or irregular, the upper ones longest and most divided, slender, articulated throughout ; every articulation having a pair of opposite, horizontal or recurved ramuli, from a quarter to half a line in length, and about a quarter the diameter of the stem, whose upper margin is pectinated with a second series of subulate branchlets, which, in luxuriant specimens, are often again and again pectinated along their inner faces. *Tetraspores* minute, spherical, borne on the tips of the abbreviated pectinate ramuli. *Favellæ* large, lobed, dark red, on the main branches. *Joints* of the stem 3 or 4 times longer than broad, of the ramuli shorter. *Colour* a fine rose-red. *Substance* flaccid and tender.

C. *cruciatum*, Ag. ; irregularly divided ; branches linear, sub-simple, articulated, each joint having two or four opposite or quaternate, slender, erect, pinnated ramuli. *Hook. Br. Fl.* ii. *p.* 339; *Wyatt, Alg. Danm. No.* 182; *Harv. Phyc. Brit. t.* clxiv.—β. *pumilum;* much smaller, the ramuli more dense, and joints shorter. *Cal. pumilum, Harv. in Hook. Br. Fl.* ii. *p.* 339.

On mud-covered rocks near low-water mark, rare. South of England and South and West of Ireland. Coast of Down, *Mr. W. Thompson.* β. at Miltown Malbay.—*Stems* 1 or 2 inches high, irregularly divided into a number of long, sub-simple branches, which sometimes bear a second or third series; branches linear, jointed, each joint furnished with two opposite or four cruciate, slender, pinnate or occasionally simple, erecto-patent ramuli, from a quarter of a line to a line in length, crowded at the tips of the branches, which, to the naked eye, have a peculiar thickened and darkened appearance. *Colour* a brownish red. *Substance* flaccid. *Tetraspores* elliptical, dark red, seated on the shortened pinnules of the ramuli. *Favellæ* unknown. Having lately had an opportunity of studying this species in its habitat at Torquay, and finding it to vary much in size, and in the length and composition of the ramuli, I do not hesitate to reduce *C. pumilum* to it as a variety.

3. C. *floccosum*, Fl. Dan.; frond capillary, very flaccid, remotely much branched; branches alternate, erecto-patent, articulated; every joint producing a pair of opposite, simple, subulate, erecto-patent, minute ramuli; tetraspores elliptical, pedicellate, produced on the ramuli, near their base. *Harv. Phyc. Brit. t.* lxxxi. *Cal. Pollexfenii, Harv. in An. Nat. Hist. vol.* xiv. *p.* 186, *t.* v. *f* 5—7. *Conferva floccosa, Fl. Dan. t.* 828.

On submarine rocks, near low-water mark. Annual. Spring. Very rare. Orkney Islands, *Rev. J. H. Pollexfen.* Aberdeen, *Dr. Dickie.*—Densely tufted, 1—5 inches long, very slender and flaccid, irregularly divided into several principal branches, somewhat dichotomous; branches naked, or furnished at intervals with short, multifid lesser branches, having an obovate outline; all the branching alternate. Every articulation of stem and branches bears a pair of slender, and very short, opposite ramuli. On these ramuli, toward their base the pedicellated *tetraspores* are borne. *Colour* a bright purplish lake. A most beautiful and distinctly characterised plant, of very rare occurrence, and seemingly confined to the northern parts of Britain.

4. C. *Turneri*, Dillw.; stems rising from creeping filaments, erect, simple or slightly branched, pinnated with opposite, spreading, simple ramuli; articulations of the stem 5—10 times longer than broad; tetraspores clustered, subracemose or corymbose; favellæ involucrated, stalked. *Harv. in Hook. Br. Fl.* ii. *p.* 339; *Wyatt, Alg. Danm. No.* 183; *Harv. Phyc. Brit. t.* clxxix. *Conf. Turneri, E. Bot. t.* 2339,

(not t. 1637). Cer. Turneri, Grev. Crypt. t. 355. Cal. repens, Lyngb.; Harv. Man. Ed. 1, p. 115. Conf. repens, Dillw. t. 18; E. Bot. t. 1608.

Parasitical on several marine Algæ, common.—*Stems* rising from creeping fibres, erect, forming a dense globular or elongated tuft, from an inch to an inch and a half high, very slender, once or twice pinnated with opposite branches similar to the stem, which are occasionally, by abortion, alternate. *Articulations* variable in length, but generally many times longer than broad. *Tetraspores* globose, with wide borders, seated along the upper sides of the pinnæ at the joints, either stalked or sessile, clustered or solitary. *Favellæ* stalked, furnished with an involucre, and resembling those of *Griffithsia*. *Colour* a fine rose-red. I do not hesitate to unite under this species the *C. repens*, of authors, which chiefly differs from *C. Turneri*, in having the ramuli often alternate.

6. C. *barbatum*, Ag.; stems (rising from creeping filaments) tufted, much and irregularly branched; branches opposite or alternate, either simple or pinnulated for half their length with minute, opposite, spine-like, erecto-patent ramuli; articulations 2 or 3 times longer than broad; capsules elliptic-oblong, sessile on the sides of the pinnulæ. *Harv. Phyc. Brit. t.* clxv.

On mud-covered rocks within tide-marks. Very rare. Ilfracombe, and on the quay at Penzance, *Mr. Ralfs*. Dredged at Weymouth, *Rev. M. J. Berkeley*.—*Filaments* densely tufted, 1 or 2 inches high, rising from creeping fibres, much and irregularly branched; branches opposite or alternate, of various lengths, and either simple or bearing others, patent, the upper and lesser branches pinnulated for half their length with minute, opposite, spine-like, erecto-patent ramuli, not a quarter of an inch in length, which are deciduous in winter. *Articulations* 2 or 3 times longer than broad, deeply coloured. *Substance* membranaceous and somewhat rigid, imperfectly adhering to paper. *Colour* a brownish or full red. *Tetraspores* elliptic-oblong, with wide borders, sessile on the sides of the pinnulæ. Under the microscope this presents many of the characters of the larger and more branched specimens of *C. Pluma*, but it is a very much larger, coarser, and more rigid plant, to the naked eye resembling *C. Turneri*; the *pinnulæ* are proportionally much shorter and more regular, and the *tetraspores* are of a different shape. Mr. Ralfs says, "If I am right, it is a perennial plant, but in winter it loses the small, opposite ramuli. The plant, both at Penzance and Ilfracombe, grows in tufts, and is generally covered with mud." The habitat, it may be observed, is very different from that of *C. Pluma*.

7. C. *Pluma*, Dillw.; stems rising from creeping filaments, erect, sub-simple or alternately branched; branches naked below, the upper half pinnated with short, erect, close-set, opposite ramuli; articulations 2—4 times longer than broad; capsules globose, stalked. *Harv. in Hook. Br. Fl.* ii. *p.* 340. *Conf. Pluma, Dillw. Suppl. t. F.*

On other Algæ, generally on the stems of *Laminaria digitata*, rare. Bantry Bay, *Miss Hutchins*. Appin, *Capt. Carmichael*. Malbay, *W. H. H.* —*Stems* rising from creeping fibres, a quarter to half an inch in height, either simple or divided into a greater or less number of alternate, or sometimes opposite branches, which are naked below, their upper half pectinato-pinnate. *Pinnæ* opposite, short or long, simple, very erect. *Tetraspores* globose, with wide borders, stalked or sessile, sometimes clustered, often terminating the pinnulæ. *Joints* of the stem and branches 2—4 times longer than broad. *Colour* a full rose-red. Nearly allied to *C. Turneri*, but much smaller and with shorter joints.

Section 2. Fruticosa. Main stems robust, opake, or nearly opake, sub-simple, filled with longitudinal (rootlike) filaments. Ramuli alternate (sp. 8—13).

8. C. *Arbuscula*, R. Br.; stems naked below, robust, cartilaginous, main branches set with shorter branches, which are densely clothed on all sides with minute, imbricated, pinnated ramuli (or plumules); ultimate pinnules simple or forked, recurved, acute, their joints twice as long as broad; tetraspores lining the inner faces of the pinnules. *Harv. in Hook. Br. Fl.* ii. *p.* 340; *Harv. Phyc. Brit. t.* cclxxiv. *Conferva Arbuscula, R. Brown! Dillw. t.* 85; *E. Bot. t.* 1916. *Dasya spongiosa, Ag.*

On rocks and stones between tide-marks. Perennial. Common on the northern and western shores of Scotland and Ireland. Very rare on the eastern shores of Scotland. Frith of Forth, *Drs. Greville* and *Arnott*. Aberdeen, *Dr. Dickie*.—*Stem* cartilaginous, inarticulate, as thick as a crow-quill at base, 3—8 inches long, shaggy with fibres, but destitute of branches below, divided above, the branches set with a second and third series similar to themselves, but shorter, the smallest about two lines long; all quadrifarious, and densely clothed on all sides with minute, pinnated ramuli or plumules. These latter are not a quarter of a line long, simply pinnate, the pinnæ long, subulate, very patent or falcato-reflexed. *Articulations* of the ramuli once and a half or twice as long as broad. *Tetraspores* spherical, with wide borders, lining the inner face of the ramuli. *Favellæ* roundish or lobed, mostly in pairs *Colour* a very dark vinous red. *Substance* of the stem cartilaginous, of the ramuli flaccid. This is the original *Conferva Arbuscula* of Brown, whose specimens I have examined. The figure in Eng. Bot. is not very characteristic: that of Dillwyn is better, except the colour, which is far too bright.

9. C. *Brodiæi*, Harv.; stem sub-opake, veiny, obscurely jointed, slender, simple, furnished throughout with patent, alternate branches, which bear at each joint short, quadrifarious, secondary branches, with a narrow, hastate outline; secondary branches laxly set with short, quadrifarious plumules; ultimate pinnules erecto-patent, obtuse, sub-simple; tetraspores roundish, sessile near the tips of the pinnules,

mostly solitary. *Hook. Br. Fl.* ii. *p.* 340; *Wyatt, Alg. Danm. No.* 184; *Harv. Phyc. Gen. t.* cxxix.

In the sea, on other Algæ, rare. Forres, *Mr. Brodie.* Coast of Northumberland, *Mr. Robertson.* Torquay, *Mrs. Griffiths* and *Miss Cutler.* Cornwall, *Mr. Ralfs.* Miltown Malbay, *W. H. H.* Annual. Spring.—*Stems* 1—3 inches high, generally undivided, as thick or thicker than hogs' bristles at base, attenuated upwards, inarticulate or with imperfect joints (which are about twice as long as broad, and full of veins), closely beset throughout its whole length with long, simple, quadrifarious branches, of which the lowest are longest, becoming gradually shorter upwards, often again furnished with a second or even third series, and all furnished at the (more or less perfect) joints with short, pinnated ramuli or plumules; the pinnules erecto-patent, either simple, or having a few secund or alternate pinnulæ tapering upwards, but not to an acute point. *Joints* of the ramuli about twice as long as broad. *Tetraspores* globose, on the inner face of the ramuli near the tip, generally solitary, occasionally 2 or 3 together, or on short secund processes of the ramuli. *Favellæ* roundish, large, solitary, or in pairs, borne by the lesser branches. *Colour* a brownish red. *Substance* cartilagineo-membranaceous, flaccid. The general outline of the frond is ovate. Specimens bearing *favellæ* are more delicate and transparent in the stem than the others.

10. C. *tetragonum*, With.; outline of the frond ovate; stem cartilaginous, sub-simple, setaceous, somewhat opake, veiny, set with sub-quadrifarious, lateral branches, furnished sometimes with a second or third series; penultimate branches pellucidly jointed, slender, elongate, set with short, alternate, patent, level-topped plumules, the lowest of which are simply pinnate, the upper sub-bipinnate; ramuli incurved, narrowed at base, suddenly acuminate, their articulations once and a half as long as broad, constricted at the joints; tetraspores exceedingly minute, oval, near the tips of the ramuli. *Harv. Phyc. Brit. t.* cxxxvi.; *Harv. in Hook. Br. Fl.* ii. *p.* 334; *Wyatt, Alg. Danm. No.* 90. *Conf. tetragona, E. Bot. t.* 1690.

Near low-water mark, on the larger Algæ, frequent. Annual. Summer. —*Fronds* 3—6 inches long, stem thicker than a hog's bristle at base, gradually attenuated upwards, repeatedly branched alternately, the branches irregularly quadrifarious, the lowest longest, and set with one or more series of lesser branches, the upper gradually shorter and more simple; the general outline of the frond being ovate, with its principal divisions tapering to the apex. *Stem* more or less obscurely jointed, naked or clothed with squarrose ramuli; branches set with quadrifarious or sub-distichous, alternate, pinnato-multifid, minute ramuli, about half a line in length, contracted at base and suddenly acuminate at apex. *Substance* firm, cartilagineo-membranaceous. *Tetraspores* excessively minute, sessile, elliptic or roundish, secund, on the upper ramuli. *Favellæ* solitary or in pairs, large. *Colour* full or brownish red, becoming darker in drying.

11. C. *brachiatum*, Bonnem.; outline of the frond lanceo-

late; stem cartilaginous, sub-simple, setaceous, somewhat opake, veiny, set with sub-quadrifarious, lateral branches, often furnished with a second series; penultimate branches pellucidly jointed, slender, elongate, set with short, alternate, very erect, level-topped plumules, the lowermost of which are most simple; ramuli erect, subulate, not narrowed at base, gradually tapering to a fine point, their articulations twice as long as broad, cylindrical; tetraspores minute, oval, near the tips of the ramuli. *Harv. Phyc. Brit. t.* cxxxvii. *C. granulatum, Harv. in Hook. Br. Fl.* ii. *p.* 334 (*not of Ag.*). *C. Harveyanum, J. Ag. in Linn.* xv. *p.* 45.

Parasitical on Algæ, near low-water mark; frequent. A more slender plant than the preceding, with longer articulations in the stem, but chiefly distinguished by the different form of the ultimate ramuli. In *C. tetragonum* the ramuli are mucronate, or suddenly tapering at the point; here they are subulate, tapering from the very base. Still, this character may possibly be variable.

12. C. *tetricum*, Dillw.; rigid; branches densely ramulose, shaggy below, plumulate above; plumules crowded, quadrifarious, simply pinnate; pinnæ acute, tapering to the base, erecto-patent; articulations 2 or 3 times longer than broad; tetraspores elliptical, minute, on short, lateral processes of the pinnules. *Harv. in Hook. Br. Fl.* ii. *p.* 342; *Wyatt, Alg. Danm. No.* 141; *Harv. Phyc. Brit. t.* clxxxviii. *Conf. tetrica, E. Bot. t.* 1915.

In the sea, generally growing on the perpendicular faces of rocks, at half-tide level. Perennial. Common on the rocky coasts of England, and of the west and south of Ireland.—*Fronds* 2—8 inches long, divided into several principal branches, closely covered with long, peculiarly straight and rigid, pinnated ramuli, mixed with simple or irregularly branched ones; the the branches having a coarse, ropy character. *Plumules* simply pinnated, the pinnæ erecto-patent, contracted at base, attenuated upwards. *Colour* a dull brownish-red. *Substance* more rigid than in most, imperfectly adhering to paper, very fragile if moistened after having once been dried. *Articulations* uniformly about once and a half as long as broad. *Tetraspores* 1—3 on each lateral process. *Favellæ* generally in pairs, minute, seated on the pinnæ, and nearly terminal.

13. C. *Hookeri*, Dillw.; stem setaceous, inarticulate or spuriously jointed, simple, set with one or more series of alternate, spreading, flexuous branches, the smaller of which are jointed; all furnished with very patent, pinnated ramuli or plumules; ultimate pinnules divaricating, their joints twice or thrice as long as broad; tetraspores along the inner faces of the ramuli near the base. *Harv. Phyc. Brit. t.* cclxxix.; *Harv. in Hook. Br. Fl.* ii. *p.* 341. *Conf. Hookeri,*

Dillw. t. 106. *C. lanosum, Harv. l. c.*; *Wyatt, Alg. Danm. No.* 139.

On rocks and Algæ between tide-marks. Annual. Spring and summer. Cawsie, *Messrs. Hooker* and *Borrer*. Not uncommon, from Orkney to Cornwall.—*Stem* 1—3 inches high, setaceous, inarticulate or spuriously jointed (the joints short and filled with veiny fibres), closely furnished throughout with long, simple branches, similar to itself, which again bear a second or third set, either quadrifarious or sub-distichous, flexuous; the lesser ones jointed, and at the joints bearing very patent, pinnated ramuli or plumules, which are sometimes naked at the base, and either simple or bipinnated above, all the pinnules very patent or divaricating. *Joints* twice or thrice as long as broad. *Tetraspores* along the inner face of the ramuli near the base, either solitary or 2 or 3 together. *Favellæ* large, on the branches, irregular. *Colour* a brownish or rosy-red, in some states preserved in drying, at other times very fugacious. The specimens of this plant from North Devon and from the South of Ireland, are much more robust and deeper coloured, and of a less delicate substance than those from Torbay and the east of Ireland, and, at first sight, strikingly resemble *C. Brodiæi*, while the latter come nearer *C. roseum*. A re-examination of the original *Conferva Hookeri*, and comparison with various varieties of *Cal. lanosum*, Br. Fl. induce me to unite the latter to the former. It is certainly a very variable plant, but the varieties run insensibly into each other.

Section 3. Rosea. Main stems slender, evidently articulated, the articulations pellucid, or traversed by a few longitudinal filaments. Branches decompound-pinnate. *Ramuli* alternate. (Sp. 14—23).

14. C. *roseum*, Sm.; stems much and loosely branched; secondary branches long, flexuous, sub-distichously plumulate; plumules lax, with a roundish outline, crowded towards the tops of the branches; pinnules long, patent, sub-simple, curved, simply pinnate; main articulations 4 or 5 times, those of the pinnæ 2 or 3 times longer than broad; tetraspores elliptical, scattered, near the base of the pinnæ. *Harv. Hook. Br. Fl.* ii. *p.* 341; *Wyatt, Alg. Danm. No.* 44; *Harv. Phyc. Brit. t.* ccxxx. *Conf. rosea, E. Bot. t.* 966.

Near low-water mark, on mud-covered rocks and Algæ. Annual. Summer. Yarmouth, *Messrs. Turner* and *Borrer*. Not uncommon, generally distributed.—*Stems* 3 or 4 inches long, setaceous, in young plants jointed, in older opake and full of veins, set throughout with long, more or less quadrifarious, patent branches, which are several times irregularly pinnated, till the plant acquires an excessively branched, entangled character; branches furnished more or less abundantly with long, simply or subsimply pinnated plumules, which are usually crowded in the upper part of the branches, giving the tips (especially of young plants) a dense appearance; the ultimate ramuli elongate, slender, the lower ones usually simple, the upper occasionally pinnulate in the upper part. *Tetraspores* elliptical or spherical, on the inner faces of the ramuli, 2 or 3 together or solitary. *Favellæ* two or more together on the branches. *Colour* in young specimens a fine purple-red, in old brownish, becoming brighter in fresh water.

15. C. *byssoideum*, Arnott; stems extremely slender, flaccid and byssoid, much divided; branches linear-lanceolate, set with long, slender, flexuous, sub-simply pinnate plumules; joints of the branches eight times, of the ramuli four times longer than broad; tetraspores solitary, sessile on the pinnæ. *Harv. in Hook. Br. Fl.* ii. *p.* 342; *Wyatt, Alg. Danm. No.* 185; *Harv. Phyc. Brit. t.* cclxii.

Near low-water mark, on other Algæ. Whitsand Bay, *Dr. Jacob*. Not very uncommon. — *Stems* extremely tender, flaccid and gelatinous, much divided from the base, either with several principal branches thicker than the rest, which bear a great number of lesser branches, or wholly composed of slender, byssoid branches, inextricably entangled together, the main stems in the coarser specimens full of veins; branches having a linear-lanceolate outline, tapering to a point, clothed with long, slender, sub-simply pinnate ramuli, either quadrifarious or distichous, all the divisions alternate. *Joints* of the stem many times longer than broad, of the ramuli about four times longer than broad. *Tetraspores* elliptical, sub-solitary near the base of the ramuli. *Favellæ* sessile on the stems, frequently three-lobed. This species has the habit and substance of *Cal. corymbosum*, with which, at one time, I was disposed to unite it. In ramification, however, it more nearly agrees with *C. roseum*, but is much more slender and delicate.

16. C. *polyspermum*, Ag.; tufts globose; filaments slender, delicate, loosely branched, somewhat naked below, distichously plumulate above; plumules linear-oblong (in outline); pinnæ short, simple, patent, acute, spine-like; articulations of the branches 4 or 5 times, of the ramuli twice as long as broad; tetraspores lining the inner faces of the pinnæ. *Harv. in Hook. Br. Fl.* ii. *p.* 342; *Wyatt, Alg. Danm. No.* 140; *Harv. Phyc. Brit. t.* ccxxxi.

On rocks and the larger Fuci, not uncommon. Annual. Spring and summer. — *Tufts* globose, 1—3 inches in diameter, dense; stems subsimple below, much branched above in a fan-like manner; the branches several times divided and set with lesser branches, all the larger ones having spine-like, alternate, subulate, short ramuli, the larger pinnated with a second series, the uppermost ones occasionally still more compound; all the ramuli spreading, sometimes reflexed. *Joints* of the stem and branches torulose, with a narrow tube. *Capsules* profuse, spherical. *Favellæ* large, roundish or ovate, binate. *Colour* a dull rose-red or purplish. In drying it adheres less perfectly than some others to paper.

17. C. *purpurascens*, Sm.; "purplish-red, repeatedly branched, very slender and tufted, joints slightly turned, thrice as long as broad, with pellucid partitions, those of the

main stems compound; capsules lateral, sessile." *Smith, E. Bot. t.* 2465; *Hook. Br. Fl.* ii. *p.* 343.

"Gathered on the beach at Brighton by *Mr. W. Borrer*, who thinks it may be *C. purpurascens* of Hudson." *Sm.* — With this I am quite unacquainted. Mrs. Griffiths informs me she has specimens gathered in Cornwall, so named by *Dawson Turner*, and *Dr. Goodenough*, that are identical with *Cal. Brodiæi.*

18. C. *fasciculatum*, Harv.; tufted; branches erect, flexuous, level-topped; plumules elongate, erect, linear-obovate, truncate; pinnæ long and flexuous, the lowermost simple, appressed, the upper erecto-patent, ramulose at the tip; articulations of the branches thrice, of the pinnæ once or twice as long as broad, sub-torulose. *Harv. in Hook. Br. Fl.* ii. *p.* 343.

At Yarmouth, *Mr. Borrer.* — 2 or 3 inches high, nearly naked at the base, much branched and tufted upwards, bushy, very slender; the apices of the branches looking, to the naked eye, as if truncated or corymbose; branches long and flexuous, very erect, their upper half closely plumulate, the plumules long and appressed. *Colour* a fine purple-red. *Articulations* of the main stem nearly opake, composed of jointed fibres. *Tetraspores* rare, sub-solitary, elliptical, at the base of the pinnæ. This description, which I now transfer from Br. Fl. was taken from a specimen in Sir W. Hooker's herbarium, marked *C. Borreri.* It did not appear to me to be the same with *Borreri*, a species with which, at that time, I was but little acquainted, but having in the interval seen many anomalous varieties of the latter, I fear that the present must be looked on as a very doubtful species. I have never seen more than Mr. Borrer's specimen.

19. C. *Borreri*, Sm.; sub-simple below, much branched in a fan-like manner above, rigid or flaccid; upper branches set with distichous plumules which are bare of ramuli below, closely pinnate above; pinnæ long, patent, simple (or ramulose at top), the lowermost longest; articulations of the branches 2—5 times, of the ramuli about twice as long as broad; tetraspores roundish, sessile in the inner face of the pinnæ. *Harv. in Hook. Br. Fl.* ii. *p.* 344; *Harv. Phyc. Brit. t.* clix. *Conf. Borreri, E. Bot. t.* 1741. *Cal. seminudum, Ag.! Harv. l. c.*; *Wyatt, Alg. Danm. No.* 187.

On rocks in the sea, rather rare. Yarmouth, *Mr. Borrer.* South of England, in many places. East coast of Ireland, *Miss Ball* and *Miss Gower.* — *Filaments* sub-simple and somewhat bare of branches, or merely set with short ramuli below, much branched in a fan-like manner above, the branches having a roundish general outline, the tips even of the lesser divisions being singularly blunt and rounded; upper branches furnished with distichous, alternate plumules, which are bare of ramuli below, and closely pinnate in their upper half, the lowermost pinnæ being longest, and some of them occasionally pinnulate towards the tips. *Substance* either rigid or very flaccid and membranaceous, a difference which probably depends on age and situation. *Colour* a full or pale rose-red, given out to fresh water. Some specimens have a very straggling look, the chief divisions being set with irregular ramuli, having something the character of a young plant of *C. tetricum*, the uppermost branches only having a few plumulate ramuli. On examination of numerous specimens, in different states, and from various localities, I am induced to unite *C. seminudum* of Agardh and of 'Br. Fl.' with the older species *C. Borreri*. The chief differences I can find are, that the state called *Borreri* is more flaccid, of paler colour, more laxly branched, and having rather longer joints; differences which, in such variable plants, are not of much value.

20. C. *affine*, Harv.; much branched; secondary branches of a roundish outline, long, alternately plumulate; plumules very narrow, linear-clavate, simply pinnate; pinnæ short, erect, increasing in length upwards, attenuate, crowded at top; articulations of branches 3 or 4 times, of pinnæ once and a half as long as broad. *Harv. in Hook. Br. Fl.* ii. *p.* 344.

Shores of Bute, on Fuci, *Dr. Greville.*—Excessively branched, 2 or 3 inches high, bushy; main filaments much divided, set with very numerous, alternate, secondary branches, of a roundish or ovate figure, alternately plumulate; plumules short, very narrow; lowermost pinnules distant, short and somewhat spine-like, uppermost elongated and crowded. *Colour* a deep red. *Articulations* of the stem four times as long as broad, closely filled with very slender, longitudinal veins. *Capsules* either in the axils of the pinnæ or on the first joint. A doubtful species.

21. C. *tripinnatum*, Ag.; frond distichously branched, capillary, decomposito-pinnate; plumules elongate, obovate, tripinnate above; upper pinnæ long and pinnulate, lower short or abortive, each pinna having at its axil a minute pinnule; pinnules long, setaceous; articulations of the stem 3—4 times, of the pinnæ about twice as long as broad; tetraspores oval, lateral, on the axillary and occasionally on the other pinnules. *Harv. Phyc. Brit. t.* lxxvii.

On rocks, at extreme low-water mark, very rare. Annual. April and May. Roundstone Bay, *Mr. M'Calla.* Plymouth, *Mr. Rohloff.*—*Filaments* 1—2 inches high, slightly tufted, perfectly distichous, having a circumscribed, fan-like outline, about triply pinnate; the primary branches or *plumules* having an obovate outline. These primary branches are bipinnate above, and simply pinnate towards the base, but the most striking character is a minute axillary ramulus rising from the first articulation of each pinnule. *Colour* a fine crimson, and substance delicate, closely adhering to paper. This species has much of the aspect of the following, but in its microscopic characters is nearer to *C. Borreri.*

22. C. *gracillimum*, Ag.; frond distichously branched, fan-shaped; filaments capillary, decomposito-pinnate; upper plumules long, narrow-ovate or lanceolate, patent, bi-tripin-

nate; articulations of the stem cylindrical, 3 or 4, of pinnæ 2 or 3 times longer than broad; tetraspores on the tips of the pinnules. *Harr. in Hook. Br. Fl.* ii. *p.* 345; *Wyatt, Alg. Danm. No.* 45.

On mud-covered rocks near low-water mark. Pier, Torquay, *Mrs. Griffiths.* Milford Haven, *Mr. Ralfs.* Falmouth, *Miss Warren.* Plymouth, abundantly, *Rev. W. S. Hore,* &c.—*Filaments* 1—4 inches high, irregularly branched, exceedingly slender, distichous; main branches few, unequally plumulate for their whole length; lower plumules short, vaguely pinnate; upper from half an inch to an inch long, narrow-ovate or lanceolate, acute, patent, bi-tripinnate; outline of the principal branches broadly ovate. *Colour* rose-red. *Tetraspores* minute, elliptical, on the tips of shortened pinnulæ. *Favellæ* roundish, lobed, on the principal branches.

23. C. *thuyoideum*, Sm.; repeatedly branched in an alternate manner, distichous; branches set with alternate, lanceolate, narrow, bipinnate plumules; articulations of the stem 2—6 times longer than broad; capsules on the tips of the pinnulæ. *Harr. in Hook. Br. Fl.* ii. *p.* 346; *Harr. Phyc. Brit. t.* cclxix. *Conf. thuyoides, E. Bot. t.* 2205. *Cal. tripinnatum, Harr. l. c. (not of Agardh)*; *Wyatt, Alg. Danm. No.* 186.

On rocks near low-water mark, rare. Yarmouth, *Mr. Borrer.* Plymouth, *Mr. Seonce.* Pier, Torquay, *Mrs. Griffiths.* Wicklow. Portaferry, *Mr. W. Thompson.* Roundstone, *Mr. W. M'Calla.*—*Frond* 1 or 2 inches high, sub-simple below, alternately branched above, the branches distichous, generally having two or more series of lesser branches, which are also alternate; the minor branches, and sometimes all the divisions of the frond, set at every joint with alternate, patent, closely bipinnate plumules, of a very narrow, linear-oblong figure. *Articulations* of the stem very variable in length in different specimens; in some twice, in others six times as long as broad, more or less swollen at the joints. *Tetraspores* on the tips of shortened pinnulæ. *Colour* a fine rose-red. *Substance* soft and flaccid. The first plumule of the branches or pinnule of the plumules frequently rises from the axil, especially in a variety having shorter joints to the stem than usual, which led me in Br. Fl. to regard this variety as the *Cal. tripinnatum* of Agardh, a species, one of whose chief characters is this axillary ramulus. Agardh's plant proves, however, on inspection of authentic specimens, to be very different, and, having been recently discovered in Britain, is above described.

Section 4. CORYMBOSA. Stems articulated; ramuli dichotomous. (Sp. 24—26.)

24. C. *corymbosum*, Sm.: capillary, flaccid, gelatinous; secondary branches alternate, excessively dichotomous, subflabellate, level-topped; ramuli dichotomous, byssoid; articulations of the branches 8—10 times longer than broad;

tetraspores solitary, axillary. *Harv. in Hook. Br. Fl.* ii. *p.* 346; *Wyatt, Alg. Danm. No.* 22; *Harv. Phyc. Brit. t.* cclxxii. *Conf. corymbosa, E. Bot. t.* 2352, *(joints too short).*

On Algæ, near low-water mark, and on rocks, not uncommon.—1—3 inches high, frond with a more or less evident principal stem, which is capillary below, byssoid above, and closely set with long, alternate branches, which are more or less divided; the penultimate ones having alternate, dichotomous, multifid branchlets of an obovate outline, rounded at top, or somewhat level-topped. The branching of these ramuli is subject to much variation, sometimes being nearly regularly dichotomous, at other times having an alternate character, but the plant is well marked to the naked eye by the peculiar, level-topped or corymbose appearance of the smaller branches, joined to their slender, byssoid aspect. *Tetraspores* minute, seated on the forked ramuli immediately below the furcation, thus seemingly axillary. *Favellæ* binate, in the axils of the branches. *Colour* a rose, or purplish red. *Substance* exceedingly flaccid and gelatinous, adhering most closely to paper, and having a fine gloss when dried.

25. C. *spongiosum*, Harv.; stems robust, cartilaginous, more or less opake and veiny, branched in every direction; branches thickly set with dense, quadrifarious, repeatedly dichotomous, round-topped branchlets; axils patent; apices short, bifid; articulations of the branches swollen at the joints, thrice as long as broad. *Harv. in Hook. Br. Fl.* ii. *p.* 346; *Wyatt, Alg. Danm. No.* 93; *Harv. Phyc. Brit. t.* cxxv.

On rocks in the sea, generally such as are perpendicular, and on other Algæ. Dunleary, 1802, *Mr. Templeton*. South of England and coasts of Ireland and Scotland.—*Fronds* 2—4 inches high, flaccid, soft, holding water like a sponge; *stems* shrubby; branches long, spreading in every direction, thickly clothed with short, secondary branchlets, about half an inch in length, which are again covered with a third set, which are dichotomously divided, and, spreading on all sides, give the plant a rounded, bushy character. Main articulations veined. *Tetraspores* solitary, axillary. *Favellæ* roundish or lobed. To the naked eye this plant has something the habit of *C. Arbuscula*, while, in its microscopic characters, it comes nearer *C. corymbosum*. It is, however, a much coarser plant than the latter, void of gloss when dry, and of a duller colour. The joints are uniformly shorter, the ramuli more regularly dichotomous, dense and quadrifarious, and the axils more patent. It was originally discovered by *Mr. Templeton*, in the station in which I afterwards gathered it 30 years later, a fact of which I was ignorant when I first described it in '*British Flora*.'

26. C. *pedicellatum*, Dillw.; stems setaceous, loosely and irregularly branched; branches naked, or set with short, alternate, somewhat tufted, sparingly dichotomous branchlets; apices obtuse; articulations variable, mostly very long; tetraspores solitary, elliptical or pear-shaped, axillary, stalked.

Harv. in Hook. Br. Fl. ii. *p.* 347; *Harv. Phyc. Brit. t.* ccxii.; *Wyatt, Alg. Danm. No.* 94. *Conf. pedicellata, E. Bot. t.* 1817.

On rocks, &c. near low-water mark, not uncommon. Summer.—*Filaments* 2—8 inches high, rather flaccid, as thick as horse-hair, branches long, and little or much divided, springing from near the base, beset with short, dichotomous ramuli, which are often crowded at the tips, so as to give the plant a pencilled appearance; apices always rounded and obtuse. *Articulations* extremely variable in length in different specimens, in some four, in others twelve times longer than broad. *Colour* a fine red, which is rapidly given out in fresh water, and becomes in the herbarium a dull dingy brown. *Tetraspores* elliptical or pear-shaped, very dark, raised on little colourless stalks situated in the axils of the branches. *Favellæ* large, single or in pairs, on the stems.

Section 5. PULVINATA. Filaments short, densely tufted, forming cushion-like tufts, or spreading in velvetty patches. (Sp. 27—29).

