

EX LIBRIS

SMITHSONIAN CONTRIBUTIONS TO KNOWLEDGE.

NEREIS

BOREALI-AMERICANA:

OR,

CONTRIBUTIONS TO A HISTORY OF THE MARINE ALGÆ
OF NORTH AMERICA.

BY

WILLIAM HENRY HARVEY, M. D., M. R. I. A.,

KEEPER OF THE HERBARIUM OF THE UNIVERSITY OF DUBLIN; PROFESSOR OF BOTANY TO THE R. D. S.;
AND CORRESPONDING MEMBER OF THE NEW YORK LYCEUM OF NATURAL HISTORY.

PART II.—RHODOSPERMEÆ.

WASHINGTON CITY:

PUBLISHED BY THE SMITHSONIAN INSTITUTION.

MARCH, 1853.

NEW YORK: G. P. PUTNAM & CO.

COMMISSION

TO WHICH THIS PAPER HAS BEEN REFERRED.

PROF. J. W. BAILEY,
DR. ASA GRAY.

JOSEPH HENRY,
Secretary S. I.

SUB-CLASS II.

RHODOSPERMEÆ, OR RED ALGÆ.

DIAGNOSIS. *Plants* rosy-red or purple, rarely brown-red, or greenish-red. *Fructification* of two kinds, diœcious:—1. *Spores* (*gemmidia*, J. Ag.) contained either in external or immersed conceptacles, or densely aggregated together and dispersed in masses throughout the substance of the frond: 2. *Tetraspores* (*sphærospores*, J. Ag. *gemmales*, Thw.) red or purple, either external or immersed in the frond, rarely contained in proper receptacles; each tetraspore enveloped in a pellucid skin (*perispore*) and at maturity separating into four *sporules*. *Antheridia* (not observed in all) filled with yellow or hyaline corpuscles. *Marine, with one or two exceptions.*

The most obvious characteristic of the plants of this sub-class is their colour, though this varies through every shade of red and purple into red brown, or pure brown; and degenerates, under the influences of sun-light and shallow water, into orange, yellow, or dull green. Still, some faint tint of redness, or the absence of *olive-green* or *grass-green*, prevents the student from confounding the faded *Rhodospereæ* with either of the other groups into which the Algæ are divided.

Their most remarkable and distinctive character however lies in their *double system* of fructification; two descriptions of spore-producing organs having been found in almost all these plants, and always being developed on *different* individuals of each species. Thus, these Algæ are strictly *diœcious*, though in a different manner from other diœcious plants; for here it is not stamens and pistils (or their analogues) which are borne on different roots; but, *some* individuals of a species produce only one kind of pistil or sporiferous organ, and *others* of the same species constantly produce a sporiferous organ of a different kind. These diverse fructifications do not appear to be different phases of the same organ, like the two sorts of flowers found in some *Polygalæ*, *Leguminosæ* and *Malpighiaceæ*, etc.; but are in their origin and development perfectly distinct, and formed with the greatest regularity, following fixed laws. The *spores* developed in either system are equally capable of reproducing the species; and as the two kinds are always formed on different individual fronds, the *idea* of each species of these plants includes two individuals, and is not complete unless both are known. Hence the necessity, in forming our generic groups, to ground them on characters taken from the peculiarities of both fructifications.

Perhaps the natural explanation of this double fructification is to regard one form of reproductive body as the true *spore*, supposed to be fertilized through the agency of an *antheridium*; and to consider the other to be merely a gemmule or bud, here

reduced to a single cell, cast off by the parent plant and capable of continuing an independent existence. If this be the true explanation of the phenomena, we have still to decide (and from analogy only, for evidence of fertilization is wanting) to which of these bodies we shall give the name of *spore*, and which we shall call *gemmule*. And here different botanists take different views, the positive evidence, as it seems to me, being nearly equally in favour of either. Having no new facts to bring forward, I shall not argue this question here; but, adopting the names *spores* and *tetraspores* for these reproductive cells respectively, shall endeavour briefly to describe their development and modification.