27. C. *Rothii*, L.; widely spreading, densely tufted; filaments slender, short, erect, dichotomous; branches long, straight, appressed; articulations twice as long as broad; tetraspores clustered, borne on short, terminal, sub-corymbose ramuli. *Harv. in Hook. Br. Fl.* ii. *p.* 347; *Harv. Phyc. Brit. t.* cxx. B; *Wyatt, Alg. Danm. No.* 188. *Conf. Rothii, E. Bot. t.* 1702.—β. *purpureum*; filaments very minute, forming continuous velvetty patches, slightly branched. *Cal. purpureum, Harv. Man.* 1*st ed.* 1, *p.* 116. *Byssus purpurea, E. Bot. t.* 192.

On marine rocks, above half-tide level. Perennial. Fruiting in winter. —*Filaments* a quarter of an inch to nearly an inch in height, forming large velvetty patches, of a deep red or purple colour. *Branches* few and very erect, either dichotomous or alternate, equal. *Fructification*, as first pointed out by the late *Capt. Carmichael*, frequently produced in the winter months.

28. C. *floridulum*, Dillw.; filaments short; densely tufted, fastigiate, sparingly branched; branches alternate or sub-dichotomous, nearly simple, appressed; articulations thrice as long as broad; tetraspores minute, oval, borne on very short, closely appressed pedicels, ranged in a secund manner along the upper branches. *Harv. l. c. p.* 348; *Harv. Phyc. Brit. t.* cxx. A. *Conf. floridula, Dillw. Suppl. t. F; Wyatt, Alg. Danm. No.* 219.

On marine rocks, near low-water mark. West of Ireland, extremely common. Orkney, *Dr. Pollexfen.* Land's End, *Mr. Ralfs.*—*Filaments* about an inch high, forming dense, fastigiate tufts, very slender and of equal diameter throughout, furnished with a few long, simple, alternate, very erect or appressed branches, some of which bear, near the apex, several alternate or secund, closely appressed ramuli, the lowest of which are longest, the upper gradually shorter, giving the apices of the branches a corymbose or level-topped character. *Joints* fully thrice as long as broad, sometimes rather longer. The fortunate discovery of the fruit by Mr. Ralfs, in April, 1840, affords at length a satisfactory character by which this long-doubtful plant may be distinguished from *C. Rothii.*

29. C. *mesocarpum*, Carm.; "filaments minute, cæspitose; branches virgate, erect; articulations 4 or 5 times longer than broad; capsules elliptical, on long pedicels." *Carm. MSS. Harr. l. c. p.* 348.

Rocks at the extremity of low-water mark. Appin, *Capt. Carmichael.* — *Tufts* contiguous, forming a broad, shaggy, purple crust. *Filaments* 2 or 3 lines long, sparingly branched; branches long, straight, erect, simple and sub-secund. *Tetraspores* crowded about the middle of the filaments, secund or opposite, on long, single-jointed or forked peduncles; the capsules, in the latter case, either in the axils or substituted for a branch of the fork. I could not discover that it sprung from creeping filaments." *Carm. MSS.* This appears to come very near *C. strictum* of Agardh.

Section 6. PARASITICA. Minute parasites. (Sp. 30—31.)

30. C. *sparsum*, Harv.; "filaments minutely tufted, scattered, sparingly branched; branches spreading, unequal; articulations twice or thrice as long as broad; tetraspores obovate, sessile, mostly axillary." (*Carm.*) *Harr. l. c. p.* 348.

On old stems of *Laminaria saccharina*, at Appin, *Capt. Carmichael.* On *Conf. rupestris* at Miltown Malbay.—Scarcely a line high, forming minute, scattered tufts. *Stems* nearly simple, erect, slightly branched beyond the middle; branches erecto-patent, alternate or secund, of unequal length; the apices obtuse. This is probably the *C. floridulum* of *Lyngbye, Hyd. Dan. p.* 136. It is better distinguished from *C. Rothii* by its minute size and scattered habit than by any peculiarity of branching. The fruit, according to Capt. Carmichael is, however, very different.

31. C. *Daviesii*, Sm.; rose-red, minute, tufted, much branched; branches flexuous or straight, scattered or close, erect, more or less furnished with short, sub-secund ramuli; articulations 3 or 4 times longer than broad. *Harv. in Hook. Br. Fl.* ii. *p.* 348; *E. Bot. t.* 2329. *C. virgatulum, Harv. l. c. p.* 349; *Wyatt, Alg. Danm. No.* 189. *C. lanuginosum, Lyngb. Harv. Man. ed.* i. *p.* 117. *Conf. lanuginosa, Dillw. t.* 45. *C. secundatum, Ag. Harv. Man. ed.* i. *p.* 117.

Parasitical on the smaller Algæ, generally on *Ceramium rubrum.*—*Filaments* 2 or 3 lines high, forming elegant, pencilled tufts, much branched; branches straight or somewhat flexuous, erect or slightly spreading, close or distant, the upper ones often closely set with minute, bud-like, 1- or 2-jointed ramuli. *Capsules* minute, elliptical, solitary or clustered. I fear the distinctions pointed out in Br. Fl. between *C. Daviesii* and *virgatulum* cannot be depended on; the latter appears to be merely a more advanced state of the former: nor can I discover any permanent characters by which *C. lanuginosum* and *C. secundatum*, *Ag.* may be distinguished. *Cal. Daviesii* bears a very close resemblance to *Trentipohlia pulchella*, a fresh-water Alga, inhabiting mountain streams.

SUB-CLASS III.

CHLOROSPERMEÆ OR CONFERVALES.

Harv. in Mack. Fl. Hib. part iii. *p.* 220, (1836); ZOOSPERMEÆ, *J. Ag. Alg. Medit. p.* i. (1842). NOSTOCHINEÆ, ULVACEÆ, CONFERVOIDEÆ (*in part.*) *Ag. Syst. pp.* xv. xxxii. ZOOSPERMEÆ *and* SYNSPOREÆ, *Dne. Sc. Nat.* xvii. *p.* 305. CONFERVACEÆ *and part of* PHYCEÆ, *Endl. Pl.* 3d *Suppl. p.* 10, 19. CONFERVACEÆ *and part of* FUCACEÆ, *Lindl. Veg. Kingd. pp.* 14, 20. (DIATOMEÆ, *or* DIATOMACEÆ, *of authors, are also a part of this sub-class*).

DIAGNOSIS.—Plants green, rarely a livid purple. *Fructification:* dispersed through all parts of the frond, the whole colouring matter being capable of conversion into propagula; 1, *spores* (*Sporidia*, Ag.), green or purple, formed within the cells, often at maturity vivacious, moving by means of vibratile cilia; 2, *coniocystæ* (Ag.), or external vesicles, containing a dense, dark-coloured, granular mass, and finally separating from the frond. *Marine, or (more generally) found in fresh-water streams, ponds, and ditches, or in damp situations. (The marine species of this sub-class are alone described in the present work).*

The plants of this sub-class are, in the vast majority of cases, at once distinguished from all other Algæ by the bright grass-green or blue-green colour of the frond. A very few are tinged with lurid purple, and a few others with brown. A simplicity of structure, and fructification dispersed through the whole colouring substance of the frond, not confined to distinct conceptacles, combined with the herbaceous green colour just spoken of, are the marks by which we recognize a Chlorospermatous Alga. When we examine these plants a little more closely, with high magnifying powers, we observe that the *spores* of a large number of them, perhaps of all, are, just at the time of their emission by the parent plant, clothed with vibratile cilia, and endowed with a peculiar motion, strongly resembling the voluntary motion of animalcules. The little spore, whilst contained within the mother cell, commences life by knocking continually against the walls of the enclosure until it has burst through them into the surrounding water; and then, with many gyrations and rapid changes of place, it swims about by means of the cilia with which it is furnished, until it reaches a substance on which it can rest and attach itself. Once attached, its seemingly voluntary motions cease. The cilia are absorbed or perish. The semblance of animal life is laid aside, and the vegetable cellule commences the growth natural to its kind, and finally becomes a plant like its parent. Some observers claim for it an animal life during the season of its ciliary movements, and certainly there is a very striking similarity between these movements and the movements which we observe in the ova of many of the lower animals, particularly of the class Radiata. But that it is a resemblance, a connexion of analogy only, I can scarcely doubt. All must admit that the two great kingdoms of animated nature—animals and plants—(for that plants are endowed with a life analogous to that of animals can no longer be doubted)—approach each other, through the lower members of either kingdom, and seem almost conterminous. In the spores of these Algæ we find one point of seeming contact, but this is laid aside on the commencement of the development of the frond. In some of this sub-class, as in the *Diatomaceæ* and *Oscillatorieæ*, the motion is not always confined to the spore, but the fully formed frond enjoys this singular power in a greater or less degree through the whole of its life-time. And, if you will have it so, the movements of the sensitive plant and of *Hedysarum gyrans* are further instances, taken from among the higher vegetables, of a movement, to all appearance spontaneous, perhaps voluntary. And if animals be distinguished from plants by their voluntary motions only, here are cases which seem to show that the distinction is one of degree and not of kind. And pursuing such a train of thought, I can hardly call it a thread of reason, we are led to question the absolute distinctions between the two great kingdoms of nature, whether a plant and an animal be not really fellow-members of a single fraternity, and not, as commonly supposed, members of distinct organic creations. But in so questioning the absoluteness of the distinctions between animal and vegetable life, we overlook not merely the crowd of other circumstances connected with animal and vegetable existence which would bear to the other side of the argument, while we fix our attention strongly on a few isolated facts that appear to make out our point:—we not only do this, but we shut our eyes to another fact with which no naturalist who has entered at all into questions of affinity can be unfamiliar, namely, that in no case do we see any group in nature in that state of entirety, unconnexion, or nudity, which will enable us to fix its limits with mathematical precision. Are we therefore to doubt that there are limits, because we cannot readily see them? Or that absolute differences do not exist because they pass *our* acuteness to make plain? I can hardly think this; and therefore is it that all the arguments brought forward in favour of the unity of animal and vegetable life appear to my (perhaps prejudiced) mind illusory; and instead of making me more satisfied that the connexion has been proved, remind me merely of those

> "False views, like that horizon's fair deceit,
> When earth and heaven but *seem*, alas, to meet!"

The question is too wide to discuss at large in the present place, nor is it of much practical importance, however interesting it may be in a speculative point of view. For all practical purposes vegetable and animal life are as opposite as the poles of a magnet. They are like two opposite and equal forces in juxta-position: there are innumerable points between the two centres of force in which one or other force preponderates in a greater or less degree:—there is also one point at which neither force preponderates; a middle point, a point of equilibrium or rest. Applying this illustration to to the animal and vegetable kingdom, such a middle point would be a point of death or annihilation—a chasm, however narrow, separating conterminous countries, at one side of which animal life is manifested, but in its lowest conceivable phase; and at the other side vegetable life, in an equally low condition. Some such boundary seems to sever such animals as the sponges, from such vegetables as the less perfect chlorospermatous Algæ — but our present knowledge of either tribe is insufficient to permit us clearly to define in words what the exact limits of this bounding line may be. In such a case it is much safer to leave the point undetermined, seeing that the probabilities are greatly in favour of the belief that, could we know the matter perfectly, such a boundary line would be discovered.

The least organized of the Chlorosperms consist of a single cell, containing a granular matter called endochrome, identical with that found in the cells of the higher vegetables. These very simple plants usually multiply by spontaneous fissure, the internal mass separating into two or more parts, round which a membrane is formed, and which thus become cells developed within the walls of the original cell. These cells burst through the mother-cell and become distinct plants, propagating others at maturity in a similar way. Such is the method of increase in the *Protococcus* or Red-snow plant, whose sudden appearance is readily accounted for by this process of multiplication, by which, in a very few generations some millions of individuals will result from one original cell. If the plant have existed on the surface of the soil on which the snow falls, its progress upwards through the snow, as new individuals are produced, will be very rapid, and thus vast spaces, many feet in thickness, are frequently tinged by a plant of extreme minuteness — so small, that except when seen in masses, it is scarcely appreciable by the eye. Sir John Ross encountered it in Baffin's Bay, covering tracts of miles in extent, and often penetrating to the depth of ten or twelve feet.

Other simple Chlorosperms are propagated by the conjugation of two cells. This is the case in the *Diatomaceæ* and *Desmidiaceæ* and in many of the Confervoid tribes. In the case of the simpler *Desmidiaceæ*, where the frond consists of a single cell, two fronds come together—a passage is formed from one to the other, and in the intermediate space the whole contents of both the parent-cells are poured, resulting in the fructification or spore. The history of such plants is analogous to that of annuals, which die when they have perfected their seeds. But besides this mode of propagation, they are likewise multiplied by the vivification and growth of the green matter with which they are filled. This matter, when mature, becomes granular, and is converted into those active spores (or zoospores) whose animal motions I have already mentioned; and which are probably analogous to the gemmæ or buds, by which more perfect plants are propagated. This, at least, is the opinion of Mr. Ralfs, one of the most accurate observers of these minute plants.

The frond in others, a little more advanced in organization, consists of several cells strung together in filaments, such as we find in Conferva and its allies. These filaments are either simple or branched, and are increased, either by additional cells continually added to the growing apices, and as it were budding out of the old cell; or else by the bipartition of the first-formed cells. In the first case, a little bud-like body is formed at the apex of an old cell, which lengthens and widens until it attains the dimensions proper to the species; when it stops, and gives birth to a bud of like character. In the second case, a transverse separation takes place in the middle of the endochrome of an old cell; a partition or dissepiment is gradually formed, and at last, two cells result from what had been one, and lengthen till they attain their normal state, when each is again capable of this fissiparous division. Such appears to be the mode of growth in *Conferva melagonium*, *ærea*, &c.; while most of the *Cladophoræ* grow by budding. The difference, however, is more apparent than real, for a fissiparous division takes place in both cases. The Confervæ are commonly propagated by zoospores; but sometimes form *sporangia*, elaborated in their cells. From the filamentous *Confervæ* the passage is easy into the Batrachospermaceæ, where a compound frond is built up by the union in bundles and whorls of a number of filaments; and also, through *Anadyomene*, into the Siphonaceæ and Ulvaceæ, where the frond assumes a multitude of forms, expanding into membranes or contracting into hollow tubes. In some of the highest members of the sub-class, as in the Caulerpaceæ, there is an obvious distinction of organs into root, stem and leafy appendages; but even in these, high in structure as they appear, no distinct conceptacles of fruit have yet been observed.

The Chlorosperms are more widely diffused than any other Algæ. A comparatively small number are found in the waters of the sea. A far larger proportion inhabit fresh-water rivers, lakes and ponds, ditches, bog-holes, the gutters of houses and sewers; — in fact, anywhere that fresh or *unfresh* water may lie; nor are they absent from the hot springs of volcanic regions, and are capable of vegetating wherever moisture and a moderate temperature prevail. Thus universally dispersed, they answer many a good purpose in the household of nature, and are specially useful in purifying the water in which they live. Unsightly as the green scum may be which they form on its surface, the growth is a renovating process, in which are consumed the deleterious matters and gases which stagnant water generally contains; while, like all green plants, they pour into the atmosphere, during sunshine, oxygen prepared in their delicate tissues from the carbonic acid on which they feed. Comparatively few of them minister to our personal wants, with the exception of a few Ulvæ which are used for food, and some of the Confervæ which have been employed, where other bandages were unprocurable, for binding fractured limbs, &c.

SYNOPSIS OF THE ORDERS.

14. Siphonaceæ. *Cells* filiform (usually of great length), simple, or branched, variously connected; either one cell forming a filiform frond; or several intertwined and anastomosing cells, forming a compound frond.

15. Confervaceæ. *Cells* cylindrical (not of great length), truncate, connected into simple or branching, rarely anastomosing filaments. *Filaments* naked, or surrounded by gelatine.

16. Ulvaceæ. *Cells* many-sided, cohering into a membranaceous, rarely gelatinous, flat or tubular frond.

17. Oscillatoriaceæ. *Cells* filiform, very long, simple, naked, or invested with mucus, or compacted together into a firmly gelatinous frond. *Endochrome* annulated.

18. Nostochaceæ. *Cells* elliptical or globose, connected in gelatinous, moniliform strings. *Filaments* separate, or several united together in a gelatinous frond.

19. (Palmellaceæ): Sub-order *Hormosporeæ*. *Cells* elliptical or globose, separate, contained within membranaceous, tubular filaments.

Order XIV. SIPHONACEÆ.

Siphoneæ, *Grev. Alg. Brit. p.* 183. *J. Ag. Alg. Medit. p.* 17. *Endl. 3rd Suppl. p.* 16. *Dne. Class. p.* 32 (also Halymedeæ and Acetabularieæ). Siphoneæ, *Lindl. Veg. Kingd. p.* 18, and Vaucherieæ (in part), *p.* 22. Vaucherieæ, Codieæ, Anadyomeneæ, Polyphyseæ and Dasycladeæ, *Kütz. Phyc. Gen. pp.* 302, 308, 311, 312. Caulerpeæ, *Grev. et Auct.* (?)

Diagnosis.—Green, marine or fresh-water Algæ, composed of continuous, tubular, simple or branched filaments, free or variously combined in cylindrical or expanded fronds.

Natural Character.—*Root*, where obvious, consisting of a mass of fibrous threads interwoven together or entangled; rarely of different character from the threads constituting other parts of the frond. *Frond* in the simplest genera (*Vaucheria*, *Bryopsis*) consisting of a single, very long, branching cell or membranous tube, filled with granular colouring matter, without any partition or dissepiment from the base to the apex of the branches. Thus, if a whole frond of *Bryopsis plumosa* be placed on a piece of glass, under water, and the tip of one of its branches be wounded, the contents of the frond may be pressed out through the lacerated part, leaving nothing but an empty skin, and showing that there is no internal diaphragm in any part of the tube. This filiform character of the cells distinguishes the genuine members of the order, the more compound among which are made up of thread-like cells, resembling those of *Bryopsis*, variously united together. In *Vaucheria* the threads remain separate, but are densely tufted together, and variously interwoven, so as, in many instances, to form spongy, cushion-like tufts. In *Codium* there is a closer connexion, the tips of the threads lying close together, or slightly cohering, and the filaments disposed in a definite order, so as to form fronds with a determined outline. In *Halimeda* the union is still more intimate, the spaces between the tips of the filaments being closed up by carbonate of lime, and thus the frond cased in a sort of epidermis, and all its parts built up into a common structure. If a piece of *Halimeda* be placed in acid, so as to dissolve the lime, its parts may readily be dissected, and it will then be seen to consist of branching cells, resembling those of a *Codium* or *Bryopsis*.

Besides the colouring matter or endochrome dispersed through the plant, and which forms in part the fructification, many plants of this order are furnished with little bodies called *coniocystæ*, through which the species is reproduced. These bodies are formed at the sides of the cells, and at first manifest themselves as small mamillæ, or tubercular or club-shaped ramuli, containing a denser colouring matter than other parts of the frond. A diaphragm is formed at their base, and thus a cell is enclosed, in which the colouring matter becomes further organized and gradually compacted into a sporangium. In some *Vaucheriæ* (as in *V. clavata*) a portion of endochrome at the apex of a branch swells, becomes dense, and at length consolidated and separated from that beneath it by a diaphragm. Thus a propagulum or gemmule is formed, which, at maturity, separates from the frond, and becomes a reproductive body. It is clothed with vibratile cilia, by which it moves about until it has fixed itself, and then, lengthening at each end, it changes into a filament, which gradually assumes the character proper to the species, and becomes a new individual. *Coniocystæ* may commonly be found on *Vaucheriæ* in spring, and on the filaments of *Codium tomentosum* in summer, but have, hitherto, been only noticed in one species of *Bryopsis*.

The plants of this order are widely dispersed. All our genera are cosmopolitan, and *Codium tomentosum* is as common on the shores of the Pacific, from high northern to high southern latitudes, as it is in the Atlantic and Mediterranean. A large number of genera are peculiar to warmer parts of the sea, some of them among the most elegant of all marine plants. Among these are *Acetabularia*, a Mediterranean and West Indian genus, with thread-like stems crowned with a papery cup (composed of filaments united together) fringed with byssoid ramuli like those of a *Bryopsis;* and *Anadyomene*, a native of the same seas, having expanded fronds like those of an Ulva, composed of tubular cells arranged in starry patterns. If *Caulerpa* belong, as I have always thought — an opinion not shared by all my fellow-students, and therefore to be reconsidered — to this order, a very remarkable tropical and subtropical genus should be mentioned, which carries the type of structure peculiar to these plants to its highest pitch. That genus contains numerous species, distinguished among Algæ as rising from prostrate, rooting stems, that form a compact mat, and serve to bind together the loose sands on which they grow. They are therefore deserving of being spoken of among the pioneers of civilization, which prepare a resting place for colonies of other plants and animals. In Brongniart's 'History of Fossil Vegetables' a fossil is figured (*Pl.* 9 *bis*, *fig.* 1) under the name *Fucoides hypnoides*, which bears a very close resemblance to *Caulerpa hypnoides*, a recent species from New Holland; and several other fossils, which appear to be the remains of species of *Caulerpa*, are known to palæontologists.

SYNOPSIS OF THE BRITISH (MARINE) GENERA.

I. Codium. *Filaments* closely combined into a sponge-like frond. [Plate 24, A.]

II. Bryopsis. *Filaments* free, pinnately branched. [Plate 24, B.]

III. Vaucheria. *Filaments* free, irregularly branched. [Plate 24, C.]

I. Codium. Stackh. [Plate 24, A.]

Frond spongy, dark green (crustaceous, globular, cylindrical or flat), composed of an interwoven mass of tubular, continuous filaments. *Fructification:* opaque vesicles attached to the filaments, near the surface of the frond. *Grev.*—Name, κώδιον, the *skin* of an animal; from the soft substance.

1. C. *Bursa*, L.; frond spherical, hollow. *Grev. Alg. Brit. p.* 186; *Hook. Br. Fl.* ii. *p.* 318. *Fucus Bursa*, *E. Bot. t.* 2183.

On rocks in the sea, very rare. Perennial? Summer. "Coast of Sussex, plentifully, *Pallas;*" *Turner.* Shores of Cornwall, *Mr. Rashleigh.* Near Torquay, *Mrs. Griffiths.* Belfast, *Mr. Templeton.*—*Frond* a globular, spongy, hollow ball, 1—8 inches in diameter. *Structure* similar to the preceding.

2. C. *adhærens*, Ag.; frond forming a velvety crust on the surface of rocks. *Harv. in Hook. Journ. Bot. p.* 305; *Wyatt, Alg. Danm. No.* 127; *Harv. Phyc. Brit. t.* xxxv. A.

On rocks in the sea, near low-water mark; very rare. Annual? At Torquay, *Mrs. Griffiths.* Land's End, *Mr. Ralfs.* Gorran Haven, &c., *Mr. Peach.* Falmouth Harbour, *Miss Warren.* Rathlin Island, Antrim, *Mr. Moore.* Tory Island, *Mr. Hyndman.*—Spreading over the rock in irregular patches of two feet or more in extent, resembling "fragments of beautiful green velvet." *Substance* gelatinous, dense, closely adhering to paper. Mrs. Griffiths, who has watched this plant from its first appearance till it had considerably extended itself, remarks, "that it does not show the least tendency to throw up a frond. It has an uneven surface, from taking the form of the rock, or even roots of coarse weeds, over which it crosses." She considers it a true species.

3. C. *amphibium*, Moore; fronds minute, erect, cylindrical, simple, obtuse, aggregated in widely-spreading strata. *Moore and Harv. An. Nat. Hist.* xiii. *p.* 321; *Harv. Phyc. Brit. t.* xxxv. B.

Turf banks, near high-water mark, but washed by every tide, at Roundstone, and at the head of Birtirbui Bay, Galway, *Mr. Wm. M'Calla.*—*Tufts* widely spreading, the bases composed of entangled fibres, among which rise numerous mamillæform fronds, from a quarter of an inch to an inch in height, usually simple, rarely emarginate or forked; having exactly the structure of the frond of *C. tomentosum*. It differs from the young of that species not merely in habitat, but also in having the fronds densely tufted together, not solitary or dispersed. The colour is a herbaceous green, and the substance soft.

4. C. *tomentosum*, Huds.; frond cylindrical, dichotomous. *Grev. Alg. Brit. p.* 185, *t.* 19; *Hook. Br. Fl.* ii. *p.* 318; *Wyatt, Alg. Danm. No.* 35; *Harv. Phyc. Brit. t.* xciii. *Fucus tomentosus, E. Bot. t.* 712.

On rocks in the sea; frequent. Perennial. Summer.—*Frond* rising from a spreading spongy base, cylindrical, from a quarter to nearly half an inch in diameter, 6—12 inches long, more or less regularly divided in a dichotomous manner; sometimes regularly dichotomous; sometimes palmato-partite, the segments forked; sometimes beset with short lateral branches. *Structure* filamentous, the centre composed of longitudinal, interlaced, colourless fibres, the circumference of radiating, horizontal, club-shaped, deep green filaments, invested by a viscid gelatine. *Fructification:* dark green ovate vesicles, borne by the club-shaped filaments.

II. Bryopsis. Lamour. [Plate 24, B.]

Frond membranaceous, filiform, tubular, cylindrical, glistening, branched; the branches imbricated, or distichous and pinnated, filled with a fine green, minutely granuliferous fluid. *Grev.*—Name, βρυον, a *moss*, and ωψις, an *appearance*.

1. B. *plumosa*, Huds.; frond filiform, branched, naked below, the branches scattered, spreading, twice or thrice pinnated, the pinnæ pectinated. *Grev. Alg. Brit. p.* 187, *t.* 19; *Hook. Br. Fl.* ii. *p.* 318; *Wyatt, Alg. Danm. No.* 128; *Harv. Phyc. Brit. t.* iii. *Ulva plumosa, E. Bot. t.* 2375.

On rocks, &c., in tide-pools. Annual. Summer and autumn.—*Frond* 1—4 inches high, more or less branched, sometimes with a nearly simple stem, set with numerous close branches; at other times much divided in a subdichotomous or irregular manner. *Branches* naked at base, in the upper part closely pinnated with subopposite, slender, distichous or rarely irregular ramuli, which gradually diminish in length to the apex. *Colour* a fine deep green. *Substance* lubricous and adhering to paper. A beautiful plant, whose branches resemble beautiful, glossy, bright green feathers.

2. B. *hypnoides*, Lamour.; frond slender, very much branched; the branches long; the ramuli capillary, irregularly inserted, somewhat erect, the lower ones elongated. *Grev.—Hook. Br. Fl.* ii. *p.* 318; *Wyatt, Alg. Danm. No.* 81; *Harv. Phyc. Brit. t.* cxix.

On rocks and stones in tide-pools, and on the larger Algæ, rather rare. Southerness, Kirkcudbright, *Sir W. Jardine, Bart.* Frith of Forth, *Mr. Hassell.* Appin, *Capt. Carmichael.* Torquay, *Mrs. Griffiths.* Portrush, north of Ireland, *Mr. D. Moore.* Roundstone, *Mr. M'Calla.*—*Frond* 2—4 inches high, much branched, the branches repeatedly divided in an alternate or irregular manner; lesser branches set with irregularly scattered, somewhat pinnate, more or less dense ramuli. *Colour* a fine yellow green. This is a more slender, very much more branched plant than the preceding, and the ramuli are irregularly scattered, sometimes issuing from all sides of the filaments.

III. Vaucheria. De Cand. [Plate 24, C.]

Fronds aggregated, tubular, continuous, capillary, coloured by an internal, green, pulverulent mass. *Fructification*: dark green, homogeneous *sporangia (coniocystæ)*, attached to the frond. *Grev.*—Named in honour of *M. Vaucher*, a distinguished writer on fresh-water *Conferræ*. (The species are natives of fresh water, with the following (British) exceptions).

1. V. *submarina*, Berk.; frond capillary, forked, fastigiate; sporangia scattered, ovate or lanceolate, sessile. *Berk. Gl. Alg. t.* 8. *V. dichotoma, β. submarina, Ag.—Hook. Br. Fl.* ii. *p.* 319.

On the muddy sea-shore, rare. Weymouth, *Rev. M. J. Berkeley.*—*Tufts* 2 or 3 inches high, not diffused, fastigiate: *filaments* much more slender than in *V. dichotoma*, less branched, the branches more irregular. *Vesicles* numerous, scattered over the upper branches.

2. V. *marina*, Lyngb.; filaments loosely tufted or distinct, branches few, very long, obtuse; sporangia solitary, obovate, pedicellate, lateral. *Carm.—Hook. l. c. p.* 319; *Lyngb. t.* 22; *Wyatt, Alg. Danm. No.* 168.

In the sea. Annual. Summer. Parasitical on *Furcellaria lumbricalis*, Appin, *Capt. Carmichael.* On mud at Torbay and Salcombe, *Mrs. Griffiths* and *Mrs. Wyatt.*—*Fronds* tufted or somewhat spreading, erect, very slender and flaccid, irregularly branched, somewhat forked; the branches erect. *Vesicles* few, scattered, broadly obovate and very obtuse, by which character it is easily distinguished from *V. submarina*, subpedicellate. *Colour* bright green, becoming rather brownish, but retaining a gloss in drying. *Mrs. Griffiths* has kindly presented me with specimens in fructification.

3. V. *velutina*, Ag.; filaments creeping; branches fastigiate, woven into a velvety stratum; sporangia solitary, globose, lateral. *Carm.—Hook. l. c. p.* 319.

On the muddy sea-shore, flooded by the tide. Annual. Spring and summer. Appin, *Capt. Carmichael.* Miltown Malbay.—"*Filaments* exceedingly tough, interwoven into a dense, velvety, green stratum, pellucid below and creeping over the mud; branches near the extremity erect, fastigiate, and more or less crooked. *Vesicles* solitary, globular, on short lateral peduncles." *Carm.*

ORDER XV. CONFERVACEÆ.

Conferveæ, *J. Ag. Alg. Medit. p.* 12. *Harv. Man. Ed.* 1, *p.* 124. *Lindl. Veg. Kingd. p.* 18. Confervoideæ, *Endl. 3rd Suppl. p.* 14.

DIAGNOSIS.—*Green*, marine or fresh-water Algæ, composed of articulated threads or filaments, simple or branched, free or surrounded by gelatine. *Cells* cylindrical, truncated.

NATURAL CHARACTER. — *Root* rarely more than a point of attachment, and often perishing on the maturity of the frond. *Frond* in all cases composed of cylindrical, truncated cells of moderate length, strung together in filaments, of which they are the *articulations*. These filaments sometimes anastomose, so as to form a net (as in *Hydrodictyon*); sometimes at maturity two separate filaments approach each other, when a species of anastomosis takes place between them, a cell in one filament becoming connected to a cell in another filament by means of a membranous tube, through which the contents of one are discharged either into the other, or else lodged in the connecting tube; in both cases forming the nucleus of the fructification. This mode of connexion, which is called conjugation, is characteristic of the sub-order *Zygnemeæ*. In most cases, however, and in all the genuine *Conferveæ*, the filaments are free one from another, either simple or variously branched; the ramification is frequently alternate, or secund, rarely dichotomous, and rarely opposite. In the sub-order *Chætophoreæ* each frond consists of several filaments combined together in a more or less perfect manner by surrounding gelatine, and frequently terminating in hair-like cellules of extraordinary length and tenuity; whilst in other species of this sub-order each cell is furnished with a very long rigid seta, and this is remarkably obvious in *Ochlochæte*, the only one of this sub-order which our limits admit.

The mode by which the frond lengthens is twofold. Either new cells are continually emitted, as buds, from the apices of the last formed cells; or else the old cells continually divide in the centre. In the first case the frond continues to lengthen by constant additions to its points, and this is truly *acrogenous;* in the other it grows equally throughout its whole length. This latter mode of increase is most frequent among the species with simple filaments. The fructification either consists of *zoospores* formed out of the colouring matter of the cells, and emitted through an aperture formed in the cell-wall; or else the whole mass of endochrome contained in a cell, and often the whole contents of two cells are concentrated into a *sporangium* or conceptacle, which is deposited in the water on the perishing of the frond. In the *Conferveæ* this sporangium is usually formed out of the contents of a single cell, but is not always lodged in the cell in which it originates; for in one genus (*Tiresias*) supplementary cells, are formed at one extremity of the cell furnishing the sporaceous matter, and in these the sporangium is lodged. In the *Zygnemeæ* the matter of two cells constantly goes to form the sporangium. This matter either collects in one of the cells, leaving the other quite empty; or else is deposited in a supplementary cell formed in the connecting tube; or (as in *Staurocarpus*), where the two cells inosculate without any tube between them, the sporangium, taking the form of a cross, lies partly in one cell and partly in the other. In the *Chætophoreæ* the sporangia are lateral and external, developed as buds from the cells of the filament, or they are the enlarged cells of the ramuli.

By far the larger number of the Confervaceæ inhabit fresh water, and are found in all parts of the world wherever water lies stagnant, and wherever it flows. The bright green, glossy threads that float on the surface of ponds and ditches are commonly species of the sub-order *Zygnemeæ*, a highly curious and beautiful family, of which there is no marine example. When young the filaments lie at the bottom of the pool, but as they approach maturity they float to the surface, where they often lie so thickly as to retain within their meshes large bubbles of air, which they have disengaged during the progress of vegetation, and which is in great part oxygen. When shallow water lies for some weeks in summer on the surface of flat land, it often becomes completely filled with the threads of these plants, which by their vegetation counteract the evil effects which the decay of other vegetables under the water would otherwise dispense, and on the clearing off of the water their relics quickly dry up, without undergoing decomposition. In this case the matted threads are soon bleached white in the sun, and form a sort of natural paper. By the older practitioners several of the *Confervæ* were used in binding up broken limbs, a purpose for which they were well adapted from their softness and power of retaining moisture; but this was before the days of oil-skin and gutta percha.

SYNOPSIS OF THE BRITISH (MARINE) GENERA.

Sub-order 1. Conferveæ. *Filaments* free, not surrounded by gelatine. *Sporangia* contained in the articulations.

I. Cladophora. *Filaments* tufted, much branched. [Plate 24, D.]

II. Rhizoclonium. *Filaments* decumbent, with root-like branches. [Plate 24, F.]

III. Conferva. *Filaments* unbranched. [Plate 24, E.]

Sub-order 2. Chætophoreæ. *Filaments* united in submembranaceous or gelatinous fronds; cells often tipped with bristles. *Sporangia* external.

IV. Ochlochæte. *Frond* disciform. *Filaments* radiating from a central point, prostrate, irregularly branched; each cell produced above into a rigid, inarticulate bristle. [Plate 25, E.]

Sub-order I. Conferveæ.

I. Cladophora. *Kütz.* [Plate 24, D.]

Filaments green, attached, uniform, branched, composed of a single series of cells or articulations. *Fruit*, aggregated granules or zoospores, contained in the articulations, having, at some period, a proper ciliary motion.—Name, from χλαδος, a *branch*, and φορεω, *to bear*. Much branched, tufted plants, chiefly marine. A few, here omitted, inhabit clear, fresh-water streams.

1. C. *Brownii*, Dillw.; filaments forming dense, cushion-like tufts, erect, rigid, flexuous, elastic, slightly branched; branches few, long, sub-simple, secund; axils acute, articulations 4 or 5 times longer than broad, the lower ones thickened upwards, the upper cylindrical. *Harv. l. c. p.* 356; *Dillw. Suppl. t. D.*; *E. Bot. t.* 2879; *Harv. Phyc. Brit. t.* xxx.; *Wyatt, Alg. Danm. No.* 225. *C. pulvinata, Brown, MS.*

On wet rocks in a cave near Dunree, North of Ireland, *R. Brown, Esq.* On shady rocks at the entrance of a small cave beyond Black Castle, Wicklow, where it is exposed to the dripping of fresh water, and the occasional overflow of the sea. Cornwall Coast, near Land's End, *Mr. Ralfs.*—This forms exceedingly dense, very rigid, tufts, of a black-green colour when growing, but, on having the water expressed, and being held to the light, exhibits a beautiful yellow-green tint. *Filaments* so matted together that it is difficult to separate a single thread. They appear to originate in a mass of creeping, branched, densely matted fibres, which form the base of the tufts. They are erect, from half an inch to an inch high, flexuous, very rigid and elastic; the branches few and nearly simple, almost always secund, very erect. A very curious and distinct plant, having, to the naked eye, a good deal the appearance of *Vaucheria terrestris*, but totally different in structure. It is perhaps allied to *C. ægagropila*. I have examined a specimen from *Mr. Brown* in the late *Mr. Templeton's* herbarium, and find it agree in every respect with my Wicklow plant.

2. C. *repens*, J. Ag.; forming dense, cushion-shaped or globular tufts; filaments short, capillary, rigid, densely matted together, rising from root-like fibres, slightly branched; branches erect, sub-simple, or forked, naked, or with a few distant, secund ramuli; articulations cylindrical, very long, (ten to twenty times as long as their diameter). *Harv. Phyc. Brit. t.* ccxxxvi.

Thrown on shore after a gale. Annual? Summer. Jersey, very rare, *Miss Turner.*—*Tufts* an inch or two in diameter, and about half an inch thick, composed of innumerable, slender filaments densely matted together. The habit is very similar to that of *C. Brownii*, but the articulations are of much greater length, and of a different form. This species is also a native of the north coast of France, and of the Mediterranean sea.

3. C. *pellucida*, Huds.; filaments cartilaginous, rigid, erect, bright green; di-trichotomous, the axils very acute, branches erect; articulations many times longer than broad. *Harv. l. c. p.* 357; *Wyatt, Alg. Danm. No.* 193; *E. Bot. t.* 1716; *Harv. Phyc. Brit. t.* clxxiv.

On rocks near low-water mark. Yarmouth, *Sir W. J. Hooker.* South of England. Several places in Ireland; very fine in Belfast Lough, *Mr.*

Thompson.—*Root* a mass of fibres. *Filaments* 4—6 inches high, setaceous, extremely rigid, tough and wiry, tufted or subsolitary, rising with an undivided stem for half an inch to an inch, then forked or trifurcate, and afterwards repeatedly branched in a di-trichotomous or somewhat umbellate manner, the uppermost branches more or less furnished with di-trichotomous or tufted ramuli. Joints of the stem and branches very long, the dissepiments rarely occurring except at the divisions of the branches; in the ramuli short, 3 or 4 times longer than broad. *Colour* a fine, glossy, transparent green, fading much in drying. It scarcely adheres to paper.

4. C. *rectangularis*, Griff.; filaments setaceous, rigid, irregularly branched; branches distant, patent, set with short, opposite, horizontal ramuli; articulations twice or thrice as long as broad. *Harv. in Hook. Br. Fl.* ii. *Addenda, p.* 10; *Wyatt, Alg. Danm. No.* 145; *Harv. Phyc. Brit. t.* xii.

In the sea, thrown up; very rare. Summer. Torquay, *Mr. Borrer* and *Mrs. Griffiths.* Roundstone, *Mr. M'Calla.* Arran, Galway, *Mr. Andrews.*—*Filaments* as thick as horse-hair, 8—12 inches long, divided in an irregular manner into a few principal branches; branches patent, more or less furnished with subdistant, horizontal, opposite ramuli, from a line to an inch in length, and either simple or bearing a second series; very rarely, by abortion, they are alternate. *Colour* a full green, fading in the herbarium. *Substance* rigid, very imperfectly adhering to paper. *Joints* uniform throughout the plant, generally 2 or 3 times longer than broad. One of the most beautiful and distinct, as it is the rarest, of the genus.

5. C. *Macallana*, Harv.; filaments setaceous, rigid, full green, very flexuous, loosely bundled together, excessively branched; branches alternate, or rarely opposite, zigzag, very patent; ramuli short, recurved, simple or pectinated, obtuse; articulations twice or thrice as long as broad; endochrome rather dense. *Harv. Phyc. Brit. t.* lxxxiv.

On the sandy bottom of the sea, in 4—10 fathom water. Annual. Summer. Dredged in Roundstone Bay, abundantly, *Mr. Wm. M'Calla.*—*Filaments* forming crisped, sub-cylindrical, loose bundles 6—20 inches long, bristling when removed from the water, of a rich grass-green, much branched and inextricably entangled, rigid. *Branches* very flexuous, irregular in length and insertion, more or less clothed with very patent ramuli. This has much of the outer habit of *C. rectangularis*, mixed with which it often occurs at Roundstone, but may at once be known by the secund or alternate ramuli. It is named in honour of its discoverer, the late *Mr. Wm. M'Calla*, a most successful and acute explorer of Roundstone and the neighbouring bays — who added many new species to the Fauna and Flora of Ireland, and whose early death is much to be regretted. Mr. M'Calla fell a victim to the cholera in the spring of the present year, (May, 1849).

6. C. *Hutchinsiæ.* Dillw.; filaments setaceous, cartilaginous, rigid, glaucous green, flexuous, tufted, bristly; ramuli curved, simple or furnished on the interior face with processes

of one articulation; articulations twice as long as broad, joints contracted. *Dillw. t.* 109; *Harv. l. c. p.* 357; *Wyatt, Alg. Danm. No.* 226; *Harv. Phyc. Brit. t.* cxxiv.

On rocks, &c., near low-water mark; rather rare. Bantry Bay, *Miss Hutchins*, and various stations on the English and Irish coasts.—*Filaments* thicker than horse-hair, 6—8 inches long, flexuous, repeatedly divided in an alternate manner; branches rather distant, spreading or divaricated, more or less furnished with short branchlets, having a few short, secund ramuli along their upper faces. *Colour* deep glaucous green, "with changeable tints when fresh, and under water appearing almost white," (*Miss Hutchins*). *Substance* rigid and tough, more or less perfectly adhering to paper. *Joints* uniform throughout the plant. Nearest *C. pellucida* in texture, and *C. diffusa* in habit and character: from the latter it is not always easy clearly to distinguish it.

7. C. *diffusa*, Roth; filaments sub-setaceous, rigid, dark or full green, flexuous, much branched; branches distant, elongated, furnished towards the top with a few short, patent, secund ramuli; articulations 3 or 4 times longer than broad. *Dillw. t.* 21; *E. Bot. t.* 2289; *Harv. l. c. p.* 358; *Wyatt, Alg. Danm. No.* 144; *Harv. Phyc. Brit. t.* cxxx.

On rocks, &c. in the sea, not uncommon. Southern shores of England and Ireland: West of Ireland. Port Rush, *Mr. Moore.*—*Filaments* 6—10 inches long, as thick as horse-hair, loosely tufted, generally so rigid as to bristle out when removed from the water, but occasionally flaccid, very flexuous, distantly branched; branches alternate, much divided, either bare of ramuli, or furnished toward the end, or sometimes generally, with short, secund branchlets. *Joints* 3 or 4 times longer than broad, nearly uniform in all parts of the frond. *Colour* either grass-green or dark green.

8. C. *nuda*, Harv.; filaments sub-rigid, slender, very straight, dull green or olivaceous (when dry), sparingly dichotomous; ramuli few and scattered, appressed, the uppermost often opposite; articulations many times longer than broad. *Harv. in Mack. Fl. Hib.* iii. *p.* 229.

On basalt rocks, in the sea. Portstewart, *Mr. D. Moore.* — *Filaments* loosely tufted, 2 or 3 inches high, sparingly branched, very straight, set with a few, scattered, very erect and appressed ramuli, the uppermost ones often opposite, which makes the apices of the branches appear three-forked. *Articulations* very long. This differs from any species with which I am acquainted, but may, perhaps, be the *C. aspera* of Agardh, which in the 'British Flora' I have doubtfully referred to *C. nigricans.* To avoid confusion, I think it better to give a new name to our present plant. In the straight filaments and erect ramuli it resembles *C. rupestris*, but differs in colour and in the great length of the joints. Perhaps it may be only a variety of the latter. (A doubtful species—1849).

9. C. *rupestris*, Linn.; filaments slender, rigid, dark green, straight, tufted, bushy; branches erect, crowded,

densely clothed with appressed ramuli; articulations 3 or 4 times longer than broad. *Dillw. t.* 23; *E. Bot. t.* 1699; *Harv. l. c. p.* 357; *Wyatt, Alg. Danm. No.* 95; *Harv. Phyc. Brit. t.* clxxx.

On rocks in the sea, about half-tide level, very common. — *Tufts* 3—6 inches long, very dark or blackish green. *Filaments* rigid, densely and closely branched, thickly clothed with very erect or appressed ramuli, scarcely adhering to paper.

10. C. *læterirens*, Dillw.; filaments much branched, bushy, forming fine tufts of a transparent yellow-green colour, grayish and without gloss when dry; branches erecto-patent, crowded, repeatedly divided; ultimate ramuli secund; joints of the chief divisions long, of the ramuli about thrice as long as broad. *Dillw. t.* 48; *E. Bot. t.* 1854. *C. glomerata, β. marina, Ag.* — *Harv. in Hook. Br. Fl.* ii. *p.* 357; *Wyatt, Alg. Danm. No.* 143; *Harv. Phyc. Brit. t.* clxxxix.

On rocks, stones and Algæ, in tide-pools, very common.—*Tufts* 4—8 inches long. Except in its marine habitat, I cannot distinguish this from *C. glomerata*, with which Agardh unites it, as it appears to me, justly. *Mrs. Griffiths*, however, than whom no one has studied this genus more carefully, is of a different opinion, and to her judgment I yield.

11. C. *flexuosa*, Dillw.; filaments very flexuous or angularly bent, jointed, often sub-opake, rather rigid, dull green, but slightly branched; branches variable in number and length, more or less divided, furnished with long, patent branchlets, whose inner edge is pectinated with a few secund ramuli; articulations thrice as long as broad. *Dillw. t.* 10; *E. Bot. t.* 1944. *Conf. fracta, β. flexuosa, Ag.* — *Harv. in Hook. l. c. p.* 356; *Wyatt, Alg. Danm. No.* 227.

In salt-water ditches near Yarmouth, *D. Turner, Esq.* In the sea, not uncommon. Torquay, *Mrs. Griffiths.* Ballycastle, *Miss Hincks.* Several other parts of the east coast of Ireland. — *Filaments* 4—8 inches long, remarkably flexuous, rather harsh to the feel. This really seems distinct from *C. fracta*, habitat out of the question; but I suspect that more than one species is confounded under this name.

12. C. *gracilis*, Griff.; filaments capillary, flexuous, silky, much branched, bright yellow-green; main branches entangled, sparingly divided, angulato-flexuous; ultimate ramuli pectinato-secund, much attenuated, straight and very long; articulations about 3—5 times longer than broad. *Griff. in Wyatt, Alg. Danm. No.* 97; *Harv. Fl. Hib.* iii. *p.* 230; *Harv. Phyc. Brit. t.* xviii.

In deep water, on rocks and Algæ. Torquay, *Mrs. Griffiths.* Youghal, *Miss Ball.* Belfast Bay, and at Ballantrae, Ayrshire, *Mr. W. Thompson.*

—*Filaments* forming soft, silky tufts, 6—12 inches long, with something of a main stem, from which spring very numerous, long, and more or less divided, very flexuous or angularly twisted branches, plentifully clothed with elongated, pectinate, secund branchlets, of which the ultimate ramuli are very long, slender, and straight or slightly curved. *Colour* a fine, rich, yellow-green, somewhat faded in the herbarium, but preserving a silky gloss. *Substance* soft, imperfectly adhering to paper. Neaily allied in character to *C. flexuosa*, but with a very different habit.

13. C. *Rudolphiana*, Ag.; filaments very long, exceedingly slender, flexuous, subgelatinoso-membranaceous, much branched, yellow-green, inextricable; branches di-trichotomous or irregular; ultimate ramuli pectinate, secund, very long and much attenuated; articulations of the main filaments many times longer than broad, here and there swollen, their granular endochrome somewhat spiral; those of the ramuli 6—10 times as long as broad. *Harv. Phyc. Brit. t.* lxxxvi. *C. Kaneana, M'Calla, Alg. Hib. No.* 29.

Parasitical on *Zostera*, and various *Laminariæ*, and other Algæ, in 2—6 fathom water. Annual. Summer. Very abundant in Roundstone Bay, Connemara, *Mr. W. M'Calla.* Falmouth, *Miss Warren.* — *Filaments* 6—20 inches long, exceedingly slender and soft, forming beautifully silky, bright green, sub-gelatinous tufts. A much more slender plant than *C. gracilis*, with longer joints and more attenuated ramuli.

14. C. *refracta*, Ag.; filaments capillary, sub-rigid, tufted, bright green, very much branched; secondary branches spreading on all sides, repeatedly divided, thickly clothed with very patent or reflexed, short branchlets, which are pectinated with ramuli on their upper surface. *Wyatt, Alg. Danm. No.* 228; *Harv. Phyc. Brit. t.* xxiv.

In the sea; in rocky pools left by the tide. Dunlecky Castle, Kilkee. Ilfracombe, *Mrs. Griffiths.* Mangan's Bay, Co. Cork, *Miss Ball.* Giant's Causeway, *Mr. W. Thompson.*—*Filaments* 3 or 4 inches long, slender, tufted; the main stems somewhat woven together or ropy, the secondary branches free, spreading on all sides and much divided; the ultimate branchlets very patent or reflexed, pectinato-secund, opposite or alternate. *Colour* a brilliant yellowish green, which is partially preserved in a dry state. *Substance* rather rigid, imperfectly adhering to paper. This beautiful plant is nearly allied to *C. albida*, but the filaments are coarser and far more rigid, the ultimate branches shorter and more patent, often strongly reflexed, and the habit by no means spongy.

15. C. *albida*, Huds.; filaments exceedingly slender, flaccid, pale yellow green (whitish when dry), forming dense, silky, or somewhat spongy, intricate tufts; branches crowded, irregular, the uppermost patent and mostly opposite; ramuli opposite or secund; articulations 4 or 5 times longer than

broad. *E. Bot. t.* 2327; *Harv. l. c. p.* 358; *Wyatt, Alg. Danm. No.* 96; *Harv. Phyc. Brit. t.* ccxxxv.

On rocks and the larger Algæ in the sea, below half-tide level; frequent. —*Tufts* 2—6 inches long, pale green, exceedingly dense or spongy, flaccid. *Filaments* extremely slender, excessively and intricately branched; the branches very irregular: ultimate ramuli short, patent, opposite or secund, issuing from almost every joint, and occasionally bearing a second set. In the herbarium it fades to a pale yellowish, wholly without gloss, by which character it is best marked from its allies. *Joints* short. *Mrs. Griffiths* finds a beautiful plant at Torquay, having many characters in common with *C. albida*, but 12 inches long and of a bright yellow-green colour, which is partially preserved in drying. For the present I regard it as a variety of this species.

16. C. *lanosa*, Roth; filaments slender, short, yellow-green, forming dense tufts; branches virgate, erect, sub-distant, straight, alternate or opposite, with a few alternate or secund ramuli, axils very acute; lower articulations twice, upper six times longer than broad. *E. Bot. t.* 2099; *Harv. l. c. p.* 358; *Wyatt, Alg. Danm. No.* 194; *Harv. Phyc. Brit. t.* vi.

In the sea, on rocks or, more frequently, on the larger Fuci.—*Filaments* forming small, entangled, woolly tufts, an inch long, pale green, stoloniferous below, branches straight and erect, all the axils very acute. In a dry state it is wholly without gloss, faded, except near the tips, where it generally preserves a glaucous green colour.

17. C. *uncialis*, Fl. Dan.; tufts very short, spongy, simple below, above divided into numerous fastigiate, woolly segments; filaments flexuous, sparingly branched, densely interwoven; ramuli distant, secund, somewhat pectinate, long, patent or incurved; articulations 2—4 times longer than broad. *Ag. Syst. Alg. p.* 111; *Fl. Dan. t.* 771, *f.* 1; *Harv. in Hook. Journ. Bot. p.* 304; *Wyatt, Alg. Danm. No.* 146; *Harv. Phyc. Brit. t.* ccvii.

On rocks near low-water mark. Torquay, *Mrs. Griffiths.* New Castle, coast of Down, *Mr. W. Thompson.* Rathlin, Antrim, *Mr. D. Moore.* Common at Balbriggan.—*Tufts* an inch high, dark green, spongy, with something the habit of *Ectocarpus tomentosus*, composed of slender, irregularly branched filaments, densely entangled. Certainly nearly allied to the preceding, with some states of which it may, without careful examination, be confounded.

18. C. *arcta*, Dillw.; filaments forming broad, somewhat starry tufts, of a full green colour, much branched; branches straight, crowded, erect; ramuli sub-appressed, opposite or alternate; articulations either uniformly twice as long as broad, or with the lower joints short, the upper very long.

Dillw. t. E.; E. Bot. t. 2098; *Harv. l. c. p.* 359. *C. centralis, Lyngb., Harv. l. c. p.* 358; *Wyatt, Alg. Danm. No.* 46; *Harv. Phyc. Brit. t.* cxxxv.

On rocks in the sea, generally above half-tide level, frequent.—*Tufts* rising from a broad disk formed of dense fibres. *Filaments* spreading in a circle, fastigiate, much branched: in the young specimens the branches are somewhat separate, all remarkably erect or straight (when it is *C. arcta* of Dillwyn and of 'Brit. Flora,' and in a still younger state *C. vaucheriæformis* of Agardh); in the older they are more or less matted together or interwoven by means of rootlike fibres which issue from the joints of the main branches, the apices only, in these specimens, produced beyond the spongy tuft, long, slender, straight, of irregular length and slightly branched; all the ramuli extremely erect and close-pressed (forming the *C. centralis* of Lyngbye and of 'Brit. Flora'). *Joints* extremely variable, sometimes uniformly twice as long as broad throughout, but more frequently the lower joints are short, those of the upper branches very long. *Colour* a fine, deep, glaucous green, partially discharged in fresh water or fading in the herbarium. *Substance* soft and retaining water. In the dry state young specimens have a glistening appearance; old ones, on the contrary, are without gloss, except the young shoots toward the summit, woolly, and considerably faded. In the 'Brit. Flora' I expressed my doubts whether *C. arcta* and *centralis* of authors, however dissimilar in their typical states, were really distinct. Since then, numerous specimens in every stage, from the extreme young to the old and battered form, kindly furnished by *Mrs. Griffiths*, have clearly shown such a gradation of character, that I no longer hesitate to unite them.

19. C. *glaucescens*, Griff.; tufts dense, glaucous green, sub-fastigiate; filaments very slender, excessively branched; branches straight and erect, the lesser ones furnished with close, very erect, straight, elongated ramuli; joints very short. *Wyatt, Alg. Danm. No.* 195; *Harv. Phyc. Brit. t.* cxcvi.

On rocks, near low-water mark, not uncommon.—*Tufts* 2 or 3 inches high, dense, somewhat level-topped, of a glaucous green colour. *Filaments* very slender (but more robust than in *C. refracta*), much branched upwards, the branches straight and erect, the lesser ones furnished with close, very erect and appressed, elongated, straight, setaceous ramuli. *Joints* thrice as long as broad. *Colour* preserved in drying.

20. C. *falcata*, Duby; densely tufted, dark green; filaments intricate at the base, ultra-capillary, rigid, much curved, irregularly branched; branches zig-zag, repeatedly divided, the lesser divisions arched, or strongly incurved and falcate, furnished along their inner faces with short, secund, blunt ramuli; articulations three or four times longer than broad, with a dense endochrome, and pellucid dissepiments. *Harv. Phyc. Brit. t.* ccxvi. *Conf. falcata, Duby, Bot. Gal.—fide Montagne.*

The bottoms of clear rock-pools, near low-water mark. Annual. Summer. Rocks outside Dingle Harbour, Kerry, *W. H. H.* Jersey, *Miss White.*—*Filaments* densely tufted, 3 or 4 inches long, thicker than human hair, nearly equal throughout, much branched; the branches curved and twisted, the lesser divisions and ramuli frequently incurved, arching or strongly hooked inwards; the whole plant crisp and squarrose. *Colour* a peculiarly rich, glossy green. *Substance* rigid, adhering to paper in drying.—I was not aware, at the time I published this plant in *Phyc. Brit.* that it had already appeared, and oddly enough, under the same specific name, in the *Botanicum Gallicon.* I am indebted to my friend Dr. Montagne for ascertaining the above synonyme of Duby.

Species found in brackish water.

21. C. *flavescens,* Roth; forming pale yellowish strata; filaments slender, sparingly branched; branches alternate or sub-dichotomous, erecto-patent, with scattered, elongate, alternate or secund ramuli; articulations 8 or 9 times longer than broad. *Harv. l. c. p.* 356; *E. Bot. t.* 2088; *Wyatt, Alg. Danm. No.* 224.

In ditches of brackish or fresh water, not uncommon.—This forms extensive strata of a light yellowish colour, which finally rise to the surface. It is allied to *C. fracta,* but the filaments are more slender, the joints longer, and the colour is different. It has a silky appearance when dry, and does not adhere to paper.

22. C. *fracta,* Fl. Dan.; forming entangled, dull green strata; filaments somewhat rigid, much branched; branches divaricating; ramuli scattered and very patent; articulations 4—6 times longer than broad. *Dillw. Conf. t.* 14; *E. Bot. t.* 2338; *Harv. l. c. p.* 356.

In ditches, lakes, &c. common.—This forms globose or long entangled tufts, frequently cohering into extensive strata, and finally rising to the surface. The filaments are much and very irregularly branched, all the branches very patent.

II. Rhizoclonium. Kütz. [Plate 24, F.]

Filaments green, jointed, uniform, decumbent, simple or spuriously branched; branches short and root-like. *Fruit:* granules contained in the cells.—Name, from ῥιζοω, to *root,* and κλων, a *branch.*

1. R. *riparia,* Roth; filaments elongated, slender, decumbent; pale green, forming wide strata, flaccid, entangled, angulato-flexuous, slightly branched; lower branches short, tentacular; upper long, sub-simple, with rounded axils; articulations 2—4 times longer than broad. *E. Bot. t.* 2100;

Harv. l. c. p. 359; *Harv. Phyc. Brit. t.* ccxxxviii. *Conf. tortuosa, Wyatt, Alg. Danm. No.* 190, (*not of Dillw.*)

On sand-covered rocks, near high-water mark, not uncommon.—Forming decumbent, dense strata of some extent. *Filaments* very slender, with a few root-like branches below, and once or twice branched above. *Colour* light green, much paler and without gloss when dry. *Conf. perreptans*, Carm., is either this species, or a closely allied form.

III. Conferva. Plin. [Plate 24, E.]

Filaments green, attached or floating, unbranched, composed of a single series of cells or articulations. *Fruit* aggregated granules or zoospores, contained in the articulations, having, at some period, a proper ciliary motion.—Name, from *conferruminare*, to consolidate, because some of the species were used by the ancients for binding up fractured limbs.—This genus, notwithstanding the *weeding* which it has received of late, requires to be still further dismembered, when the species shall have been carefully observed at all ages. Generic characters will probably be found in the different manner in which the endochrome is matured, and the manner in which new cells are formed.

* *Filaments decumbent, stratified, either unattached, or soon becoming so, and at length floating.*

1. C. *arenicola*, Berk.; threads soft, simple, extremely fine, matted, somewhat crisped, at first uniform pale green, at length distinctly jointed; articulations once and a half as long as broad, dotted; interstices pellucid. *Berk. Gl. Alg. t.* 13, *f.* 3.

"Creeping on the sandy margins of pools in a salt-marsh periodically flooded, forming a thin, soft, delicate, crisped web, of a pale yellow-green. *Threads* extremely slender, flexuous, at first self-coloured with a few scattered dots, then with manifest dissepiments, and finally the granules contract and form a distinctly defined mass of a darker green in the centre, with pellucid interstices. When dry the articulations are slightly contracted." *Rev. M. J. Berkeley.*

2. C. *arenosa*, Carm.; filaments slender, rigid, interwoven into broad strata; articulations 3—5 times longer than broad. *Harv. l. c. p.* 353.

On the flat sandy shore about half-tide level. Appin, *Capt. Carmichael.* Bantry Bay, *Mr. R. Ball.*—"This species occurs in fleeces a yard or more in extent, and of a peculiar structure. They consist of several exceedingly thin layers, placed over each other; but so slightly connected that they may be separated like folds of gauze, to the extent of many inches, without the least laceration. *Filaments* 5 or 6 inches long, about the thickness of *C. bombycina*, rigid, possessed of peculiar roughness; feeling, when pulled asunder, as if hair were drawn over a piece of rosin. *Articulations* 3—4 times as long as broad; sporular mass assuming a great variety of forms. When old the filaments become exceedingly rough and often tubercular." *Carm.*

3. C. *litorea*, Harv.; filaments thick, rigid, crisped, forming loose, extensive bundles of a dull green colour; articulations once and a half as long as broad. *C. linum, Harv. in Hook. Br. Fl.* ii. *p.* 352, *(not of Roth). Wyatt, Alg. Danm. No.* 220.

In salt-water ditches, along the muddy sea shore.—" Forming distinct, loosely interwoven, sub-cylindrical tufts of a yellowish green colour, which, in a more advanced state, changes to a dark olive; attached at one end, and resting at the bottom of the pool. *Filaments* as thick as those of *C. ærea*, rigid, brittle, and variously curved. *Articulations* filled with green matter, intermixed with large granules, irregularly contracted and compressed in drying." *Carm. MS.* This plant was called *C. Linum* in 'Brit. Flora' on the authority of Capt. Carmichael, but that name having now been ascertained to belong to the following species, it becomes necessary to assign a new name to the present one.

4. C. *Linum*, Roth; filaments very thick, of great length, deep glossy green, much curled, rigid, forming loosely entangled, harsh masses; articulations as long as broad. *C. crassa, Ag., Harv. l. c. p.* 352. *Conf. capillaris, Dillw. t.* 9; *Harv. Phyc. Brit. t.* cl. A.

In salt-water ditches, near the coast. Very abundant in the ditches by the North Wall, Dublin.—*Filaments* many feet long, twice as thick as hogs' bristles, remarkably rigid and fragile when recent, but soon becoming flaccid on exposure to the air. This is the true *C. Linum* of Roth, see *Phyc. Brit.*

5. C. *sutoria*, Berk.; threads setaceous, extremely long, flexuous, equal, dark green; articulations once and a half as long as broad; interstices pellucid. *Berk. Gl. Alg. t.* 14, *f.* 3; *Harv. Phyc. Brit. t.* cl. B.

Floating in ditches and pools subject to the influence of the tide, at Wisbeach, *Rev. M. J. Berkeley.* April. Near *C. Linum* and *C. crassa*, " from both which, however, it differs in being a much more slender plant, and of a closer habit, and by no means variegated." *Berk.*

6. C. *tortuosa*, Dillw.; filaments rigid, slender, much curled and twisted, forming broad, closely interwoven strata; articulations 2 or 3 times longer than broad. *Harv. l. c. p.* 352; *Dillw. t.* 46.

In the sea, on rocks and Algæ; common.—This forms extensive strata, often several feet in diameter, of a pale or full green colour. β. is found near high-water mark, and is usually of a duller colour, singularly bent and distorted, and from the angles throwing out tubular, indistinctly jointed, partially colourless radicles, "which adhere to particles of sand and other matters within their reach, often to a neighbouring filament." *Carm.*

7. C. *implexa*, Dillw.; filaments very slender, capillary, rather flaccid, forming extensive, much entangled, bright green strata; articulations rather longer than broad. *Harv. l. c. p.* 352; *Dillw. Suppl. t. B.*; *Wyatt, Alg. Danm. No.* 142. *C. intricata, Grev. Edin. p.* 315. *Bangia Johnstoni, Grev. in Johnst. Berw. Fl. p.* 260. Also *C. ulothrix, Lyngb.* (of 1st ed. p. 129).

On marine rocks and attached to Algæ. Bantry, *Miss Hutchins.* Berwick, *Dr. Johnston.* Frith of Forth, *Dr. Greville.* Miltown Malbay. Torquay, *Mrs Griffiths.*—*Filaments* half as thick as those of *C. tortuosa*, with shorter joints, forming densely interwoven strata, or little tufts among the branches of other Algæ. *Bangia Johnstoni*, as Dr. W. Arnott first pointed out to me, differs in no respect from this species.

** *Filaments tufted, straight, attached, erect or decumbent* (*not stratified*).

8. C. *melagonium*, Web. and Mohr; filaments elongate, scattered, straight, thick, erect, stiff and wiry, dark green; articulations twice as long as broad. *Harv. Phyc. Brit. t.* xcix. A.; *Harv. l. c. p.* 354; *Dillw. Conf. Sup. t. B.*; *Wyatt, Alg. Danm. No.* 221.

In the sea, growing on rocks at the extreme verge of low-water mark; found on many parts of the coast, but not common anywhere.—*Filaments* 5—8 inches high, thicker than bristles, scarcely tufted, generally but three or four together or solitary, remarkably rigid and wiry, tenacious and difficult to break; dissepiments somewhat contracted, very narrow, but pellucid.

9. C. *ærea*, Dillw.; filaments elongated, tufted, straight, harsh, brittle, yellow-green; articulations as long as broad. *Harv. Phyc. Brit. t.* xcix. B.; *Harv. l. c. p.* 354; *Wyatt, Alg. Danm. No.* 191; *E. Bot. t.* 1929.

In the sea, on sand-covered rocks, frequent.—*Filaments* 3—12 inches long, tufted, as thick as hogs' bristles, harsh to the touch, of a beautiful yellow-green colour, fading in the herbarium to a dirty white. Colouring matter of the joint finally parted in the centre. The articulations are visible to the naked eye.

10. C. *collabens*, Ag.; filaments elongated, straight, tufted, very thick, gelatinous and flaccid, of a splendid æruginose green; articulations once and a half as long as broad. *Harv. l. c. p.* 354. *C. ærea, β. lubrica, Dillw. Syn. p.* 48.

At Yarmouth, on a floating piece of deal, *Sir W. J. Hooker.—Filaments* 3 or 4 inches long, twice as thick as those of *C. ærea*, of a splendid verdigris-green colour, which is fully preserved in drying, very gelatinous, adhering most closely to paper. Dissepiments much contracted. A highly beautiful plant, which, I believe, has never been found more than once.

11. C. *bangioides*, Harv.; filaments elongated, very slender, soft and lubricous, wavy; joints about twice as long as broad, containing a compact, dark green mass, which is frequently bipartite; dissepiments broad, pellucid. *Harv. Phyc. Brit. t.* cclxviii.

In the sea, on rocks, &c. Breakwater, Plymouth, *Mr. Blatch.* Torquay, *Mrs. Griffiths.* Port Ballantrae, North of Ireland, *Mr. Moore.—Tufts* 3—6 inches long, of a dark green colour, lubricous, and resembling *Bangia fusco-purpurea.* Mixed with this plant Mrs. Griffiths frequently finds *Lyngbya speciosa* and a *Conferva* twice the diameter of *C. bangioides.* with contracted, bead-like joints, having most of the characters of *C. Youngana*, but much larger than that species usually is.

12. C. *Youngana*, Dillw.; filaments short, tufted, straight, bright green, somewhat rigid,; articulations once or twice as long as broad, dissepiments finally contracted. *Harv. l. c. p.* 354; *Dillw. t.* 102. *Conf. isogona, E. Bot. t.* 1930.

On rocks, &c. near high-water mark; first discovered by *Mr. W. W. Young*, on rocks near Dunraven Castle, Glamorganshire.—*Filaments* an inch long, forming small tufts, somewhat rigid (as compared with *C. collabens*), obtuse. *Articulations* variable in length, at first cylindrical, afterwards becoming contracted in a beaded manner.

*** *Of doubtful affinity.*

13. C. *clandestina*, Berk.; "threads articulated, free, distinct, uniform; bearing reproductive granules within the joints." *Berk. Gl. Alg. t.* 13, *f.* 1.

"On the under side of stones in mud highly impregnated with putrifying marine substances at Weymouth," *Rev. M. J. Berkeley.—Filaments* very minute, about a line long, at first appearing "of an opake white upon the dark mud-stained stone, gelatinous and flexuous, nearly equal throughout. Under the lens they are hyaline, and are furnished with joints about thrice as long as broad, with very evident and rather broad dissepiments and distinct granules. Sometimes the granules are wanting, probably through age." *Berk.*—Probably, as Mr. Berkeley observes, this obscure plant belongs rather to the *Leptomiti*, or at least "makes a very natural transition from the more distinctly articulated *Leptomiti* growing on decayed vegetables to the real *Confervæ*."

Sub-order 2. CHÆTOPHORÆ.

IV. OCHLOCHÆTE. Thw. [Plate 25, E.]

Frond disciform, appressed. *Filaments* cylindrical, radiating from a central point, irregularly branched, consisting of a single series of cells, each of which is most commonly produced above into a rigid inarticulate seta. *Endochrome* green. *Fructification* unknown. *Thw.*—Name, from οχλος, a *multitude*, and χαιτη, a *bristle*.