1. The *spores*, then, or *gemmidia* of J. Agardh, are always congregated in a more or less definite mass, tuft, or cluster, which we shall here call the *Sporiferous-nucleus* (*Nucleus cystocarpii*, J. Ag.) Each *spore* is a cellule, having a gelatino-membranaceous, hyaline coat, and containing a dense, subsolid, homogeneous, deeply coloured starchy mass or *endochrome*, which, on being expressed, breaks up into an impalpable granular dust. The *sporiferous nucleus* is either wholly naked (as in *Wrangelia*, *Callithamnion*); immersed in the substance of the frond (as in *Grateloupia*, *Halymenia*, *Dumontia*, etc.); lodged in wart-like tubercles (as in *Polyides*); or contained within hollow *conceptacles* (or *cystocarpia*, Kütz.) of various forms, which are either dispersed through the frond and partially immersed in it; or are borne on the ends or sides of the branches, on the midrib of leaves, or on proper fructiferous ramuli developed from some part of the stem, or of the margin or disc of the foliations. In all cases of external *conceptacles* they appear to be transformations of the ends of the branches, or of lateral ramuli; the transformed branch or ramulus being usually very much shortened, often reduced to a point. And all immersed *sporiferous nuclei* are formed from the interior strata of cells, and have generally if not always, a connection with the medullary or central stratum.

The *sporiferous nuclei* are of two kinds, distinguished by the manner in which the spores are developed in each. In families of the highest structure (DESMIOSPERMEÆ) the *nucleus* consists of a tuft of articulated, moniliform filaments, or *spore-threads*, radiating to all sides from a central point, or growing from a proper placenta lodged within a conceptacle. In these nuclei a *single* spore is formed within one or more of the cells of the filaments; and the *spore-thread* at maturity is thus more or less changed into a string of spores. In some, all the cells are changed into spores; in others, the terminal cell is alone fertile. In the less organised families (GONGYLOSPERMEÆ) the *nucleus* is formed either from a single mother-cell, from several detached mother-cells, or from such cells imperfectly joined together in moniliform strings issuing from a central point, or growing from the placenta of a conceptacle. Each mother-cell, which is at first filled with a homogeneous endochrome, becomes, by repeated cell-division, converted into a cluster of *spores*, at first retained within its walls; afterwards, on the bursting of the wall, dispersed. Thus by the evolution of one cell, a *favella*, or simple globose nucleus containing many angular spores within a hyaline periderm, is formed. By the evolution of several detached but adjacent mother-cells, a *favellidium* or compound *favella* results. And by the similar evolution of the cells of the moniliform series, the highest form of *favellidium* is produced. In all these cases the general

nucleus, as well as the particular *nucleoli*, is surrounded by a gelatinous or sub-membranaceous hyaline periderm, derived from the cell walls of the transformed cells.

The classification adopted in this memoir being based on the structure of the *nuclei*, the student will do well, if possible, to master the principles of development now explained. In many cases the structure may be easily seen by viewing under the microscope longitudinal sections of the conceptacle, particularly those of the series *Desmiospermeæ*, where the changes between ripe and unripe fruit are less marked than in the *Gongylospermeæ*. In such plants as *Polysiphonia* and *Laurencia* no careful cutting is necessary, simply bruising the conceptacles between two glasses being sufficient to expel the nucleus. In the *Sphærococcoideæ* and in *Gelidium*, &c. thin cuttings easily made after a little practice under a simple lens, must be viewed by transmitted light. In the *Gongylospermeæ* the proper structure of the *nuclei* is often difficult to be ascertained, owing to the confused crowding of spores which results from the continual self-division of the fertile cells. It may be necessary to examine thin cuttings of various ages in order to determine whether the nucleus be formed from one or many mother-cells. But in most cases where the nucleus is of a large size, very dense, with indications of internal septa, such an origin may be taken for granted. Instances of simple nuclei or *favellæ* favourable for examination occur in *Callithamnion*, *Grateloupia*, *Gloiosiphonia*; and of compound nuclei or *favellidia* in *Chondrus*, *Gigartina*, *Calophyllis*, and *Cystoclonium*.