1. O. *hystrix*, Thw. in *Harv. Phyc. Brit. t.* ccxxvi.

On stems, &c. in a lake of brackish water called "The little sea," near Wareham, Dorset, *Rev. W. Smith ;* also in fresh water ditches near Bristol, *G. H. K. Thwaites.* Forming a minute dot-like disk, on the leaves of grasses, &c.—*Filaments* closely appressed to the substance on which they grow, radiating from a central point, irregularly divided, and frequently cohering laterally. *Cells* oblong, each usually furnished with a tubular, very long, diaphanous bristle.

ORDER XVI. ULVACEÆ.

Grev. Alg. Brit. p. 168 ; *Hook. Br. Fl.* ii. *p.* 309 ; *Harv. in Mack. Fl. Hib. part* iii. *p.* 240 (in part) ; *J. Ag. Alg. Medit. p.* 14 ; *Endl. 3d Suppl. p.* 18.

DIAGNOSIS.—Green or purple, marine or fresh water Algæ, composed of small polygonal cells, forming expanded membranes, or membranous tubes ; very rarely arranged in filaments.

NATURAL CHARACTER.—*Root* a small disk. *Frond* in all the genuine plants of the order membranaceous, composed of minute, polygonal, and commonly flattened cellules cohering in filmy strata, and connected into laminæ by means of firm gelatine. The surface of the membrane is usually areolated, and in some cases beautifully tessellated, the cells being arranged in parcels of four and multiples of that number, forming regular patterns, like mosaic pavement. These membranous fronds are frequently expanded, in which case they seldom assume a definite figure, generally being of very uncertain form in different individuals of the same species, and being frequently much lacerated during growth. Sometimes the membrane (as in *Enteromorpha*) takes the form of a tube, and is then very generally branched. In *Bangia*, a genus which ought probably to be removed from the order, the frond is exceedingly slender, forming filaments which sometimes consist of a simple string of cells, ranged consecutively like those of a *Conferva*.

Most of the Ulvaceæ are of an intense, herbaceous green colour, having glassy fronds; but a few (as the *Porphyræ*, *Bangia*) are distinguished among chlorospermatous Algæ for a lurid purple colour. Except this difference in colour there is little in structure to separate these plants from those with which they are here associated. They inhabit the same places, and their mode of fructification is similar. Nothing can be more simple than the fructification of the Ulvaceæ, so far as it is known. Every cell of the frond contains its endochrome, or colouring matter, and this, at maturity, forms the spore. Each cell seems capable of furnishing a sporule, and in many cases four sporules; and thus from the breaking up of a single ulvaceous leaf millions of new individuals may arise. No wonder, therefore, that these plants multiply so fast and are so widely dispersed. They are the least local of all the Algæ; some of our common kinds being found wherever any marine vegetation exists. The shores of most countries supply *Ulva latissima* and *Enteromorpha intestinalis* and *compressa;* while *Ulva* (*Prasiola*) *crispa* is found at Spitzbergen and in the far southern antarctic lands, being one of the most northern and most southern of the Algæ. The species require a careful study; particularly those of the genus Enteromorpha. Comparatively few of the Ulvaceæ are found in fresh water. The majority grow just below high-water mark, forming the marginal belt of marine vegetation, but the marine kinds are by no means confined to this zone, but sometimes vegetate at a considerable depth, quite beyond the influence of the tide.

SYNOPSIS OF THE BRITISH (MARINE) GENERA.

I. Enteromorpha. *Frond* tubular, mostly branched. [Plate 25, D.]

II. Ulva. *Frond* leaf-like, green. [Plate 25, B.]

III. Porphyra. *Frond* leaf-like, purple. [Plate 25, A.]

IV. Bangia. *Frond* filamentous, (mostly) purple or pink. [Plate 25, C.]

I. Enteromorpha. Link. [Plate 25, D.]

Frond tubular, hollow, membranaceous, of a green colour and reticulated structure. *Fructification:* three or four roundish granules, aggregated in the reticulations. *Grev.*—Name, εντερον, the *entrail*, and μορφη, a *form* or *appearance*.

1. E. *Cornucopiæ*, Carm.; gregarious, small; fronds tubular at the base, dilated upwards, plaited, laciniated and torn at the margin. *Carm. MSS.; Hook. Br. Fl.* ii. *p.* 313. *Scytonema intestinalis, β. Cornucopiæ, Lyngb. p.* 67.

On corallines, &c., in rocky pools left by the tide. Annual. Spring and summer.—" *Fronds* gregarious, about an inch long, funnel-shaped, from a short, tubular base, expanding into a plaited, laciniated membrane, torn and jagged at the extremity. *Granules* in fours, all over the frond. *Colour* dark green below, pale above." *Carm.*

2. E. *intestinalis*, L.; fronds elongated, simple, inflated (often floating). *Grev. Alg. Brit. p.* 179; *Hook. l. c. p.* 313; *Wyatt, Alg. Danm. No.* 80; *Harv. Phyc. Brit. t.* cliv.—*β. crispa;* frond compressed, the margin crisped and curled. *Grev.*

In the sea, and in brackish and fresh-water ditches, very common. Annual. Summer.—*Fronds* often 2 feet long or more, and from a line to 2 or 3 inches in diameter, tapering at base, at first fixed by a minute root, afterwards detached and freely floating, inflated, variously waved or curled, of a full green colour, fading to yellowish and finally white.

3. E. *compressa*, L.; fronds elongated, branched, cylindrical or sub-compressed; the branches simple or nearly so, long, and much attenuated at their base. *Grev. Alg. Brit. p.* 180, *t.* 18; *Hook. l. c. p.* 314; *Wyatt, Alg. Danm. No.* 165.—*β. prolifera;* frond somewhat inflated, throwing out capillary branches on all sides. *Grev.*

On rocks, &c., in the sea, very common. Annual. Spring and summer. —*Fronds* 6—12 inches long, either capillary or several lines in diameter, more or less branched, sometimes nearly simple, sometimes very much divided and bushy; branches generally springing near the base, much attenuated below, gradually widening upwards and obtuse at the tips, by which character this variable plant is easily recognized from the four following.

4. E. *Linkiana*, Grev.; "frond cylindrical, tubular, filiform, reticulated, pellucid, of a very pale green colour, membranaceous (rigid when dry), much branched; branches attenuated." *Grev. Alg. Brit. p.* 182; *Hook. l. c. p.* 314.

In the sea. Appin, *Capt. Carmichael.* Annual. Summer.—" *Fronds*

6—12 inches in length, filiform, cylindrical, tubular, inflated, rising with a main stem about 1 line in diameter, on all sides of which, and along the whole length, the branches are inserted: branches 2—6 inches long, smaller in diameter than the stem, between erect and spreading, set with a second series, 1 or 2 inches long, which, in their turn, bear a third, which are quite capillary. The *structure* distinctly reticulated, the reticulations roundish, but angular. *Fructification:* 3 or 4 subglobose granules within many of the reticulations. *Substance* membranaceous, but firm and somewhat cartilaginous when dry, adhering very imperfectly to paper. *Colour* a very pale, yellowish green." *Grev. l. c.*

5. E. *erecta*, Lyngb.; frond cylindrical, filiform, slender, highly reticulated; branches erect, opposite or alternate, set with capillary ramuli, all attenuated to a fine point. *Hook. Br. Fl.* ii. *p.* 314; *Wyatt, Alg. Danm. No.* 166; *Harv. Phyc. Brit. t.* xliii. *E. clathrata, β. Grev. Alg. Brit. p.* 181. *Conferva paradoxa, Dillw. (authentic specimen); Griff. MS.*

On rocks in the sea, about half-tide level. Annual. Spring and summer, not uncommon.—*Frond* 4—8 inches high, cylindrical, from the thickness of a hog's bristle to half a line in diameter; stem generally undivided, closely set with opposite or alternate, simple branches, which diminish in length upwards; these are gradually attenuated to a point, and set throughout with sub-distichous, slender, setaceous, erecto-patent ramuli, 1 or 2 lines long, and all tapering at the tips, which give the plant a feathery appearance. Such is the *normal* state of this species, but there are numberless varieties, which seem to connect it with the following, as that in like manner is connected with *E. ramulosa;* and I quite agree with Sir W. J. Hooker, who, in adopting Capt. Carmichael's descriptions, says, that however distinct typical individuals of the three supposed species may appear, still, "that there are intermediate states of these plants which would rather lead me to coincide with Dr. Greville, and to unite them." Few plants are so sportive in size and ramification, and if all the varieties were described the species might easily be multiplied till we should have one for almost every marine pool!

6. E. *clathrata*, Roth; frond cylindrical, filiform, slender, highly reticulated; branches spreading, much divided, set with divaricated or recurved ramuli. *Grev. Alg. Brit. p.* 181; *Hook. Br. Fl.* ii. *p.* 315; *Wyatt, Alg. Danm. No.* 34? *E. clathrata, α. Grev. l. c. Conf. paradoxa, E. Bot. t.* 2328.

Between tide-marks. Annual. Spring and summer. Not uncommon.—*Frond* 4—12 inches high, cylindrical, from the thickness of a bristle to 1 or 2 lines in diameter, generally with an undivided stem set with close branches, which spread in all directions and bear a second, third, or fourth series, till the plant assumes a very bushy appearance; the ramuli slender, abundantly scattered, either spreading or curved back, occasionally tangled and interwoven, their apices always acute and tapering. Carmichael describes this plant as prostrate, "forming a thin, inextricable fleece," a state evidently approaching the following.

7. E. *ramulosa*, Sm.; frond compressed, highly reticulated, very much branched and interwoven, twisted, everywhere covered with spine-like branchlets. *Harv. Phyc. Brit. t.* ccxlv.; *Grev. Alg. Brit. p.* 181; *Hook. l. c. p.* 315; *E. Bot. t.* 2137. *E. clathrata*, γ. *Grev. l. c.* *E. ramulosa*, var. *minor*, *Wyatt, Alg. Danm. No.* 208.

On rocks between tide-marks. Annual. Spring. Not uncommon.—"*Fronds* 5 or 6 inches to 1 or 2 feet long, half a line in diameter, compressed, curled and twisted, much and repeatedly branched, and interwoven into a (more or less) thick and inextricable mat, and beset on all sides with short, spine-like branchlets, or rather apiculi, which render it harsh to the touch. *Substance* membranaceous, green. This species can be at once distinguished from *E. clathrata*, with which alone there is any risk of its being confounded, by mere handling, the one feeling harsh to the touch, the other soft and silky." *Carm. MSS.*

8. E. *Hopkirkii*, M'Calla; frond excessively slender and byssoid, flaccid, very much branched; branches feathery, decompound, erect, attenuated, set with minute, subulate ramuli; cellules large, hyaline, each cell containing one or two minute grains of colouring matter; the ramuli composed of a single series of such cells. *Harv. Phyc. Brit. t.* cclxiii.

Dredged in 4—10 fathom water. Annual. Summer and autumn. Goodrington, Torbay, *Mrs. Griffiths* (1838). Carrickfergus, *Mr. M'Calla* (1845).—*Fronds* 6—12 inches long or more, exceedingly slender, the main stems scarcely the diameter of human hair, the branches and ramuli more delicate. The cells of which the frond is composed are of large size, about three or four making the breadth of a branch, hyaline, with a minute grain of endochrome in the centre; the ramuli are composed of a single string of such cells. The species has been named by Mr. M'Calla in honor of the author of the '*Flora Glottiana*:' the discovery is, however, due to Mrs. Griffiths, from whom I have specimens of the date above given.

9. E. *percursa*, Ag.; frond capillary, simple, or having a few short, spine-like ramuli, nearly solid, laxly reticulated; the cells large, hyaline, (2 to 4 in the breadth of the frond); each cell containing a brilliant green grain of colouring matter. *Hook. Br. Fl. vol.* ii. *p.* 315; *Harv. Man. Ed.* i. *p.* 176; *Harv. Phyc. Brit. t.* cclxxxii.

On the oozy sea-shore, above half tide level, spreading widely. Annual. Summer. Appin, *Capt. Carmichael*. Bangor, N. Wales, *Mr. Ralfs*. Larne, *Mr. D. Moore*.—*Fronds* several inches long, as fine as human hair, decumbent, forming widely spreading, entangled strata.

II. Ulva. Linn. [Plate 25, B.]

Frond membranaceous, of a green colour, plane, (in some cases saccate, and inflated in the young state). *Fructification:* minute *granules*, mostly arranged in fours. — Name, supposed to be from *Ul*, *water* in Celtic.

1. U. *latissima*, Linn.; frond broadly-ovate or oblong, flat, delicately membranaceous, of a full green colour. *Grev. Alg. Brit. p.* 171; *Hook. l. c. p.* 311; *Wyatt, Alg. Danm. No.* 33. *U. Lactuca, E. Bot. t.* 1551.

In the sea, on rocks, stones, &c., very common. Annual. All the year round.—*Fronds* tufted, 6—18 inches long or more, and several inches wide, variously waved and lobed. *Fructification* covering the whole frond.

2. U. *Lactuca*, Linn.; frond at first obovate, saccate, inflated, at length cleft down to the base, the segments plane, unequal, laciniated, semi-transparent. *Grev.—Hook. l. c. p.* 311; *Grev. Crypt. Fl. t.* 313.

On rocks, stones, corallines, &c. in the sea. Annual. May and June. —“*Fronds* 3—6 inches in length, in the young state obovate and saccate, but very soon bursting and lacerating, at length cleft irregularly to the base.” *Grev.*—A smaller and far more tender plant than the preceding, and of a pale yellow-green colour. It adheres closely to paper in drying.

3. U. *Linza*, Linn.; frond linear-lanceolate, acute, undulate at the margin, composed of two membranes closely applied. *Hook. l. c. p.* 311; *Wyatt, Alg. Danm. No.* 164.

Rocks and stones in the sea. Annual. Summer.—*Fronds* clustered, 6 inches to 2 feet in length, half an inch to an inch and a half wide, linear-lanceolate, tapering to each extremity, much curled, of a fine grass-green colour. This species, as Dr. Greville observes, shows by its double membrane a transition to *Enteromorpha*.

III. Porphyra. Ag. [Plate 25, A.]

Frond plane, exceedingly thin, and (owing to the fructification) of a purple colour. *Fructification:* 1, scattered *sori* of oval seeds; 2, roundish *granules*, mostly arranged in a quaternate manner, and covering the whole frond. *Grev.*—Name, πορφυρος, *purple*.

1. P. *laciniata*, Lightf.; fronds deeply and irregularly cleft, with broad segments; margin variously cut and lobed. *Grev. Alg. Brit. p.* 168; *Hook. Br. Fl.* ii. *p.* 310; *Harv.*

Phyc. Brit. t. xcii.; *Wyatt, Alg. Danm. No.* 32. *Ulva umbilicata, E. Bot. t.* 2296.

In the sea, on rocks, stones, &c., very common. Annual. Spring to autumn.—*Fronds* clustered, 4—8 inches long or more, very irregularly cleft, often fixed by the centre, when dry transparent, very glossy and of a fine purple. This and the following species constitute the *Laver* of many parts of England, the *Sloke* or *Slokaun* of Scotland and Ireland. When stewed for several hours they are reduced to a sort of pulp, which is brought to table, served with lemon-juice, and is a favourite article of food with many persons.

2. P. *vulgaris*, Ag.; frond simple, broadly lanceolate, the margin much waved. *Grev. Alg. Brit. p.* 169; *Hook. l. c. p.* 310; *Harv. Phyc. Brit. t.* ccxi; also *P. linearis, Grev. Alg. Brit. p.* 180, *t.* 18; *Wyatt, Alg. Danm. No.* 163.

In the sea, on rocks, &c. with the preceding.—*Fronds* 1 or 2 feet long, and 2 or 3 inches wide, of a lanceolate figure, often much waved. Except that the frond is undivided, this does not differ from the preceding.

3. P. *miniata*, Ag.; frond solitary, plane, oblong, gelatinous, rose-red. *Hook. l. c. p.* 310.

In the sea; coast of Appin, *Capt. Carmichael.*—"My only authority for claiming this plant as a native of these shores, was a fragment found floating in the sea. It was 3 inches in diameter, plane, curled on the margin, of a bright sanguineous colour, extremely gelatinous and filled with close-set roundish sporidia. When laid on paper to dry it, it dissolved into a reddish sanies, being probably in a state of putrescence, and nothing remained but a mere stain. From its texture and fructification, it evidently does not belong to this genus." *Carm.* I know nothing of this plant.

IV. Bangia. Lyngb. [Plate 25, C.]

Frond filiform, tubular, composed (in typical species) of numerous radiating cellules, disposed in transverse rows, and enclosed within a hyaline, continuous sheath. *Spores* purple or green, one formed within each of the cells of the frond. —Named in honour of Hoffman Bang, a Danish botanist and friend of Lyngbye.

1. B. *fusco-purpurea*, Dillw.; filaments elongated, capillary, decumbent, nearly straight or somewhat curled, equal, forming a brownish-green or purple stratum, glossy; granules few (about five) in each transverse line. *Grev. Alg. Brit. p.* 177; *Hook. Br. Fl.* ii. *p.* 316; *Wyatt, Alg. Danm. No.* 167; *Harv. Phyc. Brit. t.* xcvi. *Conf. fusco-purpurea, Dillw. t.* 92; *E. Bot. t.* 2055. *Conf. atro-purpurea, Dillw. t.* 103; *E. Bot. t.* 2085.

On rocks and wood in the sea, near high-water mark; not uncommon. — Forming a lubricous, blackish-purple, occasionally greenish stratum. *Filaments* several inches long, straight or curled, variable in breadth; the narrow ones containing often but a single row of granules; the broader containing 4 or 5 rows. *Granules* large, dark purple, square, closely set.

2. B. *ciliaris*, Carm.; "filaments gregarious, very minute, simple, straight, compressed, purple; granules binate, globose." *Carm. MSS.*; *Hook. Br. Fl. p.* ii. *p.* 316.

On the old leaves of *Zostera marina*, Appin, *Capt. Carmichael.* Annual. Spring.—"This, the minutest of all the *Bangiæ*, grows on the edges of the leaves in the form of a delicate pink-coloured fringe. *Filaments* half a line in length, gelatinous, straight, compressed, rather torulose. *Granules* large, globular, arranged in pairs." *Carm.*—The granules are occasionally in a single series.

3. B.? *ceramicola*, Lyngb.; filaments very slender, flaccid, rosy; articulations equal in length and breadth; endochrome at length globular, and escaping through the tube. *Harv. l. c. p.* 355; *Lyngb. Dan. t.* 48?

In rocky pools on various small Algæ, at Appin, *Capt. Carmichael.*—"*Filaments* very slightly tufted, or rather gregarious, about an inch long, very slender and flaccid, of a purplish rose-colour. *Articulations* about as long as broad, becoming at length gibbous, when the internal mass, which was at first square, assumes a globular form, and bursts through the tube." *Carm.*

4. B.? *carnea*, Dillw.; "filaments simple, slender, short, pale red; articulations torulose, 2 or 3 times longer than broad, endochrome contracted into a solitary globule." *Dillw. Conf. t.* 84; *Harv. l. c. p.* 355.

On *Confervæ* in the river near Loughor, Glamorganshire, near its confluence with the sea, *Mr. W. W. Young.*

5. B.? *elegans*, Chauv.; filaments minute, dichotomously branched, with very patent axils; branches containing a single row of simple or binate, purple, grain-like cells. *Harv. Phyc. Brit. t.* ccxlvi.

Parasitical on the smaller Algæ, very rare. Annual. Dredged in Strangford Lough, at Portaferry, adhering to *Gracillaria confervoides*, *Mr. W. Thompson* (1838). Forming minute tufts, 1—2 lines long, resembling *Callithamnia Daviesii* in colour and size. The younger parts of the filaments contain a string of closely set lenticular grains or cells, arranged like those of a *Lyngbya*. In the older parts the cells are less regularly placed, and are more distant, of a broadly spindle-like form with a division in the centre, as if composed of two conical or sugar-loaf bodies. These are probably the ripe spores, which escape on the bursting of the tubular filament. This plant can hardly remain in *Bangia*, and will probably form the type of a new genus, to which the name *Diconia* (δὶς κωνος) may be given, in allusion to the form of its ripe spores.

ORDER XVII. OSCILLATORIACEÆ.

OSCILLATORIEÆ, *Harv. in Mack. Fl. Hib. part* 3, *p.* 164. *Endl. 3rd Suppl. p.* 12. Oscillatorieæ and Rivularieæ, *Harv. Br. Fl. J. Ag. Alg. Medit. p.* 8, 10. Oscillatoreæ, *Lindl. Veg. Kingd. p.* 18.

DIAGNOSIS.—*Green* or blue, rarely purplish, marine, or (more frequently) fresh-water Algæ, composed of continuous, tubular, simple, or rarely branching filaments, which are either free or invested in gelatine. *Endochrome* annulated, at length separating into lenticular sporidia.

NATURAL CHARACTER.—*Root,* either simply a point of attachment; or, in most cases, not obvious. *Filaments* of small size, often exceedingly minute, inarticulated, membranous; each filament formed of a single, slender, filiform tube, which is most frequently simple. These filaments are rarely solitary. In the majority, a great number of filaments lie together, either in bundles or in strata, in the latter case usually surrounded by a slimy matrix. In a few, forming the sub-order *Rivularieæ,* the filaments cohere into fronds of definite shape, in which they commonly radiate from a central point, their apices being turned to the circumference of the frond. In this sub-order also, each filament springs from a globular cell of small size, the use of which is unexplained, but which is obviously of a similar nature to the cells called "connecting cells" in the Nostochaceæ. The filaments are very rarely branched. In some cases where they have the appearance of being branched, the ramose character is owing to the lateral cohesion of two filaments; the lower part of one being applied to the side of the other. Such an arrangement is termed appositional branching, and is found in several fresh-water species allied to *Calothrix.*

The structure of the plants of this order is very uniform, the chief variety lying in the more or less perfect division of the endochrome into lenticular frustules or cells. In the *Oscillatoriæ,* and in most others, the endochrome is merely transversely striate, until just before the breaking up of the plant. But in some *Lyngbyæ*, the endochrome exists, from an early period of growth, in the form of separate lenticels. Such plants have a structure very similar to that of the simpler *Bangiæ*, through which genus a connection is established with Ulvaceæ, or of Hormospora, the conterminous genus on the side of the Palmellaceæ. With the Nostochaceæ there is a close affinity established through Sphærozyga and Spermosira; the latter of which, when very young, has a strong resemblance to an *Oscillatoria*.

Many plants of this order are celebrated for their semi-animality (according to the views of some naturalists); at least, for having independant motions, the cause of which is unexplained. The *Oscillatoriæ*, *Spirulina*, and others have this locomotive power in a greater or less degree. It has a threefold character. First there is a movement of the filament from side to side; one end being kept pretty steady, so as to form a central pivot, while the other end oscillates, like a pendulum, describing segments of circles in its passage. This sort of motion, which gives name to the genus *Oscillatoria*, though often languid, or not to be observed when specimens are examined, is sometimes exceedingly vivid, the threads rapidly changing place from one side of the field of view to the other. Coincident with this oscillation, we often observe the end of the filament which describes the circle to *bend* first to one side and then to the other, something as the head of a caterpillar or a worm does when the animal is gliding over unknown ground, or as if the creature were seeking something at either side of its line of march. This sort of movement is less frequently noticed than the oscillation, but I have repeatedly witnessed it, and it far more nearly resembles the movement of an animal than any other vegetable motion with which I am acquainted, except, perhaps, that of *Bacillaria paradoxa*. The third sort of motion is more the result of the other two than an independent movement: it is a simple progression. The whole phenomenon may perhaps be resolved into a spiral onward movement of the filament. If a piece of the stratum of an *Oscillatoria* be placed in a vessel of water, and allowed to remain there for some hours, its edge will first become fringed with filaments, radiating as from a central point, with their tips outwards. These filaments, by their constant oscillatory movements, are continually loosened from their hold on the stratum, cast into the water, and at the same time propelled forward; and as the oscillation continues after the filament has left its nest, the little swimmer gradually moves along, till it not only reaches the edge of the vessel, but often—as if in the attempt to escape confinement—continues its voyage up the sides, till it is stopped by dryness. Thus in a very short time a small piece of *Oscillatoria* will spread itself over a large vessel of water. I am not aware that the filaments ever return to the stratum after they have once left it: their course is ever "ahead,"—which looks more as if they were obeying some condition imposed on them than if their movements were spontaneous, like those of animalcules. There is indeed a wide difference between the calm, undeviating onward course of these singular vegetables and the wild and wayward wanderings and contests of animalcules, as seen in the field of an oxy-hydrogen microscope. But such difference, though it may afford probability of a difference in the *nature* of the life enjoyed by the two entities under review, by no means proves this difference; for we must remember that there are animals as inert, and apparently as passionless, as our *Oscillatoria*. And let not the undeviatingly onward course be assigned to vegetables *solely*, for if animals (*some* at least) were always sane, their course would be, like that of the *Oscillatoria*, still onward,—seeking an "Excelsior" which is ever in advance of their position. Seriously, I am unable to explain satisfactorily the movement of these vegetables,—for vegetables, and not animals, I believe them to be,—and I have no wish to theorize on the subject. Our knowledge is yet far from sufficient to allow of our dogmatizing on this point: our maxim must still be, observe.

SYNOPSIS OF THE BRITISH (MARINE) GENERA.

I. Rivularia. *Filaments* radiating from a point, immersed in firmly gelatinous, globose or lobed fronds, of definite shape. [Plate 26, A.]

II. Schizothrix. *Filaments* rigid, in branching bundles, at length splitting. [Plate 26, B.]

III. Calothrix. *Filaments* short, tufted, fixed by their base only. [Plate 26, C.]

IV. Lyngbya. *Filaments* elongate, decumbent, flaccid. [Plate 26, E.]

V. MICROCOLEUS. *Filaments* minute, needle-shaped, enclosed, many together, in membranous or gelatinous sheaths. [Plate 26, D.]

VI. OSCILLATORIA. *Filaments* needle-shaped, straight, or slightly curved, short, heaped together in gelatinous strata, oscillating. [Plate 26, F.]

VII. SPIRULINA. *Filaments* spirally twisted, lying in a mucus stratum. [Plate 27, C.]

I. RIVULARIA. Roth. [Plate 26, A.]

Frond globose or lobed, rarely incrusting, green or olivaceous, fleshy or gelatinous, firm, composed of continuous, inarticulate filaments, annulated within, and surrounded by, or set in, gelatine.—Name, in allusion to the fresh-water habitat of some of the original species. The following are found in the sea.

1. R. *plicata*, Carm.; fronds rather large, densely gregarious, gelatinous, compresso-plicate, often hollow and ruptured, dark green; filaments many times dichotomous, attenuated. *Harv. l. c. p.* 392. *Lichen corrugatus*, *Dicks.*, according to a specimen given by Dickson himself to Mr. Borrer.

On the rocky sea-shore, about high-water mark, or in situations where it is only occasionally inundated with salt water. Appin, *Capt. Carmichael.* Torbay, *Mrs. Griffiths.* Eyrmouth, *Dr. Johnston.* Ballantrae, Ayrshire, *Mr. W. Thompson.* Innischerig Island, Co. Clare; and elsewhere.—"*Fronds* growing from a smooth gelatinous stratum, from a line to half an inch in diameter, mostly confluent and distorted by mutual pressure, gelatinous, and in their more advanced state often hollow and ruptured. *Filaments* dichotomous, tapering to a fine point, obscurely striated. *Globules* few in number, pellucid, lodged within the filaments, which at length break off, leaving the globule attached to the base of the dismembered branch." *Carm.*

2. R. *atra*, Roth; fronds minute, scattered, globose, smooth, firm, glossy black; filaments deep green, slender, densely packed. *Harv. l. c. p.* 392; *E. Bot. t.* 1798; *Harv. Phyc. Brit. t.* ccxxxix.

In the sea, on rocks, corallines, Algæ, &c.—*Fronds* 1 or 2 lines in diameter, very hard; *filaments* densely packed.

3. R. *applanata*, Carm.; fronds minute, gregarious, orbicular, depressed, black; filaments simple, attenuated, the apices free. *Harv. l. c. p.* 392.

On rocks and stones, between tide-marks, *Capt. Carmichael.*—" *Fronds* a line in diameter, gregarious, often confluent, circular, depressed, spongy, of an opaque black colour, shrinking, splitting, and becoming grayish in drying. *Filaments* one-fourth of a line in length, simple, attenuated to a point, loose at the apex, of a bluish green colour." *Carm.* This seems to differ from *R. atra* in its depressed form and simple filaments. I am not acquainted with it.

4. R. *nitida*, Ag.; frond large, gelatinoso-coriaceous, lobed and plaited, often bullated, lubricous, shining, deep green; filaments simple or pseudo-branched. *Harr. l. c. p.* 393; *Wyatt, Alg. Danm. No.* 50; *Harv. Phyc. Brit. t.* lxviii. *Riv. bullata, Berk. Gl. Alg. t.* 2, *f.* 1.

On rocks between tide-marks. Annual. Summer and autumn. South of England and South and West of Ireland.—*Fronds* tremelloid, tufted or gregarious, much lobed, the lobes sinuous; in a young state compressed and filled with gelatine, in age hollow and distended; from half an inch to an inch in diameter. *Colour* a deep but very vivid olive-green, lubricous and subgelatinous to the touch. *Substance* firm, elastic, not easily lacerated. *Filaments* either simple or pseudo-branched, waved, laxly set in the interior of the lobe, but closely packed together on the exterior. *Striæ* closely set and conspicuous.

II. Schizothrix. Kütz. [Plate 26, B.]

"*Filaments* involved in a thick, lamellar sheath, rigid, curled, thickened at the base, at length longitudinally divided. *Spermatia* lateral." *Kg.* Name, from σχιζω, to *divide*, and θριξ, a *hair*.

1. S. *Cresswellii*, Harv.; forming dense, soft, pulvinate, convex tufts; filaments very slender, curved, fastigiate, collected into branching bundles. *Harv. Phyc. Brit. t.* clx.

On sandstone maritime rocks, near high-water mark, exposed to the drip of fresh water. Annual. Winter. Near the Picket rock, Sidmouth, *Rev. R. Cresswell.*—Spreading over the surface of the rock in continuous, convex, roundish or oval patches, which run one into another, and cover the rock for spaces several inches in diameter. *Colour*, in the tuft, greenish olive; in the filaments yellowish.

III. Calothrix. Ag. [Plate 26, C.]

Filaments destitute of a mucous layer, erect, tufted or fasciculate, fixed at the base, somewhat rigid, without oscillation. *Tube* continuous; endochrome green, densely annulated, at length dissolved into lenticular *sporidia*.—Name, *καλος*, *beautiful*, and *θριξ*, a *hair;* the filaments being very slender and delicate.

1. C. *confervicola*, Ag.; filaments minute, glaucous, erect, subulate, rigid, tufted. *Harv. Phyc. Brit. t.* ccliv.; *Harv. in Hook. Br. Fl.* ii. *p.* 367. *Conf. confervicola, Dillw. t.* 8; *E. Bot. t.* 2576; *Wyatt, Alg. Danm. No.* 229.

On marine, filamentous Algæ; very common.—*Filaments* 1 or 2 lines high, rigid, forming scattered or continuous tufts. "Internal mass at length consolidated into lenticular sporidia, which escape at the end of the tube, either singly or cohering in short cylinders." *Carm. MS. cum icone.*

2. C. *Mucor*, Ag.; "filaments hyaline, rigid, straightish, erect, forming olivaceous green tufts." *Ag. Syst. Alg. p.* 70; *Harv. l. c. p.* 367.

On marine Algæ, at Brighton, *Mr. Borrer.* Unknown to me.

3. C. *luteola*, Grev.; "filaments hyaline, yellowish, exceedingly slender, elongated, flexible, scattered." *Grev. Crypt. Fl. t.* 299; *Harv. l. c. p.* 367.

On marine filiform Algæ, rare. Appin, *Capt. Carmichael.*—"Plant of a pale yellowish colour, investing the stems of the filiform Algæ with its numerous filaments, and giving them a most delicate, feathery appearance." *Grev.*—Capt. Carmichael thus describes the plant in his MSS. under the name of *C. melaleuca.* "Filaments in small tufts, a line or two in length, exceedingly slender, tortuous, tapering, of a snow-white colour, and so opaque as to appear intensely black when viewed against the light. Most of them are variegated with pellucid fasciæ, caused by the destruction or escape of the colouring matter. In the water, this minute parasite gives a downy appearance to the plants on which it grows." *Carm. MS.*

4. C. *scopulorum*, Web. and Mohr; filaments minute, erect, curved, flexuous, simple, sub-attenuate, dirty green, agglutinated at the base, forming a continuous, velvety stratum. *Harv. in Hook. Br. Fl.* ii. *p.* 368; *Harv. Phyc. Brit. t.* lviii. B. *Conf. scopulorum, Dillw. t. A.*; *E. Bot. t.* 2171.

On marine rocks, near high-water mark, common; spreading in dark green slippery patches.—The filaments are a line in height, flexuous, slightly attenuated to a subacute point, simple, slimy at the base, and under the microscope of a dull yellowish green; striæ indistinct.

5. C. *fasciculata*, Ag.; filaments erect, very straight, dark green, subulate, with a setaceous point, fasciculately pseudo-branched, forming a continuous, velvety stratum. *Harv. in Hook. Br. Fl.* ii. *p.* 368; *Harv. Phyc. Brit. t.* lviii. A.

Marine rocks, below high-water mark. Miltown Malbay.—*Stratum* very dark shining green. *Filaments* 2 or 3 lines high, tufted, erect, straight, attenuated to a long setaceous point. They are sometimes simple, but more generally furnished with 2—6 erect, closely pressed, pseudo-branches; the striæ are strongly marked and very closely set. The filaments, in my specimens, are longer, straighter, more acuminated, and of a darker colour than I find them in an authentic specimen from Agardh.

6. C. *pannosa*, Ag.; filaments long, rigid, very much curled and twisted, obtuse, densely interwoven together into lamellated tufts or honeycombed strata; endochrome dark green, densely annulated. *Harv. Phyc. Brit. t.* lxxvi.

Near high-water mark, growing on rocks or on *Fucus canaliculatus*. Roundstone Bay, *Mr. Mc'Calla.*—*Filaments* half an inch long, very much curled, intricately woven together into laminated bundles, formed into a sort of honeycombed stratum.—I omit here the Sidmouth and Kilkee habitats given in the 'Phycologia,' the specimens from those stations requiring a new examination, and being possibly distinct.

7. C. *hydnoides*, Carm.; filaments elongated, flexuous, cylindrical, obtuse, interwoven at the base, the tips cohering in rigid, erect, tooth-like fascicles. *Harv. l. c. p.* 369. *Scytonema hydnoides, Carm. MS. cum icone.*

On the clayey sea-shore, at the flood level. Appin, *Capt. Carmichael.*—"This species occurs in thin, dark, olive-coloured (black-green under the microscope) patches, from half an inch to 2 or 3 inches in diameter. *Filaments* much branched, the lower part interwoven into a thin stratum mixed with the clay over which they creep; while the terminal branches stand erect in close conical tufts, resembling the teeth of a *Hydnum.*" *Carm. MS.* This plant is allied to *C. scopulorum*, but has a very peculiar habit.

8. C. *cæspitula*, Harv.; filaments forming close, convex tufts, blackish-green, flexuous, flaccid, obtuse, here and there spuriously branched. *Harv. l. c. p.* 369.

Marine rocks near high-water mark. Miltown Malbay, rare.—*Tufts* very convex, $\frac{1}{4}$—$1\frac{1}{2}$ inch in diameter, deep blackish green, flaccid, growing on the naked rock, or attached to corallines, &c. *Filaments* densely packed together, often twisted round each other in small bundles, either simple or pseudo-branched, obtuse, cylindrical; branches erect. *Striæ* very strongly marked and closely set.

IV. Lyngbya. Ag. [Plate 26, E.]

Filaments destitute of a mucous layer, free, flexible, elongated, continuous, decumbent. *Endochrome* (green or purple) densely annulated, and finally separating into lenticular *sporidia.*—Name, in honour of *H. C. Lyngbye*, author of an excellent work on the Algæ of Denmark. Distinguished from *Oscillatoria* by its long, flexile filaments, and from *Calothrix* by its stratified habit.

* *Filaments perfectly continuous; endochrome cylindrical, imperfectly annulated.*

1. L. *majuscula*, Dillw.; filaments very thick, issuing in long, crisped bundles from a blackish green stratum, tortuous, simple or slightly pseudo-branched. *Harv. l. c. p.* 370; *Wyatt, Alg. Danm. No.* 147; *Harv. Phyc. Brit. t.* lxii. *Conf. majuscula, Dillw. Conf. t. A.*

Thrown up by the sea. Santon Sands, *Miss Hill.* Bantry Bay, *Miss Hutchins.* Torbay, *Miss Griffiths.* Belfast Bay. *Dr. Drummond.* Portrush, *Mr. D. Moore.—Filaments* forming blackish green, interwoven strata, from which they issue in crisped bundles, 1 or 2 inches long, very tortuous, simple, or occasionally agglutinated together so as to appear branched. Diameter greater than that of any of the genus, twice or thrice as great as that of *L. muralis. Endochrome* dull green, annuli difficult to observe, close set; border of the tube broad and colourless. A fine species, erroneously referred by Agardh to his *L. crispa*, which, according to an authentic specimen, is a very different plant, of a verdigris-green colour, and thrice as slender.

2. L. *ferruginea*, Ag.; filaments slender, flaccid, forming a lax stratum, of a verdigris-green colour, which gradually changes to a pale chesnut. *Harv. l. c. p.* 370. *L. ferruginea, β. versicolor, Ag. Syst. p.* 73. *L. subsalsa, Carm. MS.*

In small mud-bottomed pools by the sea-side, filled at spring-tides. Appin, *Capt. Carmichael.*—" *Stratum* exceedingly thin and lax, extensive, at first of a vivid green colour, but passing gradually into a pale chesnut." *Carm. Filaments* an inch long, flaccid, bent in various curves but scarcely tortuous, of a pale verdigris colour under the microscope; striæ rather evident and subdistant. Capt. Carmichael's plant is of a dull verdigris hue, without gloss. I have compared it with an authentic specimen from Agardh, and can detect no difference, except in colour, which, according to Carmichael, varies with the age of the individual. Agardh's *β.* appears to answer to the British plant very exactly.

** *Filaments imperfectly articulated; endochrome distinctly annulated, separating into lenticular articulations, with pellucid dissepiments.*

3. L. *Carmichaelii*, Harv.; filaments very long, thickish, curled and tortuous, cylindrical, floating under water, and forming extensive, grass-green strata. *Harv. l. c. p.* 371; *Harv. Phyc. Brit. t.* clxxxvi. A. *L. crispa, Carm. MSS. cum icone (not of Agardh)*; *Wyatt, Alg. Danm. No.* 230.

On marine rocks and Fuci. Appin, *Capt. Carmichael.* Plymouth and Torbay. *Mrs. Wyatt.* Cornwall and Anglesea, *Mr. Ralfs.* Coast of Ireland.—" *Stratum* almost co-extensive with the object on which it grows. On *Fucus vesiculosus* it may be found upwards of a foot in extent, on the rocks, of 20—30 yards, covering them with an intensely green fleece. *Filaments* fixed at the base, but fluctuating freely with the agitation of the water; several inches long, flaccid, at length becoming curled and convoluted, when the sporidia, bursting through the tube, leave it partially empty and pellucid." *Carm.*—Transverse striæ very evident and sub-distant. When dry it is of a dull green, without gloss or any glaucous or verdigris hue, and to the naked eye strongly resembles *Conferva rivularis.*

4. L. *speciosa*, Carm.; filaments long, thick, flaccid, straight, at length curled, the margin crenate, freely floating in the water, and forming extensive, bright green strata; glossy when dry. *Harv. l. c. p.* 371; *Wyatt, Alg. Danm. No.* 196; *Harv. Phyc. Brit. t.* clxxxvi. B.

On marine rocks and Fuci. Appin, *Capt. Carmichael.* Torquay, *Mrs. Griffiths.* St. Michael's Mount, *Mr. Ralfs.*—"This plant covers the whole surface of the rock or stone, floating loosely in the water; but, when left by the tide, spreading over it in a thin, intensely green fleece. The filaments are twice as thick as those of the former species, 3 or 4 inches long, straight and flaccid, at length becoming curled and crenated by the marginal protrusion of the sporidia. These are of a very flat, lenticular form, and when ripe burst through the sides of the tube, leaving it here and there colourless." *Carm. MSS.*—When dry it is of a deep glossy green. Mrs. Griffiths' and Mrs. Wyatt's specimens are intermixed with *Conferva bangioides.*

5. L. *flacca*, Dillw.; filaments short, tufted, straight, bright green, flaccid; articulations half as long as broad. *Harv. l. c. p.* 354; *Dillw. t.* 49; *E. Bot. t.* 1943.

On Fuci and floating timber.—*Filaments* half an inch to an inch long, forming broad, bright green tufts. It adheres closely to paper.

V. Microcoleus. Desmaz. [Plate 26, D.]

Filaments minute, rigid, straight, transversely striated, bundled, and inclosed within gelatinous or membranaceous, simple or branched *fronds;* from the apices of which they oscillate.—Name, μικρος, *small*, and κολεος, a *sheath*.

1. M. *anguiformis*, Harv.; fronds snake-like, simple, decumbent, tapering much to the extremity; filaments slender, with distant striæ. *Harv. Phyc. Brit. t.* ccxlix.

Pools of brackish water, near the shore, at Dolgelly, *Mr. Ralfs.*—Forming a dense stratum on the surface of the mud. The sheaths are much twisted and grouped together without order. *Colour* a dull, dark green.—The *M. marinus* of the first edition of this work, so far as the description goes, is founded in error; that description having been drawn up from specimens of *Homœocladia anglica* incorrectly understood and imperfectly examined. What Capt. Carmichael's specimens may be I have not the means of determining: possibly they are the same as our *M. anguiformis.* I am afraid to quote the *Oscillatoria chthonoplastes, &c., Lyngb.*

Hyd. Dan. p. 92, *t.* 22, without having an authentic specimen to guide me.

VI. Oscillatoria. Vauch. [Plate 26, F.]

Filaments invested by a common, mucous matrix, rigid, elastic, oscillating, simple, continuous. *Endochrome* divided by close, parallel, transverse striæ.—Named from the curious motion observed in the filaments, which resembles the *oscillation* of a pendulum. The species of this genus are very numerous, and it is almost impossible to lay down characters by which they may at all times be distinguished. In the following descriptions, the *colour* of the *strata* always refers to the appearance presented to the naked eye; that of the *filaments*, to what they appear in a dry state. Most of the species are found in fresh water, both stagnant and running: some in thermal springs; some on damp ground; very few in salt water, and still fewer in the open sea. The following have more or less claims on the marine flora.

1. O. *littoralis*, Carm.; stratum vivid, æruginous-green; filaments thick, deep green, curved; striæ conspicuous, close. *Harv. l. c. p.* 375; *Harv. Phyc. Brit. t.* cv. A.

In pools along the muddy sea-shore, flooded by spring tides. Appin, *Capt. Carmichael.*—" *Stratum* exceedingly thin, slimy, bullated by the extrication of air-bubbles, of a dark green colour, spreading to an indefinite extent over the muddy bottom of the pool. *Filaments* 1 or 2 lines long, much thicker than those of *O. nigra*, straight or slightly curved, radiating very irregularly and generally in twisted bundles. *Striæ* strongly marked, at intervals of about one-third the diameter of the filament." *Carm. MSS.* Most allied to *O. limosa.* In a dry state it is membranaceous, and scarcely adheres to paper.

2. O. *subsalsa*, Ag.; stratum membranaceous, æruginous-green, smooth; filaments slender, densely interwoven; striæ distant, indistinct. *Harv. l. c. p.* 376; *Ag. Syst. Alg. p.* 66?

At Brighton, " on a plank between high and low water mark," *Mr. Borrer.*—*Stratum* æruginous or bluish green. smooth, without gloss when dry, peeling off in membranaceous flakes; *filaments* hyaline, slender, densely packed, either straight or curved; *striæ* not very evident. In habit, it somewhat resembles *O. littoralis;* but the filaments are much more slender, and the stratum more membranaceous.

3. O. *spiralis*, Carm.; stratum coriaceous, greenish-black, without lubricity; filaments spirally twisted, radiating in all directions. *Harv. l. c. p.* 377; *Harv. Phyc. Brit. t.* cv. B.

On rocks by the sea-side, where birds are in the habit of resting. Appin, *Capt. Carmichael.*—" It spreads over the dry, naked earth. *Stratum* several feet in extent, firm, coriaceous, of a glossy black colour, void of lubricity. *Filaments* about half a line in length, twisted like a cork-screw, radiating in all directions." *Carm.*

4. O. *nigro-viridis*, Thw.; stratum of a very dark olive-green colour; filaments delicate pale green, rigid, with obtuse, curved apices; striæ inconspicuous, distant about half the diameter of the filament; endochrome very slightly granulose. *Thw. in Harv. Phyc. Brit. t.* ccli. A.

In a brackish ditch at Shirehampton, Bristol, *Mr. Thwaites.—Stratum* thick, dark olive-green, almost black, growing on mud and subsequently floating. *Filaments* pale dull green, with distinctly curved apices.

5. O. *subuliformis*, Thw.; stratum of an intense æruginous green colour; filaments bright green, subuliform; striæ inconspicuous, distant from one-half to three-quarters of a diameter of the filament; endochrome not evidently granulose. *Thw. in Harv. Phyc. Brit. t.* ccli. B.

With the preceding. Summer and autumn. *Mr. Thwaites.—Stratum* thin, appearing black in the water, but when taken out, of a beautiful deep blue-green colour.

6. O. *insignis*, Thw.; stratum of a dark brown, almost black colour; filaments brown, of considerable diameter, their apices obtuse, slightly oblique and ciliated; striæ conspicuous, very close; endochrome distinctly granulose. *Thw. in Harv. Phyc. Brit. t.* ccli. C.

With the preceding. November. *Mr. Thwaites—Stratum* thin, spreading over decaying vegetable matter. *Filaments* very large and rather brittle.

VII. Spirulina. Turp. [Plate 27, C.]

Filaments lying in a mucous layer, rigid, simple, spirally twisted, vividly oscillating. Tube continuous; *endochrome* green, more or less distinctly annulated.—Name, a diminutive of *spira*, a twist or curl.

1. S. *tenuissima*, Kütz.; stratum very lubricous, æruginous, subradiant; filaments densely spiral, very slender, parallel, flexuous. *Harv. Phyc. Brit. t.* cv. C.

On decaying Algæ, in a brackish pool, near Menai Bridge; and on sticks in brackish pools, at Penman Pool, Dolgelly, *Mr. Ralfs.* Aberdeen, *Dr. Dickie.*—Forms a gelatinous pellicle of a rich green colour. *Filaments* very slender, vividly oscillating.

2. S. *Hutchinsiæ*, Kütz.; "marine, æruginous, aggregated; spirals very dense, distinct." *Kütz.*

Shirehampton, *Mr. Thwaites.*

Order XVIII. NOSTOCHACEÆ.

Nostochinæ, *Harv. Man. ed.* 1, *p.* 13. Nostochineæ, *Endl. 3d Suppl. p.* 12. Nostocheæ, *Lindl. Veg. King. p.* 18. *Kütz. Phyc. Gen. p.* 30. *(Part of Nostochinæ, Ag. and other authors.)*

Diagnosis.—Green, fresh-water, or rarely marine, Algæ, composed of moniliform filaments, lying in a gelatinous matrix.

Natural Character.—Plants sometimes furnished with firmly gelatinous, but never truly membranaceous, fronds of definite outline, variously lobed or extending into sub-regular branches; sometimes mere masses of jelly or slime, through which filiform strings of cells are dispersed. *Cells* spherical or oval, filled with bright green endochrome, linked together, end to end, into moniliform filaments, which are sometimes simple, sometimes, but rarely, branched, and are almost always curved or twisted, often taking a spiral direction. In the higher examples of the order a multitude of such threads is contained within a firm jelly, through every part of which they are dispersed; but in the lower members the filaments are separated, or lie in an indefinite slimy substance. The cells composing the filaments are of two kinds; first, the bright green ones already described, which constitute the greater part of the filaments; secondly, solitary cells of different form and size to the rest, destitute of endochrome, and often clothed with cilia. These cells occur at intervals in all the filaments, but vary in position, being sometimes found at one end of the filament, sometimes in the centre. They are called "connecting-cells" or "heterocysts." Their use is unexplained, unless they be representatives of the male system in these plants. This would seem probable by their never altering their character, while fructification is constantly formed in the other cells. The regularity of their occurrence, and the definite position they occupy, seem to show that they have some prominent office.

The Nostochinæ are chiefly found in fresh-water streams, and in damp places and ditches. Very few are found in the sea, and these only along the margin of the tide, on the heaps of decaying Algæ. Several occur in ditches of brackish water, and these are admitted into the present work. All the kinds we have here to notice are of very minute size, but some of the fresh-water kinds and those found on damp soil have fronds of large dimensions. The gelatinous substances often seen late in autumn on damp garden-walks, and called "fallen stars," a name derived not from their lustre but from the suddenness of their appearance, are species of the genus *Nostoc.* These dry up into mere films in dry weather, and expand again after the first shower, so that they are not always so suddenly produced as they appear to be. The structure of these *Nostocs* is simpler than that of the species of *Collema,* among Lichens, but there is much affinity between these plants; and through *Nostoc* the passage from the Algæ into the Lichens is thus clearly established.

SYNOPSIS OF THE BRITISH (MARINE) GENERA.

I. Monormia. A single moniliform filament included within a spirally twisted and convoluted gelatinous frond.

II. Sphærozyga. *Filaments* free, moniliform, usually destitute of an evident sheath.

III. Spermosira. *Filaments* free, moniliform; each enclosed in a membranous, cylindrical, filamentous tube.

I. Monormia. Berk. [Plate 27, A.]

Frond branched, composed of a single, moniliform thread, following the convolutions, immersed in gelatine. *Berk.*—Name, μονος, *one*, and ορμος, a *necklace.*

1. M. *intricata*, Berk. *Gl. Alg. p.* 46, *t.* 18; *Harv. Phyc. Brit. t.* cclvi.

In ditches of the marsh to the south of Frindsbury canal, near Gravesend, in great abundance in June, 1832, *Rev. M. J. Berkeley*. Shirehampton, near Bristol, *Mr. Thwaites*.—" Forming small, roundish, gelatinous masses, floating amongst different species of *Lemna* in fresh water, but probably within the influence of the tide, and also amongst *Enteromorpha intestinalis*, and even within the frond in brackish water. The plant is at first of an olive-yellow, gradually assuming a greener tint, and when dried, of a deep verdigris. Very gelatinous, delicately branched; the branches very flaccid. Under a high magnifier, the whole plant is evidently composed of gelatine, in the centre of which runs a single, moniliform filament, following the ramifications, and in its progress curling to and fro repeatedly across the thread; the joints being nearly globular. The specimens from the interior of *Enteromorpha* are paler, and have often longer joints amongst the globular ones." *Berk.*—A most interesting and beautiful plant, forming a clear link between *Nostoc* and *Sphærozyga*. I am indebted to Mr. Berkeley for specimens.

II. Sphærozyga. Ag. [Plate 27, D.]

" *Filaments* free, simple, moniliform, consisting of a series of ordinary cells interrupted here and there by a cell of a different kind (*connecting-cell*, or *heterocyst*) which is generally of a larger size, and often ciliated." *Thw.*—*Spores* formed from the ordinary cells.—Name, from σφαιρα, a *globe*, and ζυγος, a *yoke*. The name *Anabaina*, applied to this genus by Bory, and adopted in our first edition, is pre-occupied for a genus of Euphorbiaceæ, by A. de Jussieu.

1. S. *Carmichaelii*, Harv.; " spores large, oblong, twice or thrice as long as broad, commencing to be formed from the cells most distant from the ciliated connecting one." *Thw. Harv. Phyc. Brit. t.* cxiii. A. *Belonia torulosa, Carm. in Hook. Br. Fl.* 2, *p.* 379; *Harv. Man. ed.* 1, *p.* 167. *Anabaina marina, Brèb.*

On decaying marine Algæ about half-tide level. Appin, *Capt. Carmichael*. Menai Bridge and Barmouth, &c., *Mr. Ralfs*. Shirehampton, *Mr. Thwaites*.—" In the beginning of autumn, vast quantities of the filamentous Algæ (*Dictyosiphon*, *Ectocarpus*, &c.) are detached from their places of growth, and deposited here and there along the shore in extensive fleeces. When these fleeces begin to decay, the *Sphærozyga* makes its appearance in the form of a very thin gelatinous pellicle, of a vivid green colour, spreading over the surface of the decaying mass. The pellicle is made up of straight, brittle, slightly moniliform *filaments*, one fourth of a line in length, and tapering at both ends. The intervals between the striæ are considerably longer than their diameter, and the green matter becomes at length consolidated into elliptical sporidia, of a brownish colour, beginning at the middle of the filament." *Carm.*

2. S. *Thwaitesii*, Harv.; spores elliptical, once and a half as long as broad, commencing to be formed from the cells

most distant from the ciliated connecting one." *Thw.* *Harv. Phyc. Brit. t.* cxiii. B.

On the muddy sides of ditches of brackish water, also floating. Dolgelly, *Mr. Ralfs.* Shirehampton, *Mr. Thwaites.* Portbury, Somerset, *Mr. Broome.*—"Very gelatinous, deep green, sometimes almost black. *Filaments* pale green, curved, entangled; connecting-cells large, ciliated, subspherical, slightly oblong, of a lighter colour than the ordinary cells, which are somewhat compressed. *Spores* of a deep brown when mature." *Thw.*

3. S. *Broomei*, Thw.; "spores numerous, elliptical, twice as long as wide, not much exceeding in width the ordinary cells, commencing to be formed from the cells nearest the connecting-cells; connecting-cells smooth, rather longer than wide." *Thw.* *Harv. Phyc. Brit. t.* clxxiii. A.

Ditches at Shirehampton, *Mr. C. E. Broome* and *Mr. Thwaites.*—"A very distinct species, first detected by C. E. Broome, Esq., an excellent cryptogamic botanist, after whom it is named." *Thw.*

4. S. *Berkeleyana*, Thw.; spores large, twice the width of the ordinary cells, oblong, half as long again as wide, becoming brown when mature, generally two on each side the connecting-cell, which is spherical, slightly compressed; young filaments included, one or several together, in a defined, mucous sheath." *Thw.* *Harv. Phyc. Brit. t.* clxxiii. B.

Ditches at Shirehampton, *Mr. Thwaites.*—"This fine species, which is named in honour of the Rev. M. J. Berkeley, is interesting from the circumstance of its filaments, when young, being enclosed, often several together, in definite, gelatinous sheaths, out of which they appear to escape before the spores are mature. There are other species, occurring in fresh-water, which exhibit the same peculiarity of structure, but it does not seem to have hitherto been noticed."

5. S. *Ralfsii*, Thw. MS.; filaments straight or nearly so; ordinary cells sub-quadrate; spores cylindrical with truncated ends, of very unequal length, and scattered irregularly throughout the filament; connecting-cells oblong.

In brackish and in fresh-water ditches near Bristol, *G. H. K. Thwaites.* For the reception of this and some other closely allied species it is proposed to constitute a new genus (*Dolichospermum*), characterized by their spores being of unequal length and scattered irregularly throughout the filament.

III. Spermoseira. Ag. [Plate 27, E.]

"*Filaments* slightly mucous, free, simple, cylindrical, enclosed in a very delicate, membranous tube. *Cells* lenticular; connecting-cells larger, compressed." *Thw.* *Spores* formed from the ordinary cells. — Name, from σπερμα, a *seed*, and σειρα, a *chain*.

1. S. *litorea*, Kütz.; filaments robust, nearly straight, composed of very short, closely packed, compressed cells; spores elliptical, not wider than the cells; connecting-cells also elliptical, shorter than their width and not wider than the ordinary cells. *Harv. Phyc. Brit. t.* cxiii. C.

In muddy brackish ditches. Barmouth, *Rev. T. Salway.* Dolgelly, *Mr. Ralfs.* Shirehampton, *Mr. Thwaites.*—"Scarcely gelatinous, forming a deep green, fleecy covering to floating plants, on which it occurs. *Filaments* of considerable diameter, nearly straight. Ordinary cells of a beautifully blue-green colour, very short and compressed, giving the filaments the appearance of an *Oscillatoria;* connecting-cells of a pale reddish: sometimes the plant is of an uniform, dull green." *Thw. Spores* elliptical, placed with their longer diameter at right angles with the filament, at length acquiring a deep brown colour.

2. S. *Harveyana*, Thw.; "filaments much curved, composed of cells nearly as long as broad; spores exactly spherical, almost twice the diameter of the cells; connecting-cells subquadrate, rather longer than wide, and of the same width as the ordinary cells." *Thw. Harv. Phyc. Brit. t* clxxiii. C.

Muddy ditches at Shirehampton, *Mr. Thwaites.*— "This beautiful species differs from *S. litorea*, in its spores being not at all compressed, and its ordinary cells much longer, compared with their width. The membranous sheath investing the filament is with difficulty seen, and the plant bears considerable resemblance to some species of *Sphærozyga*. The curved filaments and spherical spores render it not very unlike *Monormia intricata*, from which it is, however, perfectly distinct." *Thw.*

Order XIX. PALMELLACEÆ.

Sub-order Hormosporeæ.

Hormosporeæ, *Thw. in Harv. Phyc. Brit. t.* ccxiii.

Diagnosis. — *Cells* contained in confervoid, simple or branched, tubular filaments.

(This supposed sub-order consists of a single genus, of which two species only are known, both of which have been found in England).

Hormospora. Brèb. [Plate 27, B].

Filaments gelatinous, confervoid, each inclosing a linear series of oval or spherical cells. *Endochrome* green. *Fructification:* cells of the filaments enlarged and converted into spores.—Name, ὁρμος, a *necklace*, and σπορα, a *seed* or *spore*.

1. H. *ramosa*, Thw.; filaments branched; endochrome radiated. *Harv. Phyc. Brit. t.* ccxiii.

Growing attached to the filaments of *Cladophora fracta*, in a salt-water lake, near Wareham, Dorset, *Rev. W. Smith.* On a rock within reach of the tide at Clevedon, Somersetshire, sparingly intermixed with *Cocconema cistula*, *Mr. Thwaites.* August and September.—"*Filaments* gelatinous, irregularly branched. *Cells* at first subcylindrical and closely coherent; subsequently becoming oval and distinct. *Endochrome* pale green, radiating from a central nucleus. Filaments at length resolved into separate spores, each of which is surrounded by a considerable amount of gelatine. The filaments, when young, are not unlike those of a *Sphæroplea*, between which genus and the *Palmelleæ*, *Hormospora* would seem to form a connecting link." *Thw. l. c.*

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R.

S.

GLOSSARY.

Abnormal : contrary to the regular (or *normal*) order of growth.

Accessory (ramuli) : branchlets, differing from the ordinary branchlets, and fitted to a special purpose.

Acotyledonous (plants) : plants which are propagated by spores: *Cryptogamia.*

Acrogenous : growing from the top.

Acuminated : produced into a long, slender and, usually, sharp point.

Adnate : adhering to an object by the whole surface.

Air-vessel : a hollow portion of the frond, filled with air.

Amorphous : without definite shape.

Analogue : } when a plant strik-
Analogous : } ingly resembles another of a different genus, or family, so as to represent it, it is said to be the *analogue* of that plant.

Anastomose : to grow into another body, and unite with it.

Annular : }
Annulated : } formed into rings.

Apex, pl. *apices :* the top of anything.

Apical : belonging to the apex.

Appositional (branches) : when two branches lie together, and partly unite, so as to appear like a compound branch. In some Confervoid Algæ (*Oscillatoriaceæ*), a *seemingly* branched filament is composed of many simple filaments, so lying together ; such would be called an appositionally branched filament.

Appressed : closely approximated, or, (in branching), when the smaller branches lie close to the larger ones, standing *very erect.*

Areolated : } marked out into regu-
Areola, æ : } lar spaces (or *areolæ*), like a pavement.

Articulation : when a frond consists of a single string of cells, each cell is called an articulation ; literally, a joint.

Articulated : having a jointed appearance.

Asci : membranous cases in which the spores of Lichens and Fungi are contained.

Axil : the angle formed by the insertion of a branch, or division of a frond.

Axis : a central column; or, the central portion or medullary substance of the frond.

Base : the bottom of anything.

Basal : belonging to the base.

Branchlet : (same as *ramulus*) ; the ultimate division of a compound frond.

Byssoid : exceedingly slender, like cobwebs.

Calcareous : formed of carbonate of lime.

Calli : hard parts.

Capitate: terminating in a knob, or head.
Capitulum: a terminal knob, or head.
Capillary: as slender as human hair.
Capsule: a spore-case, or conceptacle.
Carnose: fleshy; having the substance of flesh.
Cartilaginous: resembling gristle.
Cell:—cellular tissue: when a small portion of a plant is examined under the microscope, its substance is found to consist of minute, membranous sacs, either empty or filled with coloured matter. These *sacs* are called cells, and, in the aggregate, cellular tissue.
Cellular (structure): when the cells are packed together like those of a honeycomb; or without obvious arrangement.
Cellulose: the chemical substance, of which the walls of the cells are composed.
Ceramidium: a conceptacle of an ovate form, pierced by a terminal pore, and containing a tuft of spores rising from the base of the cavity. (See page 69).
Chlorophyll: the green matter contained in the cells of a plant.
Cilia: properly applied to exceedingly minute, vibratory hairs found on the spores of certain Algæ. The term *cilia* (literally an eye-lash) is also used for slender ramuli or processes fringing the margin of larger branches or lobes.
Cirrhous: resembling tendrils of a vine.
Class: a primary division of the vegetable kingdom, consisting of *Orders;* as an order consists of *Genera;* and a genus of *Species.*
Clavate: shaped like a club, slender at the lower end and gradually thickening upwards, to a blunt point.
Coccidium: a hemispherical or spherical conceptacle, without pore, containing a tuft of spores on a central placenta. (See page 69).
Compressed: between cylindrical and flat, as if a cylinder were partially flattened.
Concentric: having a common centre; as when several circles are drawn one within the other.
Conceptacle: a hollow case containing a tuft or cluster of spores.
Conferroid: resembling a *Conferva,* that is, a thread formed of a single row of *cells* or *articulations.*
Coniocystæ: the name given to the fruit or sporangium of *Vaucheria, Codium,* &c.
Constricted: partly or wholly closed by a circular fold, as if tied in by a string passed round.
Continuous: without any appearance of joint, or other interruption, internal or external.
Cordate: heart-shaped.
Coriaceous: having the substance of leather.
Corneous: having the substance of horn.
Corymbose: an arrangement of branches, where they pass off at different heights from a main stalk, and their tops are on a level or form a convex surface.
Cosmopolitan: found in all parts of the world (or in *most* parts).
Cruciate: shaped like a cross.
Crustaceous: hard and expanded like a crust.
Cuneate: } shaped like a wedge.
Cuneiform: }
Cuticle: the skin or external layer.

Decumbent: lying flat, along the ground.
Deflexed: bent downwards.
Denticulate: having small, tooth-like projections along the margin.
Dichotomous: branched by repeated forkings, each division dividing at its apex continually into two subdivisions.
Diœcious: having stamens and pistils (or antheridia and spores) on distinct roots.

Dissepiment: the membrane or partition separating one cell, or articulation of a filament from another.
Distichous: in two opposing ranks.
Divaricate: spreading at very wide or obtuse angles.

Ellipsoidal: of a shape most resembling oval.
Elliptical: oval (not *ovate*).
Embryo: the germ or young plant contained in a seed.
Endochrome: the coloured contents of the cells.
Epidermis: the outer coating of cellular tissue.
Epiphytic: growing on another vegetable, but attached to the surface only.
Erumpent (tetraspores): prominent, as if bursting through the epidermis.

Falcate: shaped like a sickle.
Fasciculate: tufted.
Fastigiate: when the branches are parallel and all point upwards, as in the Lombardy poplar.
Favella: a form of conceptacular fruit, described at p. 69 and p. 157.
Favellidium: a favella, immersed in the frond. (See page 69).
Fibro-cellular: } *Fibroso-cellular:* } when the cells are firm and elongated and strung together in threads or filaments.
Filament: a string of cells, placed end to end.
Filiform: thread-shaped; also, slender and cylindrical.
Flabelliform: shaped like a fan.
Flaccid: as if deprived of a stiffening matter (familiarly *limp*).
Flexuous: bent from side to side.
Foliiferous: bearing leaves.
Free: standing separate and distinct; also, unattached.
Frond: the whole plant.
Fusiform: shaped like a spindle or a rolling-pin, thick in the middle and tapering to either extremity.
Gelatinous: having the substance of jelly.
Gemmules: buds, which at length fall off and grow into new individuals.
Genus: a group of *species*, nearly related to each other, having a common character in their fructification, and (usually) a similarity of general aspect.
Gonidia: reproductive cells or germs formed in the substance of the plant, and afterwards becoming free and separated from the parent.

Habit: the outward aspect, or general appearance which a plant has to the eye.
Habitat: the place of growth in which a plant is found.
Heterogeneous: having more than one nature or substance.
Homogeneous: having a uniform substance or structure.
Hyaline: transparent and colourless, as water or glass.

Imbricated: overlapping at the edge like the tiles on a roof.
Inarticulate: without joints or interruptions to continuity.
Inflated: swollen, as if puffed out with air.
Internode: the space between two joints of a stem; an *articulation*.
Involucre: } *Involucrate:* } ramuli subtending a conceptacle, forming a more or less perfect whorl around it.
Involute: rolled inwards.
Iridescent: reflecting the changeable colours of the rainbow, or of mother-of-pearl.

Lacinia: a narrow lobe or segment.
Laminia: the surface of a frond, or *blade* of a leaf.
Lanceolate: flat, broad in the middle and narrowed to each end, like the head of a lance.
Level-topped: same as *fastigiate*.
Lichenoid: irregularly lobed, and

decumbent, like one of the leafy lichens (as *Peltidea*).

Linear: long and narrow, with parallel sides.

Lobe: one of the portions of a deeply cut frond.

Lobule: a diminution of lobe.

Matrix: that from which something else is formed or developed.

Membranaceous: thin and filmy; also (when applied to *substance*), soft and tender, but not gelatinous.

Metamorphosed: changed in appearance, or converted to another purpose.

Mitriform: shaped like a bishop's mitre, or like a loaf of sugar.

Moniliform: like a string of beads.

Monœcious: having stamens and pistils (or antheridia and spores) on the same root, but not in the same flower or conceptacle.

Mucronate: having a small projecting point, or *mucro.*

Mucus: organic gelatine or slime.

Nemathecium: a wart-like protuberance composed of vertical filaments closely packed together.

Node: a joint or interruption in a stem.

Nodose: with swollen joints.

Normal: regular, orderly.

Ob: used as a prefix to a word, mean, contrarywise; as *ob-ovate*, the reverse of *ovate*, &c.

Oblong: broadly linear.

Opake: } the reverse of transparent.
Opaque: }

Orbicular: circular, round.

Order: a group of plants consisting of numerous *Genera;* the next division under a *Class.*

Ovate: broad at one end and narrowed towards the other, like the outline of an egg.

Palmate: divided, like a hand, into several finger-like lobes.

Papillated: covered with little nipple or wart-like prominences, called *papillæ.*

Paranemata: filaments which accompany spores in the fructification of many Algæ. (See page 9).

Paraphyses: distended paranemata; also applied to abortive spores.

Parasitic: growing on another plant, and subsisting on nourishment derived from it.

Parietal: attached to the wall or lining of a cell or conceptacle.

Patent: spreading, open.

Pectinated: arranged as the teeth of a comb.

Pedicel: } the stalk of the fruit.
Peduncle: }

Pelagic: growing in many distant parts of the ocean, widely dispersed.

Penninerved (leaf or frond): when the nerves are placed at each side of the midrib like the plumes of a feather.

Percurrent: running through from top to bottom.

Pericarp: the seed-vessel, or case in which spores are lodged, or the walls of the same.

Peripheric: belonging to the outer stratum or periphery.

Periphery: the circumference, or outer stratum of cells in a cylindrical frond.

Perispore: the case or skin which surrounds the spore.

Phyllodium: a flattened, leaf-like portion of the frond.

Pinna: one of a series of opposite or alternate, distichous branchlets.

Pinnule: a secondary pinna.

Pinnated: furnished with distichous leaves or branchlets, ranged like the plumes of a feather.

Pinnatifid: deeply incised in a semipinnate manner.

Placenta: the part to which the spores are attached.

Plumule: a pinnated branchlet.

Polygonal: having many angles.

Polyhedral: having many sides.

Polymorphous: assuming many shapes.

Process: any prominence or projecting part, or small lobe.

Proliferous : when a new leaf or frondlet springs out of an old one.
Propagulum : a reproductive portion of a frond, which is not a regular spore.
Pulvinate : shaped like a cushion or pillow.
Pyriform : like a pear.

Quadrifarious : spreading on four sides, or (more loosely) spreading on all sides of the stem or branch.
Quaternate : in fours.

Racemose : having several stalked conceptacles along a branchlet.
Radicle : a little root, or the fibrous part of a root.
Ramellus : a diminutive of the following.
Ramulus : a minute branch, usually applied to the ultimate divisions of a branching frond. The *ramellus* is generally an appendage to the ramulus, and of different structure.
Receptacle : a portion of the frond of definite shape, containing the fructification.
Recurved : bent backwards.
Reniform : kidney-shaped ; broader than long, very obtuse, with two shallow rounded lobes at the base.
Reticulate (surface) : marked with inosculating lines, like the meshes of a net-work ; or formed of large, flat, polygonal cells.
Retiform : like a net-work.
Revolute : rolled back.

Secund : arranged along one side only.
Septum : a partition.
Serrated : toothed like the edge of a saw : the teeth are called *serratures.*
Sessile : having no stalk.
Setaceous : equal in diameter to a hog's bristle.
Setiform : shaped like a bristle.
Silicules : little pod-like fruits.
Sinuated : when the margin has numerous shallow, obtuse indentations.
Sorus, pl. *sori :* a cluster of spores.
Sporaceous : convertible into spores.
Sporangium : a spore-case, with its contents.
Spore : the representative of *seed* in cryptogamic plants. It is in all cases a simple cell.
Sporidium : a reproductive, spore-like body, but not a true spore.
Sporophylla : small leafy lobes, containing *tetraspores.*
Stichidia : pod-like receptacles containing tetraspores.
Stipes : the stem or stalk of a leafy frond.
Stipitate : having a stem or stalk.
Stratum : a layer.
Stria : a narrow line or mark.
Stupose : covered with woolly hairs.
Subulate : shaped like an awl.

Tentacular : resembling the *tentacula* or feelers of a snail, long and slender.
Terete : round, in opposition to flat.
Ternate : in threes.
Ternately-parted (tetraspores) : when only three of the sporules are seen at one view.
Tetraspore : a spore or gemmule dividing at maturity into four parts.
Transverse : across.
Trichotomous : dividing continually in threes.
Truncate : terminating abruptly, as if broken off.
Tubercle : a term synonymous with coccidium.
Type : generally means, as here used, the perfect representation or idea of anything : thus, a *typical* specimen embodies the characteristics of the species in an eminent degree, &c.

Ultra : more than.
Urceolate : shaped like an ancient pitcher, egg-shaped, with a narrow protruding mouth.

Virgate: long and straight, like a wand.

Whorled: surrounding a branch, in a ring.

Zigzag: angularly bent from side to side.

Zoned (tetraspores): when the tetraspore is divided into rings or zones, by cross lines.

Zoospores: spores (or gemmules) which have a proper locomotive power, resembling the voluntary motions of animals.

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PLATE I.

A. Sargassum, page 14.

Fig. 1, a branch of *S. vulgare;* the *natural size.* 2, a receptacle. 3, section of the same. 4, a spore. 5, a vesicle, cut open; all more or less *magnified.*

B. Cystoseira, page 16.

Fig. 1, a branch of *C. fibrosa;* the *natural size.* 2, a receptacle and vesicle. 3, section of the receptacle. 4, a spore; all *magnified.*

C. Halidrys, page 15.

Fig. 1, part of a branch of *H. siliquosa;* the *natural size.* 2, a vesicle, cut open, showing the internal septa, connected by slender threads. 3, part section of a receptacle. 4, spore; all *magnified.*

D. Fucus, page 18.

Fig. 1, part of a frond of *F. vesiculosus;* the *natural size.* 2, part section of a receptacle, showing three conceptacles. 3, a spore, containing eight sporules; both *magnified.*

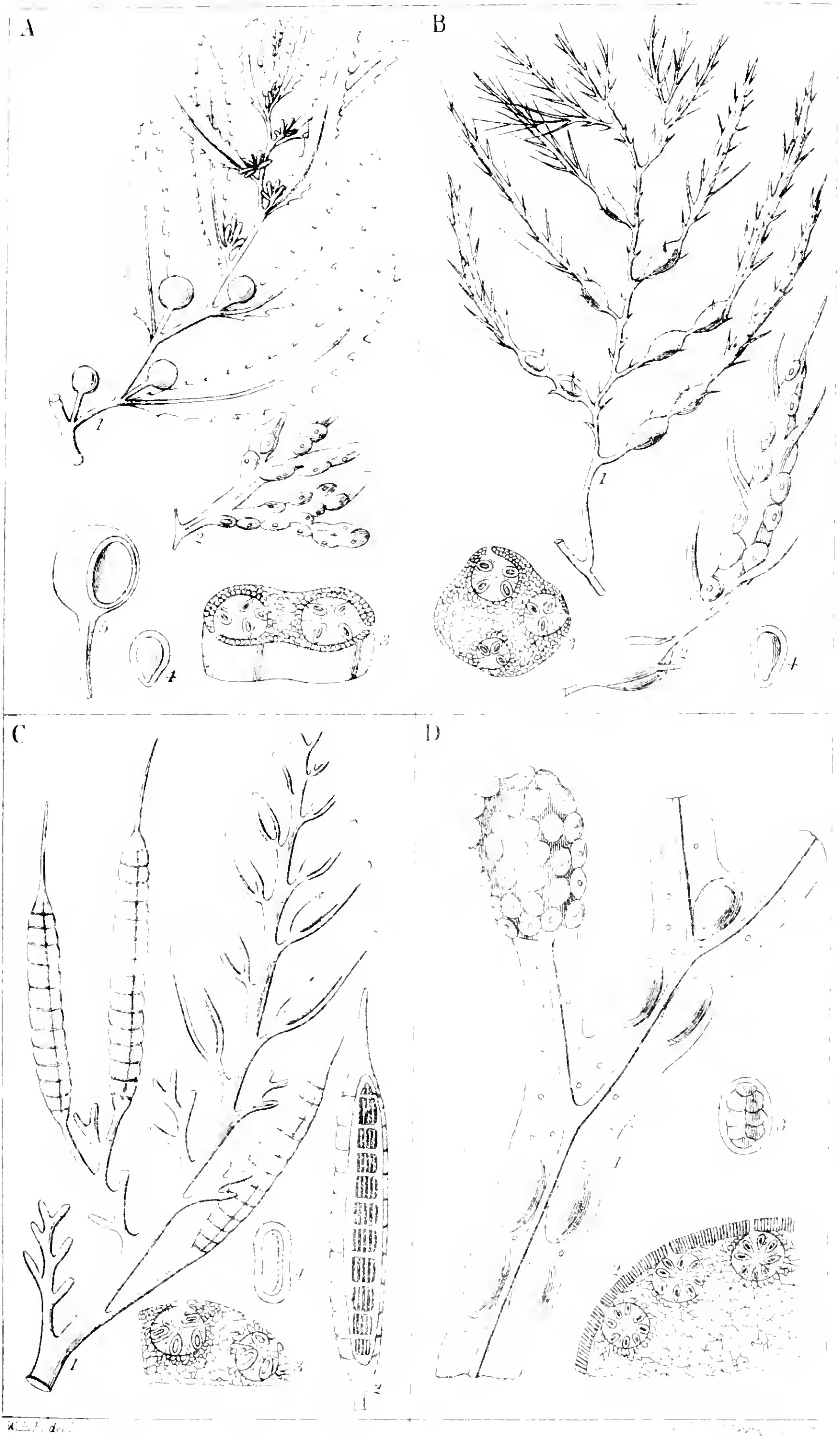
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PLATE II.

A. PYCNOPHYCUS, page 18.

Fig. 1, *P. tuberculatus;* the *natural size.* 2, part of cross section of a receptacle. 3, a spore; *magnified.*

B. HIMANTHALIA, page 20.

Fig. 1, *H. lorea;* young and full-grown plants. 2, part of cross section of a receptacle. 3, a spore, containing four sporules; *magnified.*

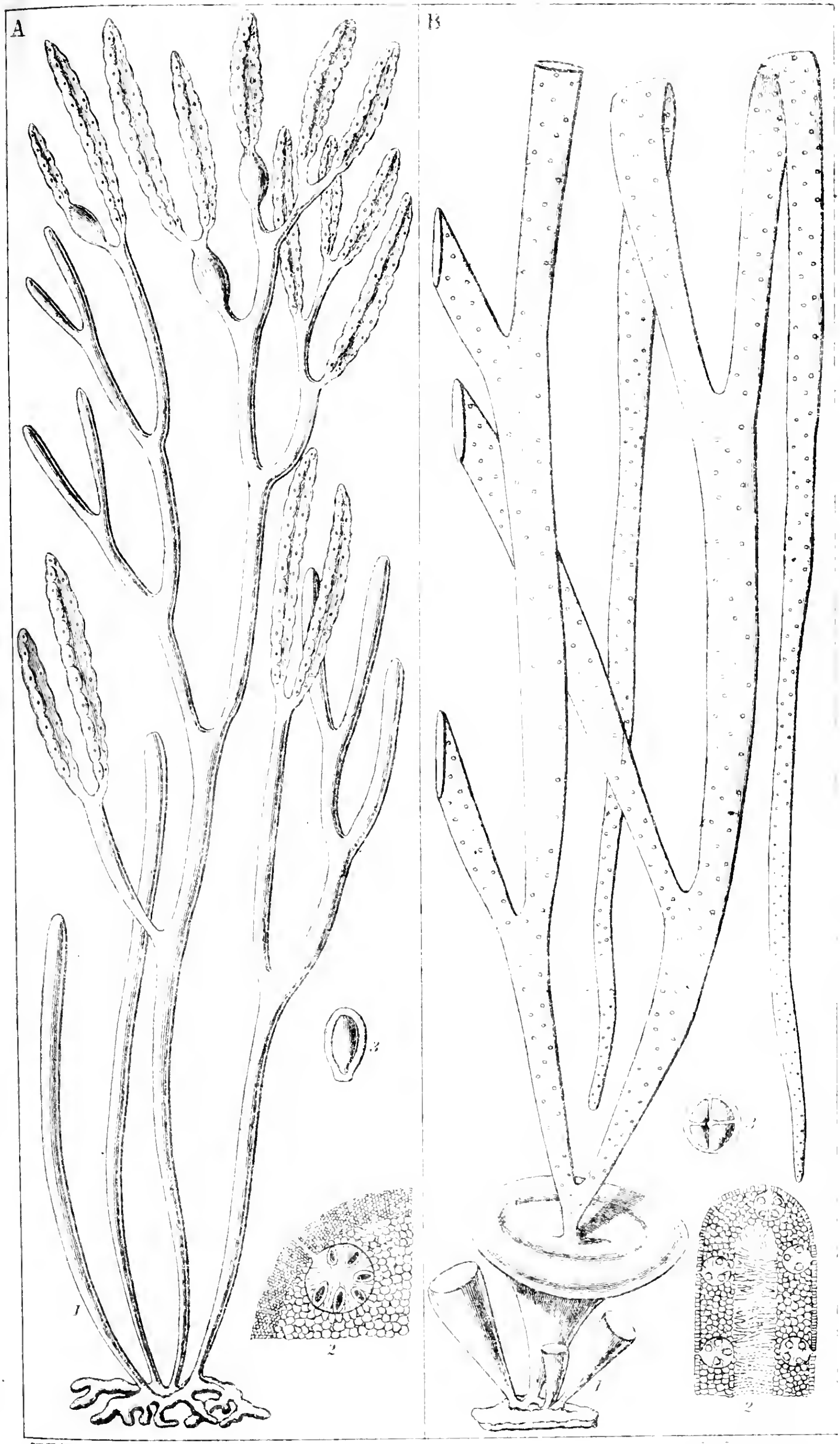

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PLATE III.

A. ALARIA, page 29.

Fig. 1, *A. esculenta;* the *natural size.* 2, part of cross section of a sorus. 3, spores from the same; *magnified.*

B. CHORDA, page 31.

Fig. 1, *Chorda filum;* the *natural size.* 2, vertical section of the frond. 3, vertical section of a small portion of the wall, showing the large internal cells and the stratum of spores. 4, spores from the same. 5, an antheridium? ; all *magnified.*

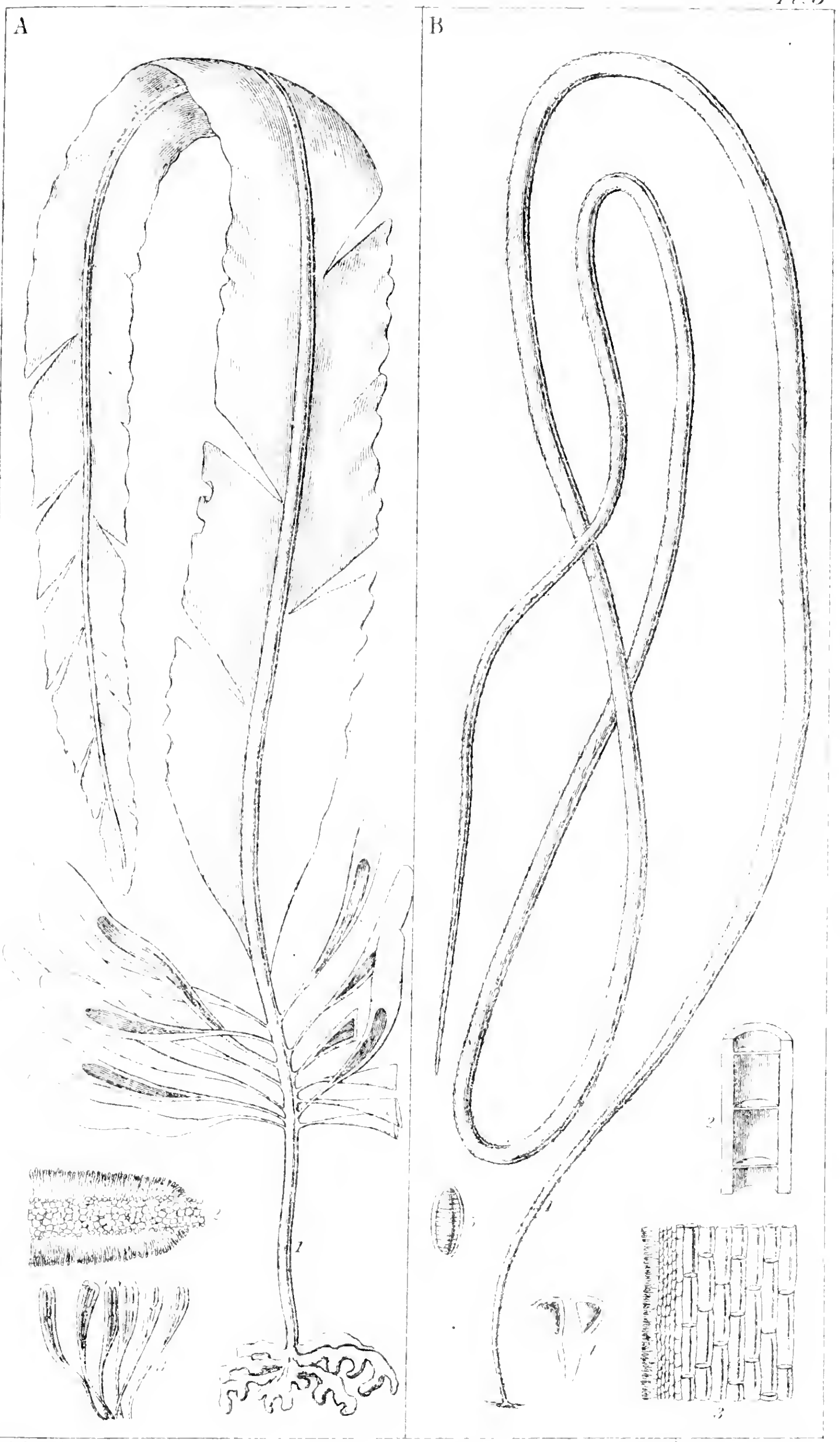
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PLATE IV.

LAMINARIA, page 29.

Fig. 1, *L. digitata;* showing the form of the full-grown frond. 2, the same, in the act of throwing off the frond of the previous season; both figures *on a reduced scale.* 3, cross section of the frond. 4, spores; both *magnified.*

Pl. 4.

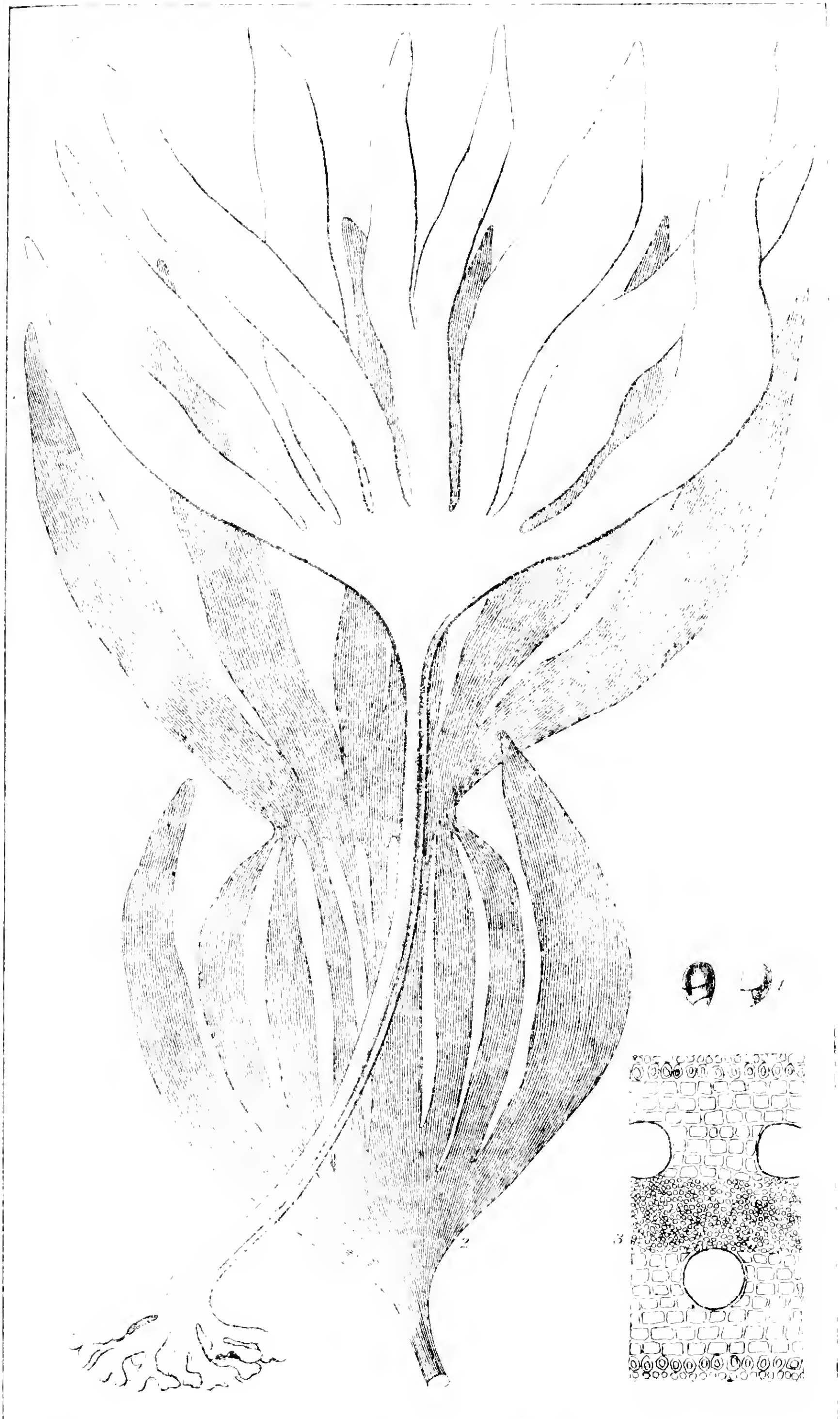

PLATE V.

A. SPOROCHNUS, page 25.

Fig. 1, *S. pedunculatus;* the *natural size.* 2, receptacles. 3, spores and filaments from the same. 4, one of the fibres of the crest. 5, cross section of the stem; all *magnified.*

B. CARPOMITRA, page 25.

Fig. 1, *C. Cabreræ;* the *natural size.* 2, portion of the frond, with a fertile branch. 3, receptacle. 4, filament from the same. 5, cross section of the frond; *magnified.*

C. ARTHROCLADIA, page 24.

Fig. 1, branch of *A. villosa;* the *natural size.* 2, small part of the frond. 3, pods, containing spores. 4, longitudinal section of the frond. 5, cross section of the same; all *magnified.*

D. DESMARESTIA, page 23.

Fig. 1, branch of *D. aculeata;* the *natural size.* 2, longitudinal, and 3, cross, sections of the stem, *magnified.* 4, branch of *D. ligulata,* the *natural size.*

Pl. 5

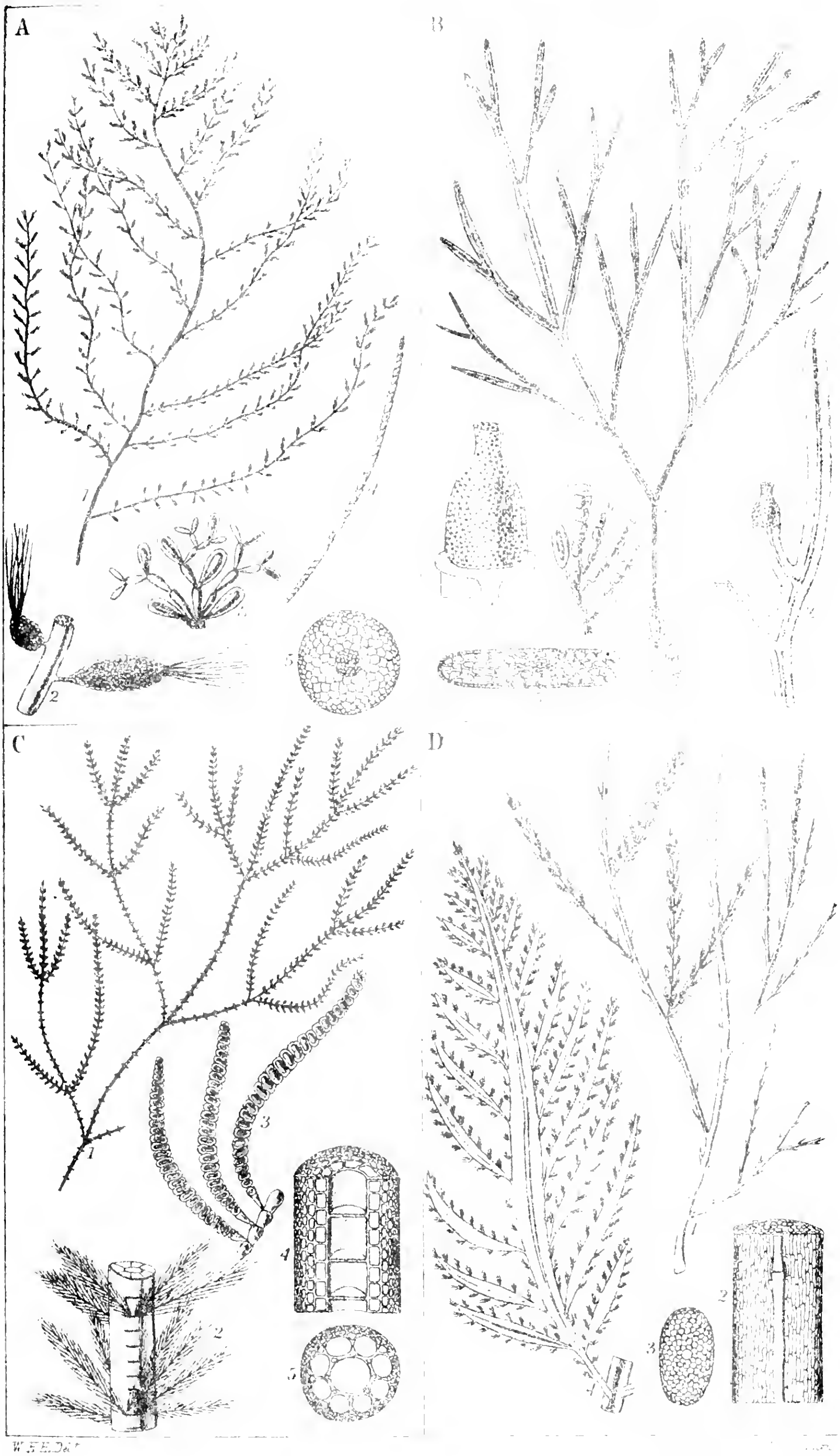

PLATE VI.

A. CUTLERIA, page 35.

Fig. 1, *C. multifida;* the *natural size.* 2, a morsel of the frond with a sorus. 4, antheridia. 5, transverse, and 6, longitudinal, sections of the frond; *magnified.*

B. HALISERIS, page 36.

Fig. 1, *H. polypodioides;* the *natural size.* 2, morsel of the frond with scattered spores. 3, small portion with sorus. 4, spores; *magnified.*

C. PADINA, page 37.

Fig. 1, *P. Pavonia;* the *natural size.* 2, a sorus. 3, spores. 4, circinate apex of the frond, with fringe; *magnified.*

D. ZONARIA, page 38.

Fig. 1, Fronds of *Z. parvula,* on a piece of Nullipore. 2, portion of the frond. 3, cellular structure of the surface; *magnified.*

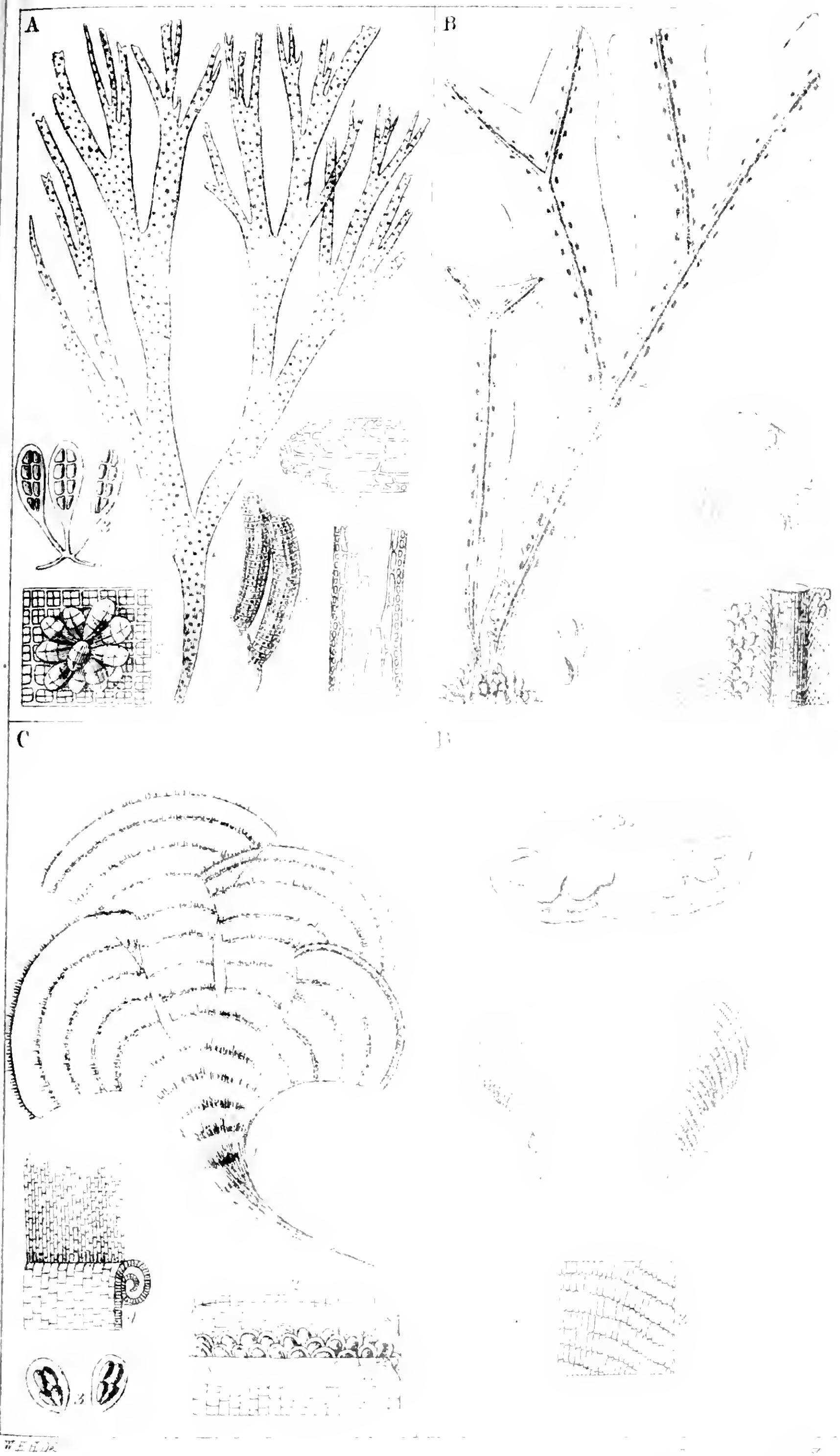
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PLATE VII.

A. Dictyota, page 39.

Fig. 1, *D. dichotoma;* the *natural size.* 2, sorus, on a small portion of the frond. 3, vertical section of the same. 4, spore, containing four sporules. 5, fragment of the frond with scattered spores; *magnified.*

B. Taonia, page 38.

Fig. 1, *T. Atomaria;* the *natural size.* 2, portion of the frond, showing spores in bands and scattered. 3, section of the frond with spores in situ; *magnified.*

C. Stilophora, page 39.

Fig. 1, *S. rhizodes;* the *natural size.* 2, fragment of the frond, with sori. 3, cross section of frond and sorus. 4, spore and filament or paranema.

D. Dictyosiphon, page 40.

Fig. 1, *D. fœniculaceus;* the *natural size.* 2, portion of the frond, with scattered spores. 3, spore. 4, cross section of a younger portion, and 5, of an older portion, of the frond. 6, cellular tissue from the interior of the same; all *magnified.*

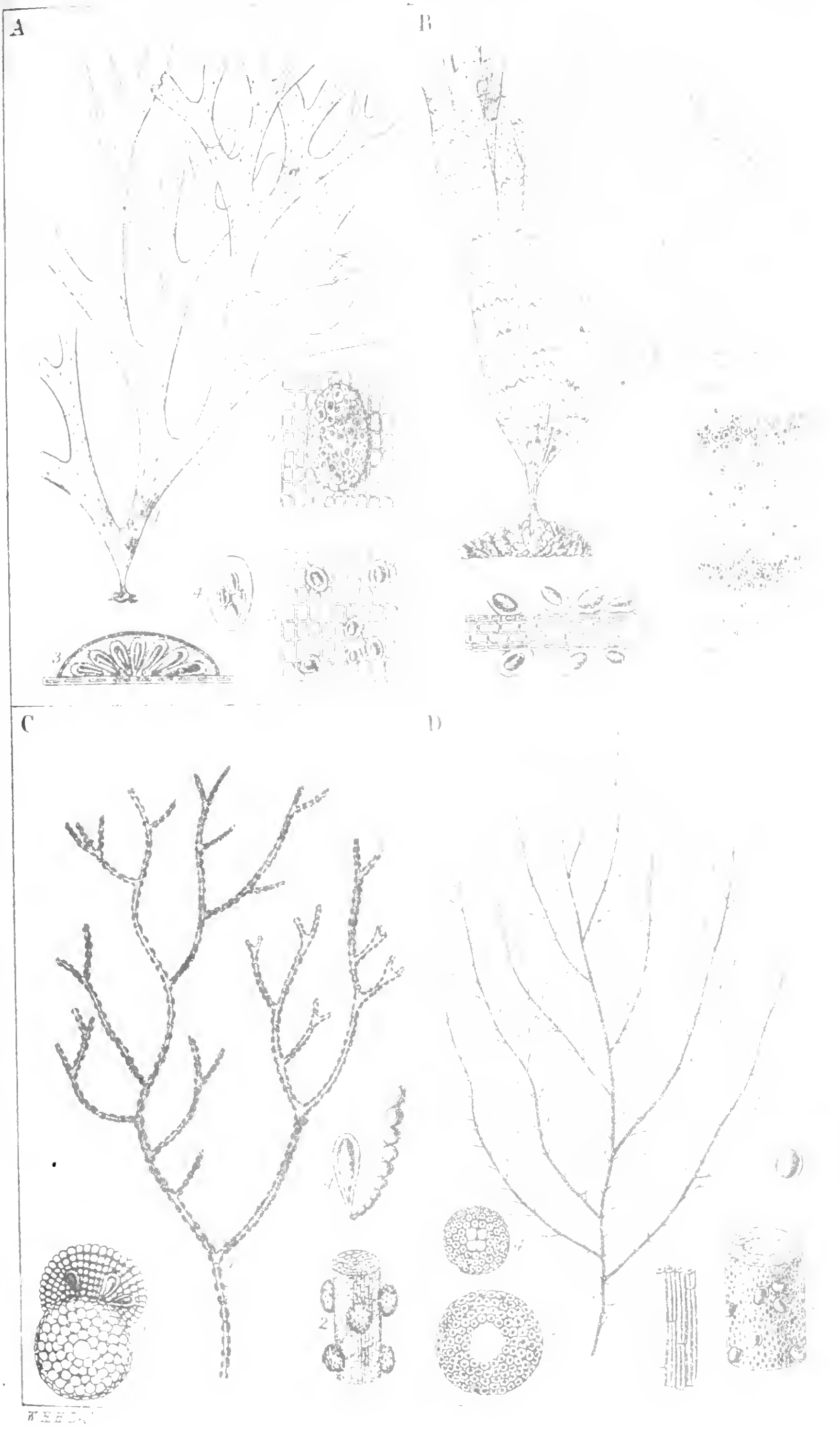
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PLATE VIII.

A. Striaria, page 41.

Fig. 1, *S. attenuata ;* the *natural size.* 2, small portion of the frond, with sori in transverse rows. 3, a sorus on a fragment of the frond. 4, a spore; all *magnified.*

B. Punctaria, page 41.

Fig. 1, *P. plantaginea ;* the *natural size.* 2, small portions of the frond with scattered spores. 3, small portions with a sorus. 4, section of frond through the centre of a sorus. 5, spores; all *magnified.*

C. Asperococcus, page 42.

Fig. 1, *A. Turneri ;* the *natural size.* 2, small portion of the surface with sori. 3, section of frond and sorus. 4, spore; all *magnified.*

D. Litosiphon, page 43.

Fig. 1, Tuft of *L. pusillus ;* the *natural size.* 2, portion of a frond, clothed with hairs. 3, small portion of the same with spores. 4, 5, cross sections of the frond; all *magnified.*

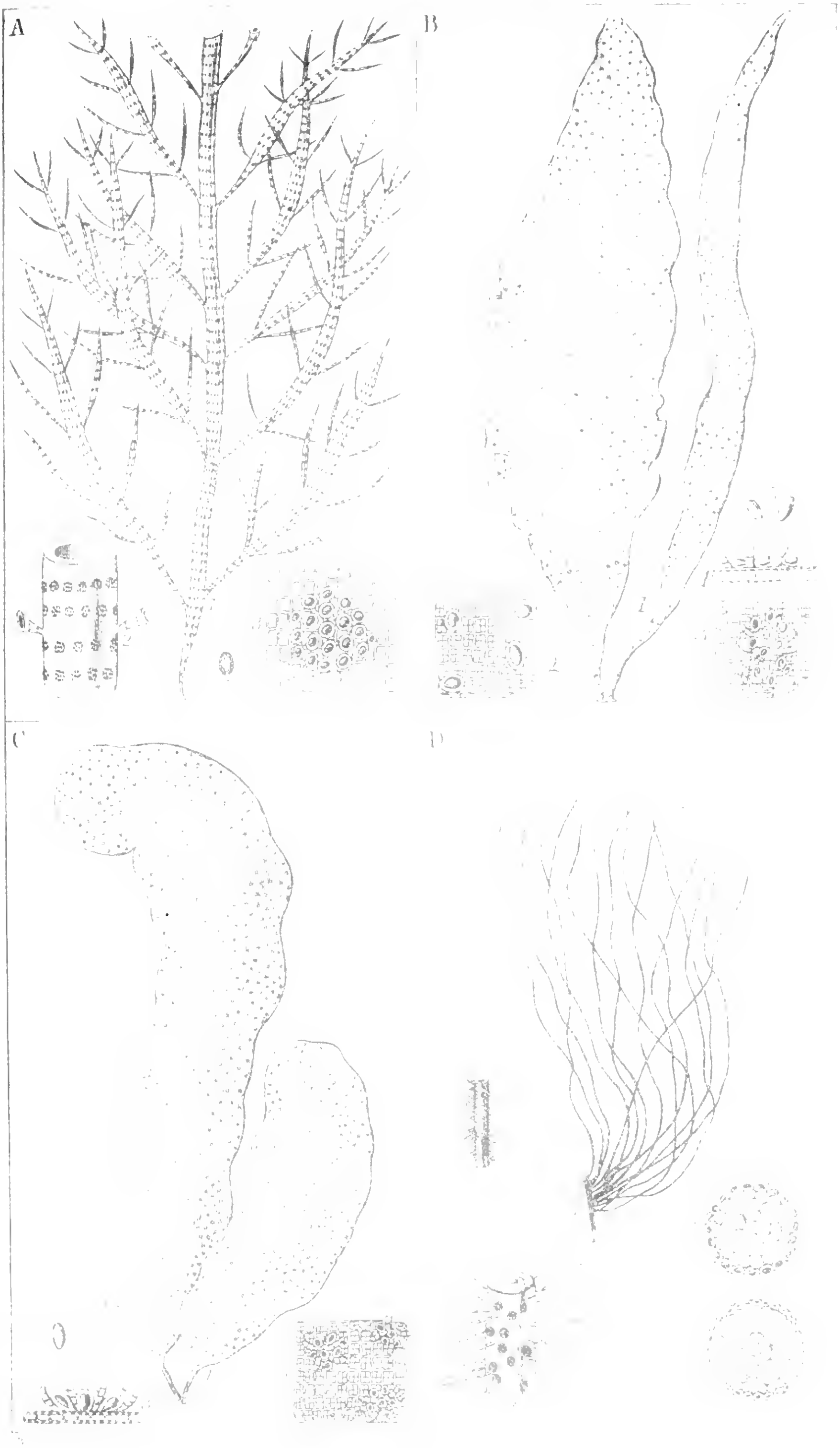
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PLATE IX.

A. CLADOSTEPHUS, page 54.

Fig. 1, *C. verticillatus;* the *natural size.* 2, a whorl of ramuli on a fragment of the stem. 3, a barren ramulus. 4, a fertile ramulus, from a winter specimen. 5, cross section of the stem; *magnified.*

B. SPHACELARIA, page 55.

Fig. 1, *S. scoparia;* the *natural size.* 2, pinnated branch or plumuli from the same; *magnified.* 3, *S. cirrhosa,* the *natural size.* 4, plumuli of the same. 5, apex of a ramulus, with sphacelated tip. 6, part of ramulus, with fruit; *magnified.*

C. ECTOCARPUS, page 58.

Fig. 1, *E. siliculosus;* the *natural size.* 2, silicular spore of the same. 3, branch with fruit. 4, branch of *E. littoralis,* in fruit. 4, immersed *spore.*

D. MYRIOTRICHIA, page 63.

1, Tufts of *M. clavæformis* growing on *Chorda lomentaria;* the *natural size.* 2, a frond. 3, ramulus, spore and fibres, from the same; *magnified.*

PLATE X

A. CHORDARIA, page 46.

Fig. 1, *C. flagelliformis;* the *natural size.* 2, segment of a cross section of the frond. 3, longitudinal slice. 4, spore and paranema; *magnified.*

B. MESOGLOIA, page 47.

Fig. 1, *M. virescens;* the *natural size.* 2, small portion of the frond. 3, filaments from the same; *magnified.*

C. LEATHESIA, page 48.

Fig. 1, *L. tuberiformis;* the *natural size.* 2, vertical section of the same; *magnified.* 3, *L. Berkeleyi;* the *natural size.* 4, filaments from the same; *magnified.*

D. RALFSIA, page 49.

Fig. 1, *R. deusta;* the *natural size.* 2, vertical section of frond, with sori. 3, filaments composing the periphery of the frond. 4, spore and paranemata from a sorus; *magnified.*

E. MYRIONEMA, page 51.

Fig. 1, *M. punctiforme*, growing on *Ceramium rubrum;* the *natural size.* 2, a plant of the parasite on a joint of the Ceramium. 3, spores and filaments; *magnified.*

F. ELACHISTEA, page 49.

Fig. 1, *E. fucicola*, growing on *Fucus vesiculosus;* the *natural size.* 2, a small part of the parasite, showing a dichotomous filament from the tubercle; the filaments or paranemata of the spores; the spores, and the bases of the long, free filaments, all in situ. 3, spore and paranemata; *magnified.*

PLATE XI.

A. ODONTHALIA, page 77.

Fig. 1, *O. dentata;* a branch, the *natural size.* 2, tuft of ceramidia. 3, spores from the same. 4, tuft of stichidia. 5, a tetraspore; all *magnified.*

B. RHODOMELA, page 78.

Fig. 1, Branch of *R. subfusca;* the *natural size.* 2, small ramulus with young ceramidia. 3, a ceramidium. 4, stichidia (borne in winter). 5, a tetraspore. 6, cross section of the frond; all *magnified.*

C. BOSTRYCHIA, page 79.

Fig. 1, *B. scorpioides;* the *natural size.* 2, apex of a branch. 3, cross section of the frond. 4, longitudinal section of the same; *magnified.*

D. RYTIPHLÆA, page 80.

Fig. 1, *R. pinastroides;* the *natural size.* 2, ramuli bearing stichidia. 3, a stichidium. 4, ramuli bearing ceramidia. 5, a ceramidium. 6, longitudinal section of the frond; all *magnified.*

PLATE XII

A. Polysiphonia, page 82.

Fig. 1, *P. variegata;* the *natural size.* 2, a ceramidium. 3, a spore. 4, ramulus with immersed tetraspores. 5, a tetraspore. 6, small portion of the stem. 7, cross section of the same, to show the six siphons, surrounding the central tube; all *magnified.*

B. Dasya, page 93.

Fig. 1, *D. arbuscula;* the *natural size.* 2, ramellus bearing stichidia. 3, a ceramidium. 4, cross section of the stem; all *magnified.*

C. Laurencia, page 97.

Fig. 1, *L. pinnatifida;* the *natural size.* 2, apex of branch with tetraspores. 3, a tetraspore. 4, apex of a branch with ceramidia. 5, spores; all *magnified.*

D. Bonnemaisonia, page 97.

Fig. 1, *B. asparagoides;* the *natural size.* 2, apex of a branch, with ceramidia alternating with the ramuli. 3, a ceramidium. 4, a spore; all *magnified.*

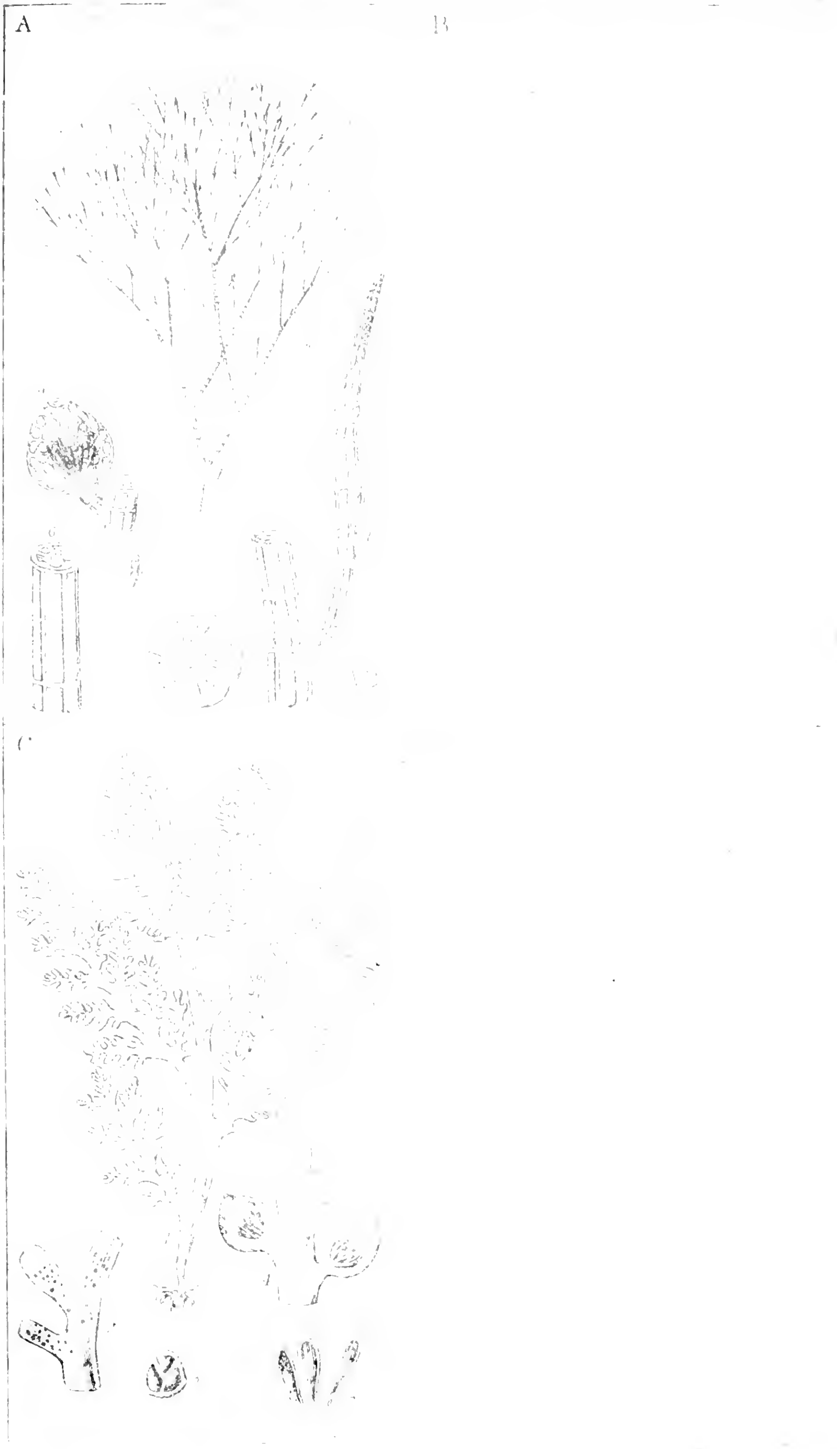
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PLATE XIII.

A. Chrysymenia, page 99.

Fig. 1, *C. clavellosa*, a small plant; the *natural size.* 2, ramulus with imbedded tetraspores. 3, a tetraspore. 4, small branch, with ceramidia on its ramuli. 5, a ceramidium; all *magnified.*

B. Chylocladia, page 100.

Fig. 1, *C. kaliformis*, a small plant; the *natural size.* 2, apex, bearing ceramidia on the ramuli. 3, a ceramidium. 4, tufted spores from the same. 5, apex having tetraspores imbedded in the ramuli. 6, a tetraspore; all *magnified.*

C. Corallina, page 105.

Fig. 1, *C. officinalis;* the *natural size.* 2, small part of the frond, with terminal ceramidia. 3, a ceramidium cut open. 4, a tetraspore. 5, small part of the frond, after the lime has been removed; *magnified.*

D. Jania, page 107.

Fig. 1. Tufts of *J. rubens*, the *natural size.* 2, a fertile branch of the same. 3, ceramidium. 4, tetraspores, from the same. 5, part of an articulation of the frond, after the lime has been removed; *magnified.*

PLATE XIV

A. MELOBESIA, page 107.

Fig. 1, *M. fasciculata.* 2, leaf of *Zostera*, on which *M. membranacea* is growing; both the *natural size.* 3, fronds of *M. membranacea*; *magnified.*

B. LITHOCYSTIS, page 111.

Fig. 1, Part of a frond of *Chrysymenia clavellosa*, on which *L. Allmanni* is growing; the *natural size.* 2, fronds of *L. Allmanni*; *very highly magnified.*

C. HILDENBRANDTIA, page 110.

Fig. 1, *H. rubra*, growing on a pebble; the *natural size.* 2, small portion of the frond, viewed vertically. 3, vertical section of the frond, cut through a conceptacle. 4, a tetraspore; all *magnified.*

D. PEYSSONELIA, page 144.

Fig. 1, *P. Dubyi*, growing on a fragment of stone; the *natural size.* 2, vertical section, cut through a wart. 3, tetraspores; both *highly magnified.*

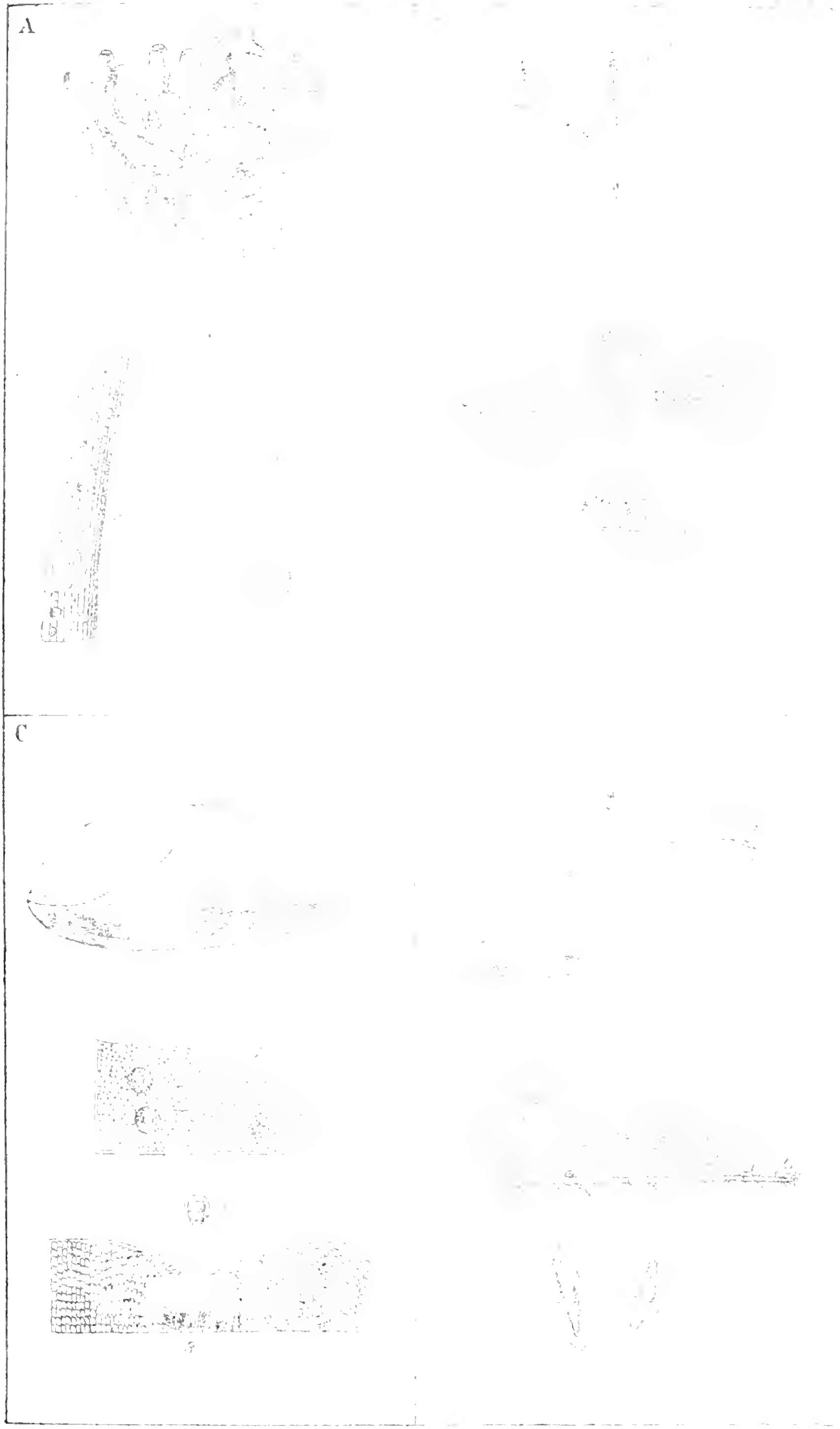

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PLATE XV.

A. Delesseria, page 113.

Fig. 1, *D. sanguinea;* 2, winter branch with sporophylla; the *natural size.* 3, a sporophyllum or leaflet, containing tetraspores. 4, a tetraspore; *magnified.* 5, a winter branch with coccidium; the *natural size.* 6, a coccidium on its stalk. 7, spores; *magnified.*

B. Nitophyllum, page 116.

Fig. 1, *N. punctatum;* the *natural size.* 2, fragment with spores. 3, a tetraspore. 4, fragment with tubercle. 5, spores from the same; *magnified.*

C. Plocamium, page 119.

Fig. 1, *P. coccineum;* the *natural size.* 2, branch with tubercle. 3, tubercle further enlarged. 4, branch with sporophylla. 5, a sporophyllum. 6, a tetraspore from the same; all *magnified.*

D. Stenogramme, page 123.

Fig. 1, *S. interrupta;* the *natural size.* 2, portion of the frond, with young and mature fruit. 3, section of the frond; *magnified.*

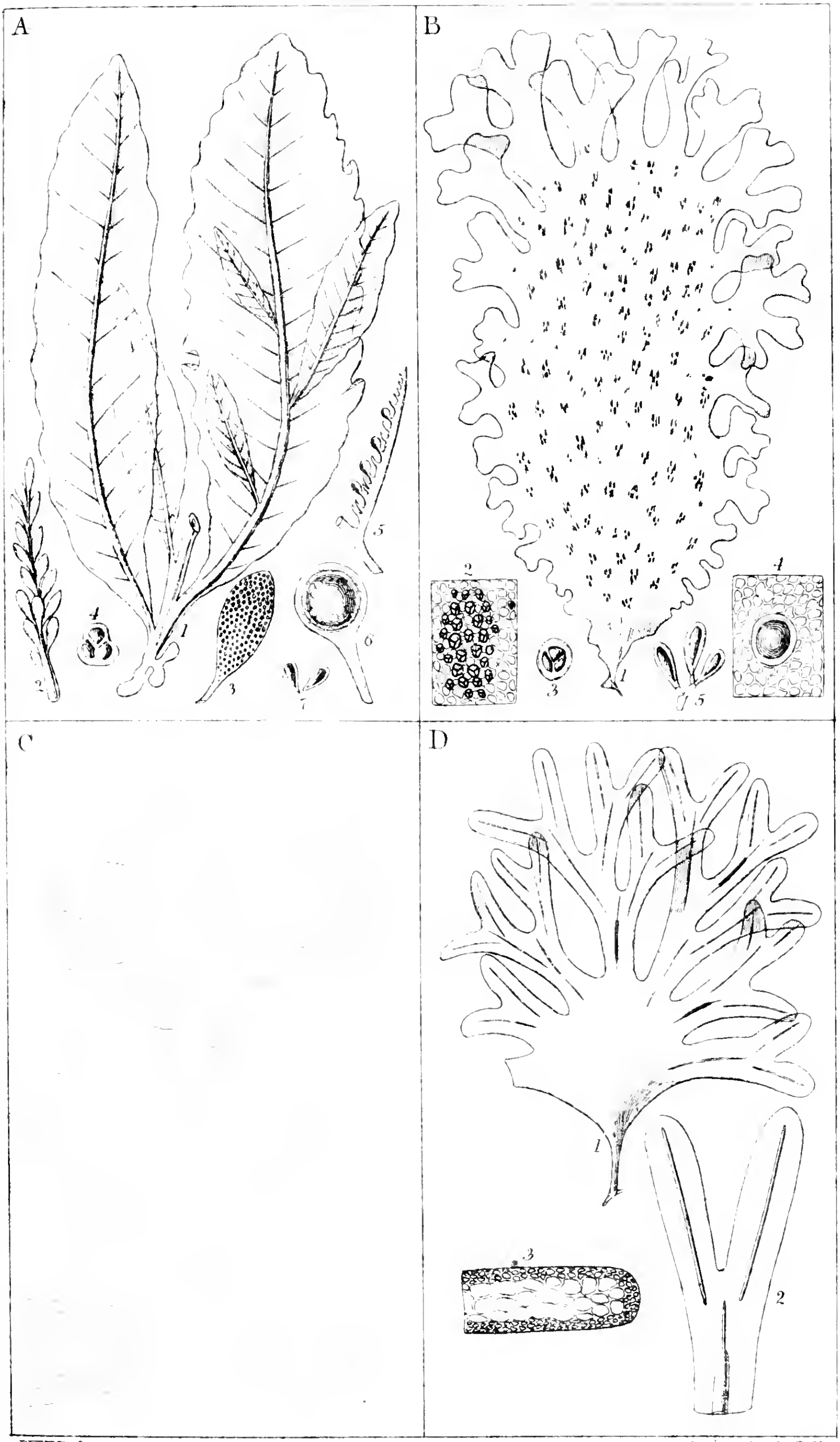

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PLATE XVI.

A. Rhodymenia, page 124.

Fig. 1, *R. laciniata;* the *natural size.* 2, 3, portions of the margin, with coccidia of different sizes. 4, portion of the margin, with sorus. 5, tetraspores; all *magnified.*

B. Sphærococcus, page 128.

Fig. 1, *S. coronopifolius;* the *natural size.* 2, fragment, with fructification. 3, a tubercle. 4, longitudinal, and 5, transverse, slices of the frond; *magnified.*

C. Gracilaria, page 128.

Fig. 1, *G. confervoides;* the *natural size.* 2, vertical sections of tubercle. 3, longitudinal, and 4, transverse, slices of the frond.

D. Hypnea, page 130.

Fig. 1, *H. purpurascens;* the *natural size.* 2, fragment of a branch, with imbedded tubercles. 3, a tetraspore. 4, longitudinal, and 5, transverse, slices of the frond; all *magnified.*

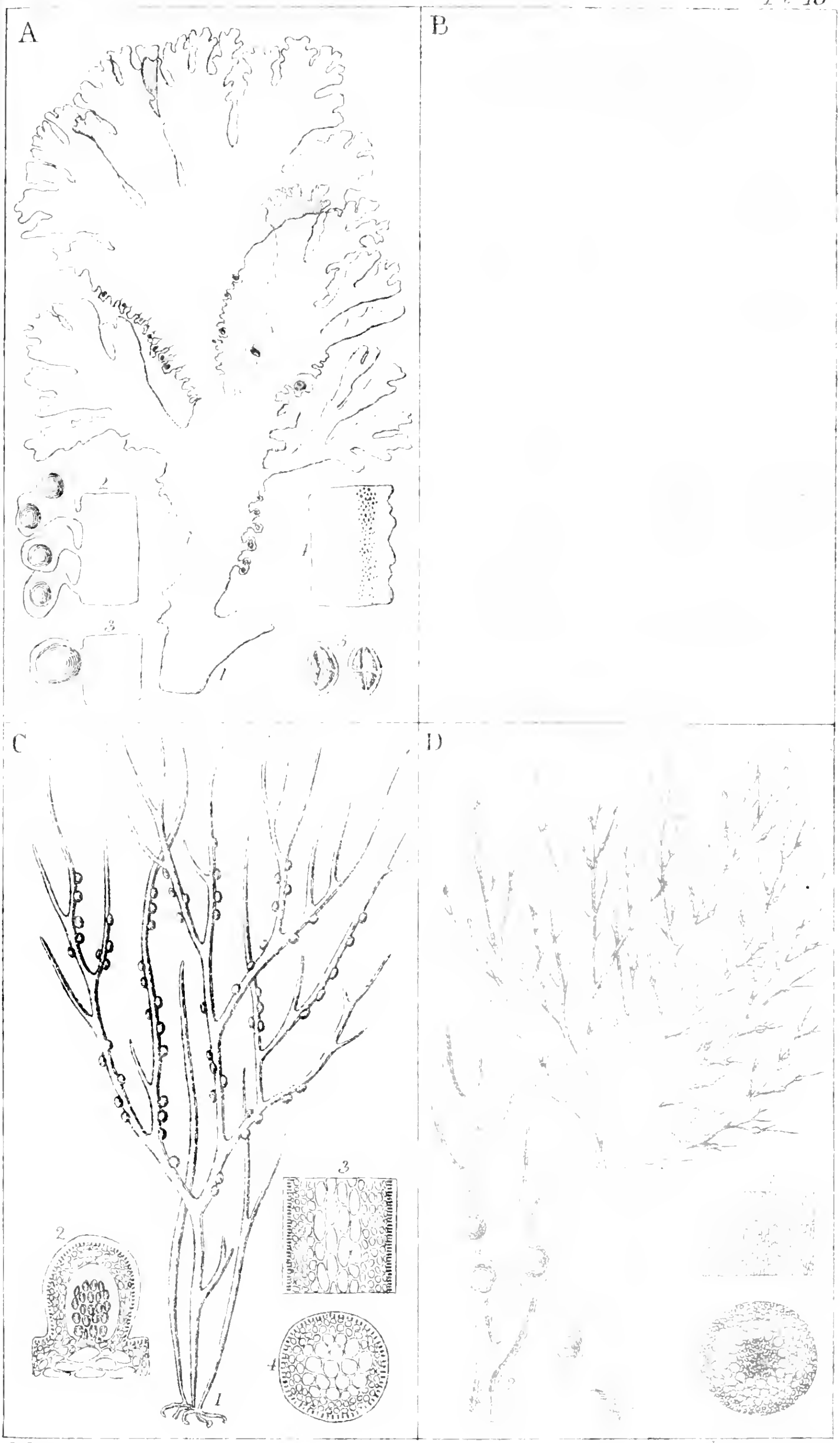
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PLATE XVII.

A. Grateloupia, page 137.

Fig. 1, *G. filicina ;* the *natural size.* 2, branch with tetraspores. 3, longitudinal section of the same. 4, a tetraspore. 5, branchlet with favellidia. 6, transverse section of the same ; *magnified.*

B. Gelidium, page 137.

Fig. 1, *G. corneum.* 2, the same, var. *latifolium ;* both the *natural size.* 3, a ramulus with tetraspores. 4, tetraspores *(dispores).* 5, a favellidium imbedded in a swollen ramulus. 6, spores ; all *magnified.*

C. Gigartina, page 139.

Fig. 1, *G. acicularis ;* the *natural size.* 2, branchlet with fruit. 3, vertical section of a fruit. 4, longitudinal slice of the frond ; all *magnified.*

D. Chondrus, page 141.

Fig. 1, *C. crispus ;* the *natural size.* 2, cross section of an imbedded sorus. 3, a tetraspore. 4, longitudinal slice of the frond ; *magnified.*

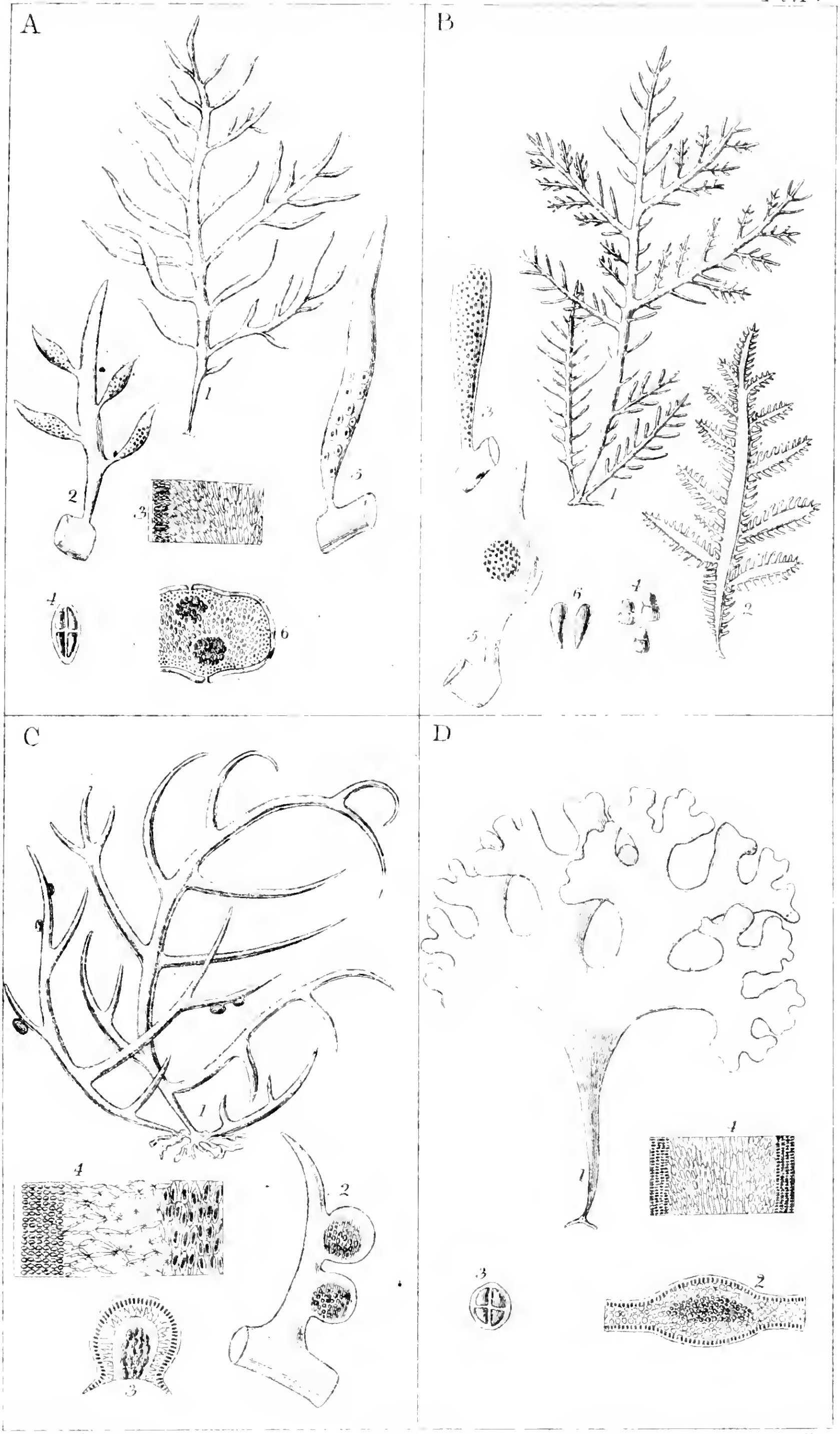
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PLATE XVIII.

A. PHYLLOPHORA, page 142.

Fig. 1, *P. rubens;* the *natural size.* 2, a nemathecium. 3, filaments from the same. 4, tubercles. 5, spores from the same; all *magnified.*

B. GYMNOGONGRUS, page 145.

Fig. 1, *G. Griffithsiæ;* the *natural size.* 2, part of a fertile branch with nemathecium. 3, section of nemathecium. 4, chained tetraspores from the same; all *magnified.*

C. FURCELLARIA, page 146.

Fig. 1, *F. lumbricalis;* the *natural size.* 2, cross section of a portion of the frond, showing tetraspores imbedded among the filaments of the periphery. 3, a tetraspore attached to a filament; all *magnified.*

D. POLYIDES, page 146.

Fig. 1, *P. rotundus;* the *natural size.* 2, section of part of the frond, and of one of the warts. 3, favellidium from the wart. 4, a spore. 5, a tetraspore from another specimen; all *magnified.*

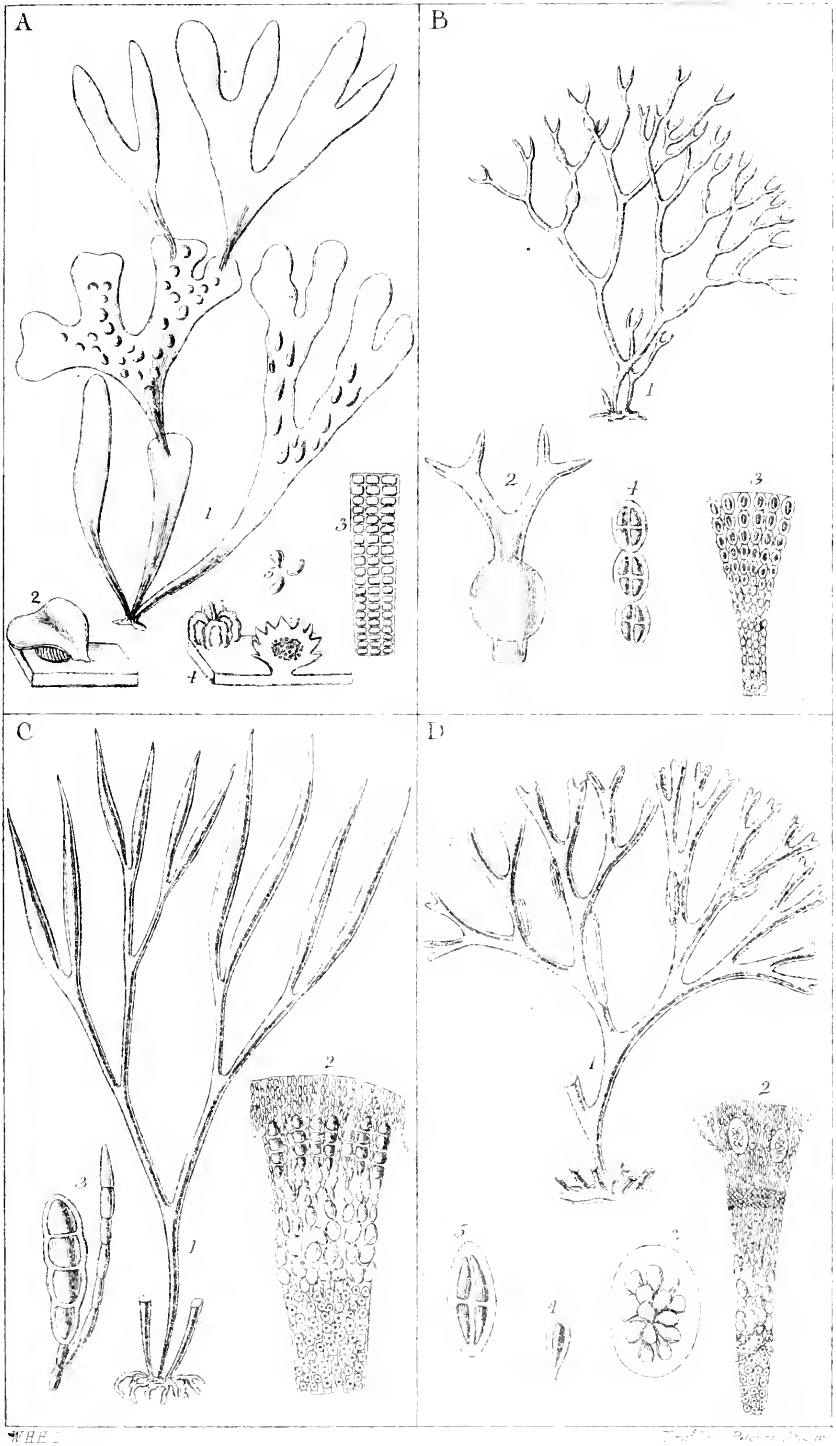
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PLATE XIX.

A. Iridæa, page 150.

Fig. 1, *I. edulis;* the *natural size.* 2, section of a frond with favellidia. 3, section of a frond with tetraspores. 4, tetraspores; all *magnified.*

B. Kallymenia, page 149.

Fig. 1, *K. reniformis,* the *natural size.* 2, section through a favellidium. 3, a tetraspore, from another specimen; both *magnified.*

C. Ginannia, page 148.

Fig. 1, *G. furcellata;* the *natural size.* 2, small portion of the frond. 3, longitudinal, and 4, transverse sections of the same, the latter showing immersed favellidia; all *magnified.*

D. Halymenia, page 148.

Fig. 1, *H. ligulata,* the *natural size.* 2, cross section of the frond. 3, a favellidium. 4, spores. 5, portion of the surface cells; all *magnified.*

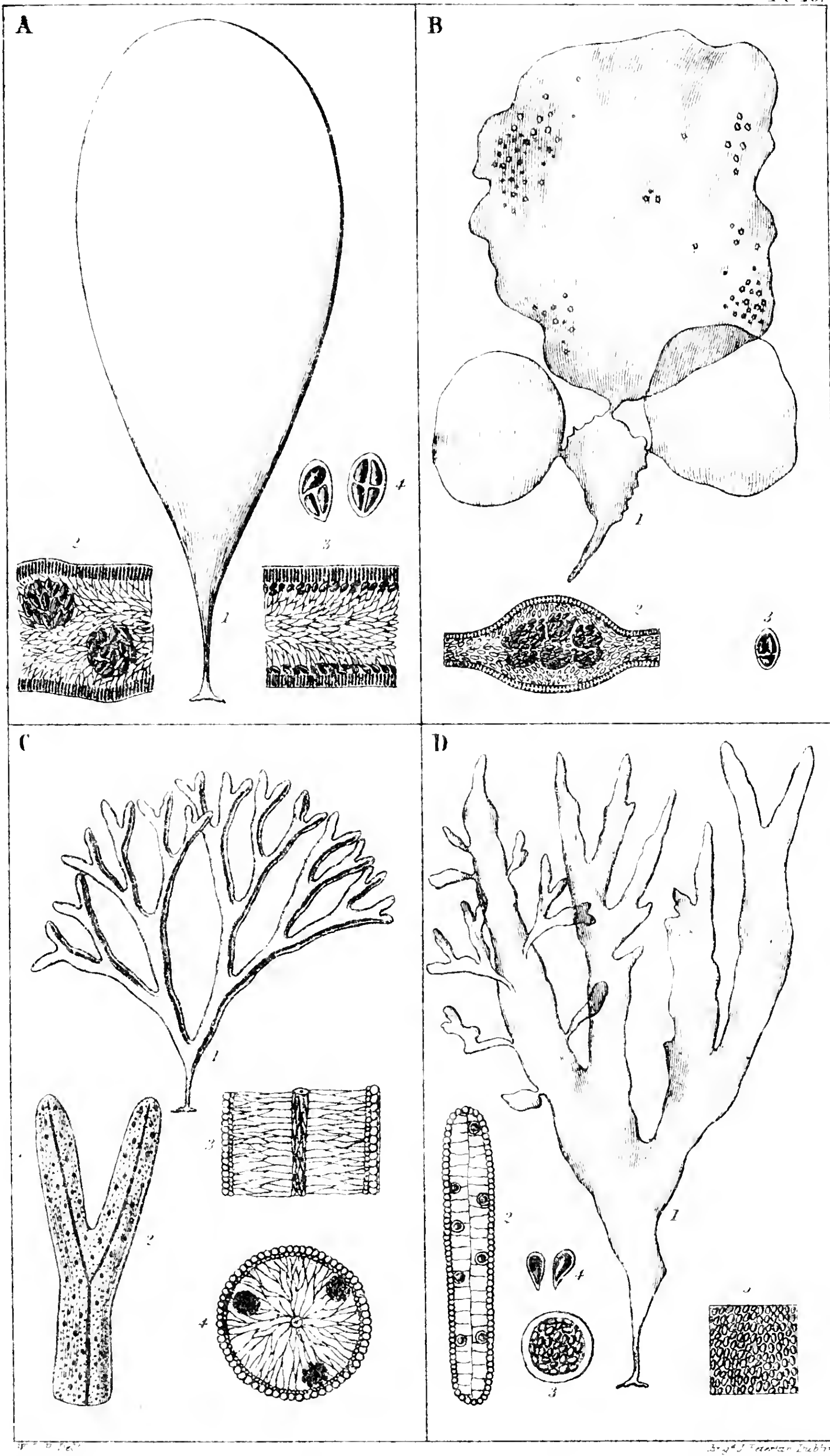
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PLATE XX.

A. Dumontia, page 147.

Fig. 1, *D. filiformis;* the *natural size.* 2, small portion of the frond, in fruit. 3, favellidium, attached to the inner face of the wall of the frond; *magnified.*

B. Catenella, page 151.

Fig. 1, *C. Opuntia;* the *natural size.* 2, a frond magnified. 3, a tetraspore. 4, a favellidium, immersed in one of the ramuli. 5, vertical section of the frond; all *magnified.*

C. Cruoria, page 151.

Fig. 1, *C. pellita,* growing on a portion of rock; the *natural size.* 2, vertical section of the skin-like frond. 3, filaments of which the frond is composed; all *magnified.*

D. Naccaria, page 152.

Fig. 1, *N. Wigghii;* the *natural size.* 2, portion of one of the branches, with fertile ramuli. 3, filament bearing a spore from the ramuli. 4, transverse section of the stem; all *magnified.*

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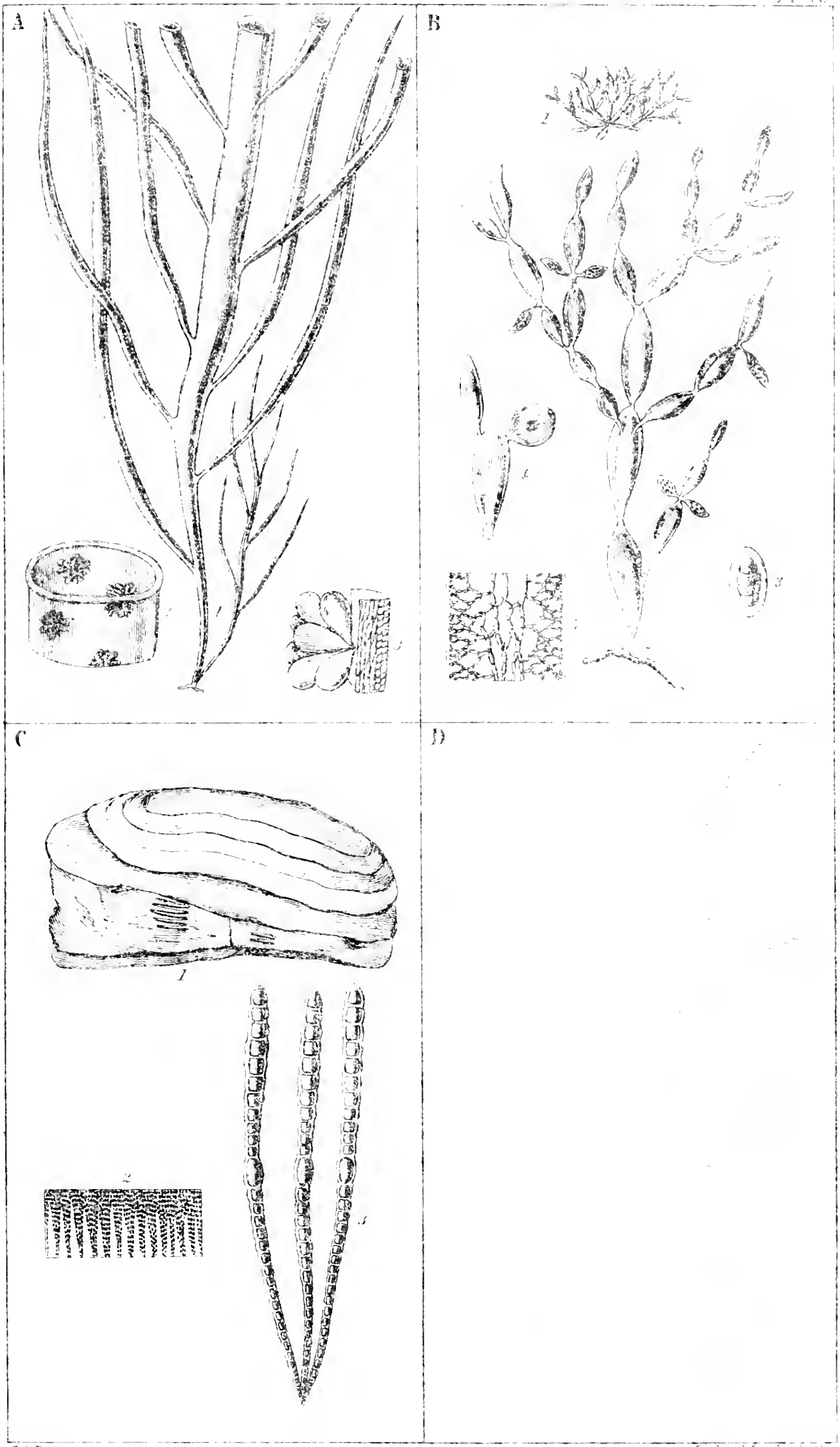

PLATE XXI.

A. Gloiosiphonia, page 152.

Fig. 1, *G. capillaris;* the *natural size.* 2, ramuli, in fruit. 3, transverse section of a branch, showing the tubular frond. 4, portion of the wall of the frond, with favellidium; all *magnified.*

B. Nemaleon, page 153.

Fig. 1, *N. multifidum;* the *natural size.* 2, filaments from the periphery of the same. 3, favellidium surrounded by moniliform filaments; both *magnified.*

C. Dudresnaia, page 154.

Fig. 1, *D. divaricata;* the *natural size.* 2, segment of a cross section of the frond. 3, favellidium; both *magnified.*

D. Crouania, page 155.

Fig. 1, *C. attenuata,* growing on *Cladostephus spongiosus;* the *natural size.* 2, portion of one of the branches. 3, whorl of ramuli from the same. 4, tetraspore attached to one of the whorled ramuli; all *magnified.*

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PLATE XXII.

A. PTILOTA, page 159.

Fig. 1, *P. plumosa*; the *natural size*. 2, favella on its peduncle, surrounded by involucral ramuli. 3, favella removed. 4, ramulus bearing tetraspores. 5, a tetraspore. 6, pectinated ramulus; all *magnified*.

B. MICROCLADIA, page 160.

Fig. 1, *M. glandulosa*; the *natural size*. 2, ramulus with favella. 3, favella. 4, ramulus with tetraspores. 5, a tetraspore; all *magnified*.

C. CERAMIUM, page 161.

Fig. 1, *C. rubrum*; the *natural size*. 2, ramulus with favellidium. 3, ramulus with imbedded tetraspores. 4, a tetraspore; all *magnified*.

D SPYRIDIA, page 166.

Fig. 1, *S. filamentosa*; the *natural size*. 2, fragment with pedunculated favellæ. 3, fragment with ramuli bearing tetraspores. 4, a tetraspore. 5, a transverse, and 6, a longitudinal, section of the frond: *magnified*.


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PLATE XXIII.

A. CALLITHAMNION, page 171.

Fig. 1, *C. Borreri;* the *natural size.* 2, a pinnated branch, or *plumule* of the same, bearing tetraspores on the ramuli. 3, a ramulus with tetraspores. 4, a favella on a truncated plumule; *magnified.*

B. GRIFFITHSIA, page 167.

Fig. 1, *G. corallina;* the *natural size.* 2, part of a branch with involucrated tetraspores. 3, an involucre, to whose ramuli tetraspores are attached, surrounding a fragment of the stem. 4, a tetraspore. 5, part of a branch with favellæ; *magnified.*

C. SEIROSPORA, page 170.

Fig. 1, *S. Griffithsiana;* the *natural size.* 2, part of the main stem. 3, dichotomous ramulus, partly converted into strings of spores. 4, tetraspores; all *magnified.*

D. WRANGELIA, page 199.

Fig. 1, *W. multifida;* the *natural size.* 2, fragment of stem with whorled ramuli, bearing a whorled and pedunculate favella. 3, spores from the favella. 4, ramulus with tetraspore. 5, a tetraspore; all *magnified.*

PLATE XXIV.

A. Codium, page 193.

Fig. 1, *C. tomentosum;* the *natural size.* 2, filaments from the same, in fruit; *magnified.*

B. Bryopsis, page 194.

Fig. 1, *B. plumosa,* the *natural size.* 2, part of a branch; *magnified.*

C. Vaucheria, page 195.

Fig. 1, *V. submarina;* the *natural size.* 2, portion of a fertile filament; *magnified.*

D. Cladophora, page 198.

Fig. 1, *C. falcata;* the *natural size.* 2, small branch with secund, falcate ramuli; *magnified.* 3, ramulus, *more highly magnified.*

E. Conferva, page 207.

Fig. 1, *C. tortuosa;* the *natural size.* 2, portion of a filament; *magnified.*

F. Rhizoclonium, page 206.

Fig. 1, *R. riparium;* the *appearance to the naked eye.* 2, portion of a filament, *magnified.*

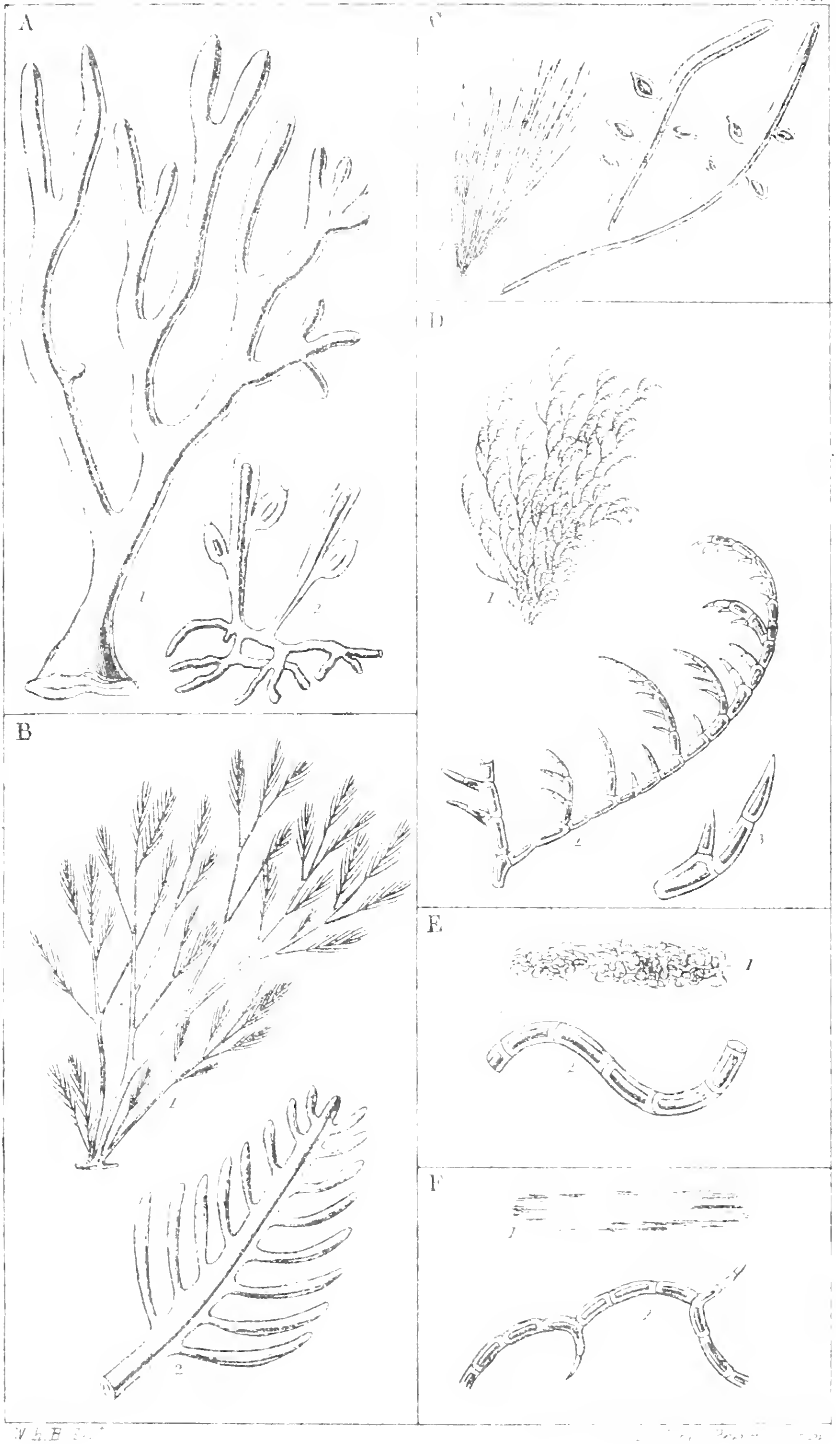
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PLATE XXV.

A. Porphyra, page 216.

Fig. 1, *P. laciniata;* the *natural size.* 2, portion of the membrane; *magnified.*

B. Ulva, page 216.

Fig. 1, *U. latissima;* the *natural size.* 2, portion of the membrane; *magnified.*

C. Bangia, page 217.

Fig. 1, *B. fusco-purpurea;* tuft, the *natural size.* 2, portions of filament. 3, transverse section of a filament; *magnified.*

D. Enteromorpha, page 213.

Fig. 1, *E. compressa;* the *natural size.* 2, small portion of the same; *magnified.*

E. Ochlochæte, page 211.

Fig. 1, *O. hystrix;* fronds, the *natural size*, parasitical on a leaf of grass. 2, one of the tufts; *magnified.* 3, portion of a filament from the same; *very highly magnified.*

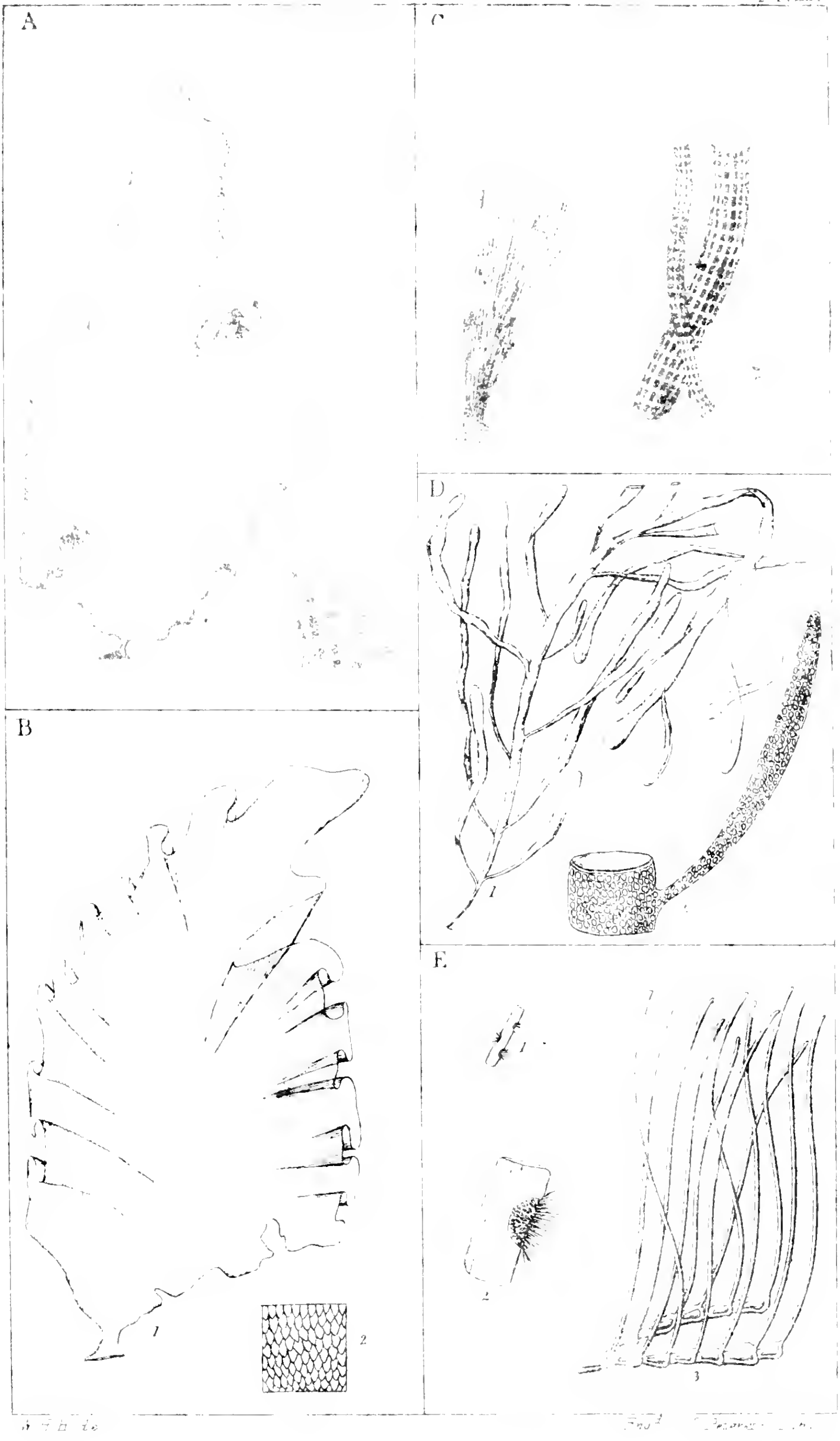
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PLATE XXVI.

A. Rivularia, page 222.

Fig. 1, *R. atra*, on a stone; the *natural size.* 2, vertical section of a frond. 3, filament from the same; *magnified.*

B. Schizothrix, page 223.

Fig. 1, *S. Cresswellii*, on a stone; the *natural size.* 2, filaments from the same; *magnified.* 3, portion of a filament; *very highly magnified.*

C. Calothrix, page 223.

Fig. 1, *C. confervicola*, growing on *Ceramium rubrum*; the *natural size.* 2, filaments from the same; *magnified.* 3, small fragment of a filament; *highly magnified.*

D. Microcoleus, page 227.

Fig. 1, *M. anguiformis*; the *natural size.* 2, a sheath; *magnified.* 3, filament from the same; *highly magnified.*

E. Lyngbya, page 225.

Fig. 1, *L. majuscula*; the *natural size.* 2, portion of a filament; *magnified.*

F. Oscillatoria, page 228.

Fig. 1, stratum of *O. insignis*, as it appears to the eye. 2, filament of the same species; *highly magnified.* 3, filament of *O. nigro-viridis*; *magnified.*

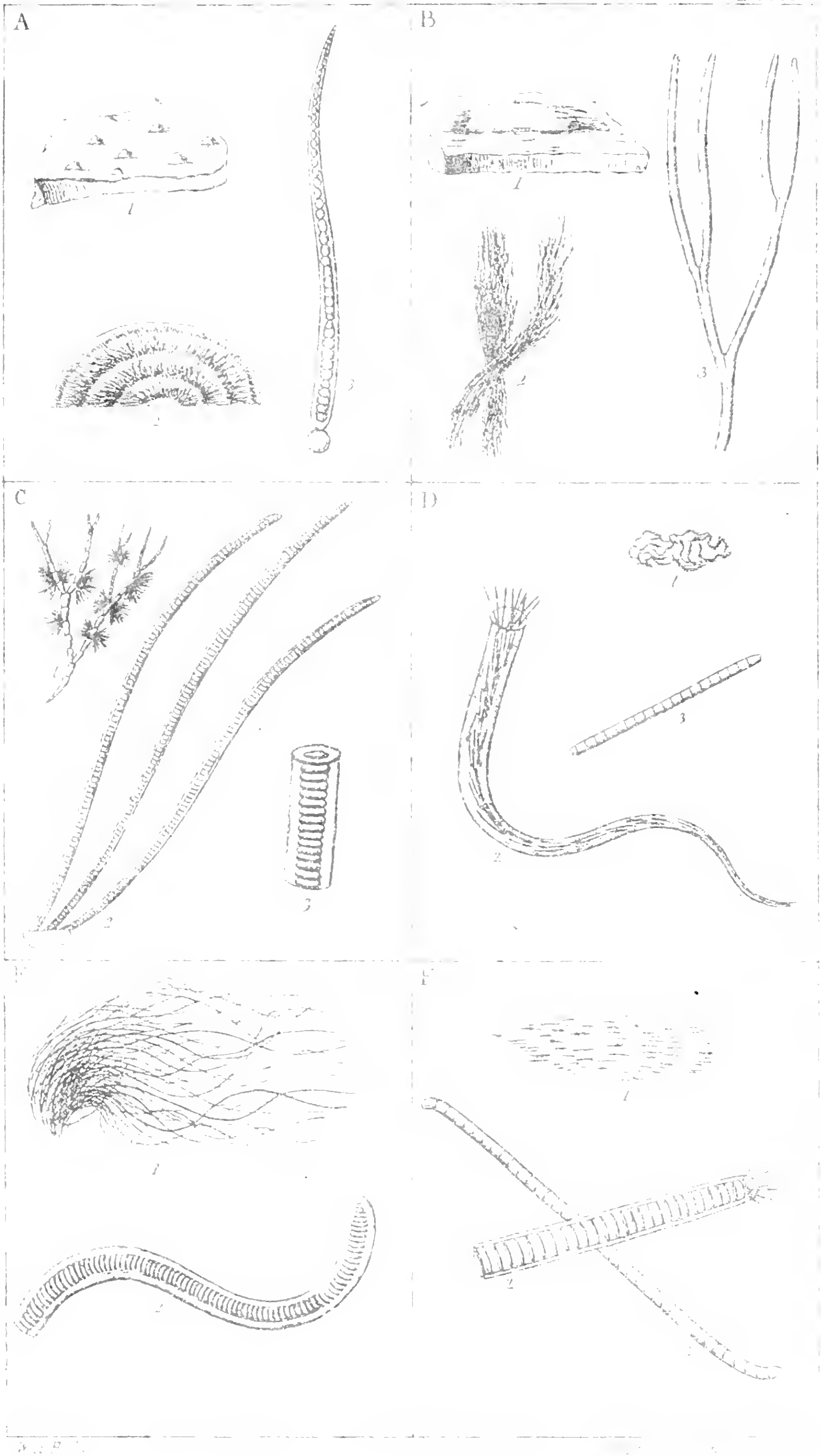
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PLATE XXVII.

A. Monormia, page 231.

Fig. 1, portion of the gelatinous fronds, as they appear to the eye. 2, part of a frond; *magnified.* 3, filament from the same; *highly magnified.*

B. Hormospora, page 235.

Fig. 1, young, and *fig.* 2, full-grown plant of *H. ramosa.* 3, spore from the same; all *highly magnified.*

C. Spirulina, page 229.

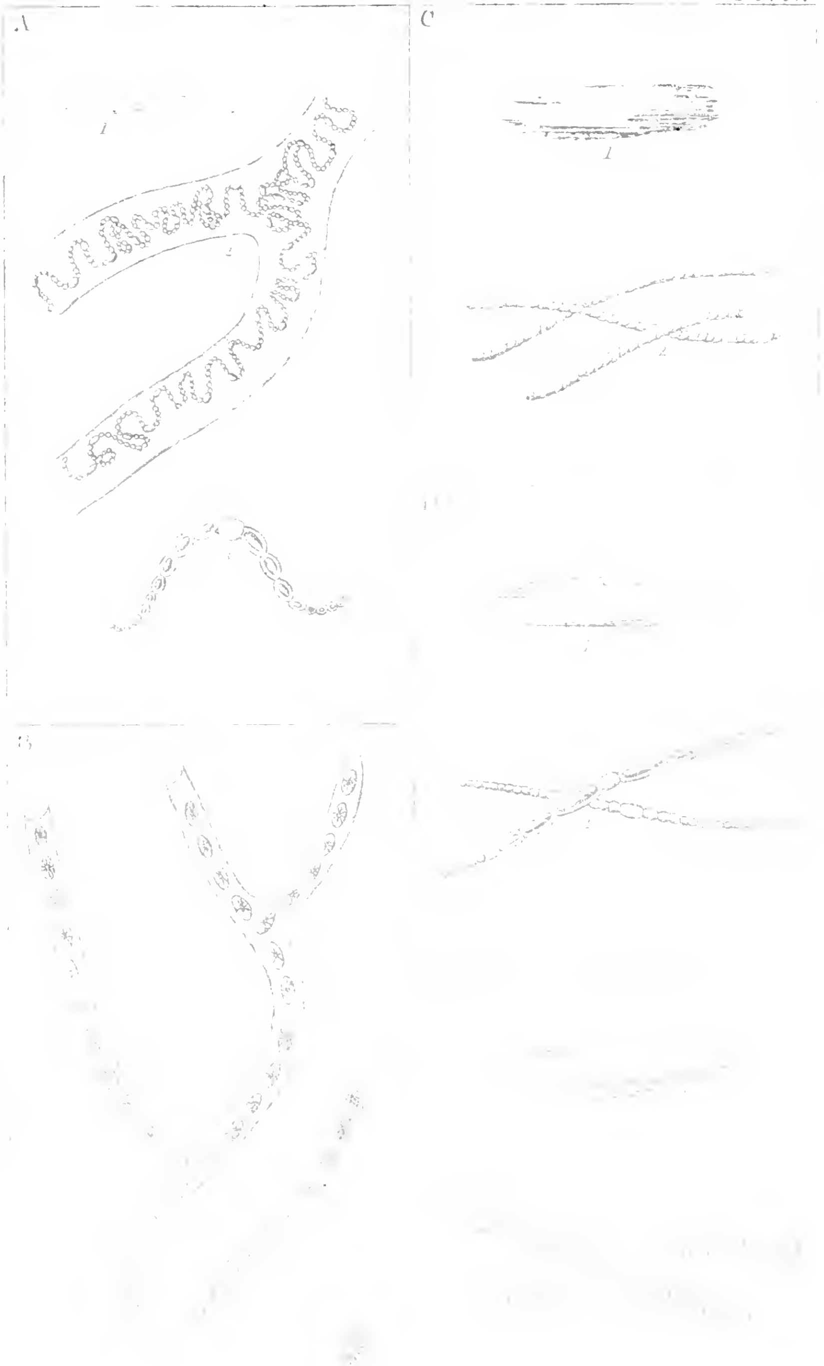
Fig. 1, *S. tenuissima;* the stratum as it appears to the eye. 2, filaments from the same; *very highly magnified.*

D. Sphærozyga, page 232.

Fig. 1, stratum of *S. Carmichaelii*, as it appears to the eye. 2, a young and an old filament of the same species; *very highly magnified.*

E. Spermoseira, page 233.

Fig. 1, stratum of *S. litorea*, as it appears to the eye. 2, filaments from the same; *highly magnified.*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