2. *Tetraspores* (*Sphærosporæ*, J. Ag. *Tetrachocarpia*, Kütz.) are commonly formed in compound fronds by the evolution of some of the cells of the cortical layer, or in the simple, filiform kinds by the transformation of the ultimate ramuli. They are either dispersed equally through the surface cellules of the whole frond; or confined to the ramuli; or grouped together in definite spots called *sori*; or lodged in external wart-like excrescences (*nemathecia*); or in proper leaflets (*sporophylla*); or in ovate or lanceolate, podlike receptacles (*stichidia*). Wherever placed, they agree in structure; each *tetraspore* containing, within its hyaline, gelatino-membranaceous coat or *perispore*, a dense, four parted, deeply coloured endochrome, dividing at maturity into four (rarely eight or more) *sporules*. The mode of division of the nucleus varies in different species, and should be carefully observed by the student, as generic distinctions are sometimes grounded on this character. In some tetraspores the mass is quartered by two lines crossing each other at right angles in the centre; such are called *cruciate* tetraspores. In others the mass splits into four unequal parts, three of which only are visible on the lateral view, divided from each other by three lines radiating from the centre; such are called *tripartite*, *ternately parted* or *triradiate* tetraspores. Again, there are others, of an oblong or cylindrical form, divided by three parallel, transverse lines into annular portions; and such are called *zonate*, *annular*, or *transversely parted* tetraspores.

The natural arrangement of the RHODOSPERMEÆ in Orders and genera offers many more difficulties to the student than that of the MELANOSPERMEÆ, owing to the greater complication of the organs of fructification; the minuteness of the parts which require to be dissected that their proper structure may be understood; the much more varied forms which the *frond* assumes; but especially the great diversity

of *internal* structure which prevails among plants that have *externally* a close resemblance. This last peculiarity compels us, in order to understand their true affinities, to acquire an intimate knowledge of the anatomy of the frond; and this is only to be learned, in the compound species, by a patient examination of transverse and longitudinal slices, always a tedious, and sometimes a difficult process. In the generic distribution proposed by the earlier systematic writers, the external form of the conceptacle, or the colour and substance of the frond, were chiefly considered; in most cases, irrespective of the anatomic structure. Thus, plants the most opposite in internal composition, and producing fructification fundamentally diverse, were often placed in the same genera. A notable instance of such unnatural association occurs in the old genus, *Sphærococcus*, Ag. which included almost every round-fruited species which had no other "local habitation or name;"* and this at the arbitrary will of the author, for the generic character assigned to the assemblage could not be said to apply to a tithe of the species placed in it. Dr. Greville first reformed this group, separating *Rhodymenia*, *Gracilaria*, *Chondrus*, *Phyllophora*, *Gelidium*, *Gigartina*, *Hypnea*, and *Iridæa* from it, a sufficient evidence of the chaos it then contained. No doubt Dr. Greville's system was a vast improvement on that of the elder Agardh; but his genera were often founded on the external habit of the frond, and sometimes included plants as little related *naturally* to each other as those placed in the old group *Sphærococcus*. Thus, *Rhodymenia*, Grev. comprised all the old *Sphærococci* with a red, expanded, membranous, ribless frond, no matter what the internal structure of the frond, or of the fructification. Examination has shown the structure of both frond and fruit to be extremely different among the plants thus associated, and compelled the separation of the new genera, *Calophyllis*, *Rhodophyllis*, *Rhizophyllis*, *Euthora*, and *Calliblepharis*, while of those that remain some belong to *Gigartina*, some to *Gracilaria*; and of the sixteen species enumerated by Dr. Greville, only five belong to the modern genus *Rhodymenia*; the rest dispersing into three different Orders. This example may suffice. Dr. Greville's system was published in 1830. The next decided improvement in system was developed in 1841–1842, by Professor J. Agardh,† who, in describing the Algæ of the Mediterranean and Adriatic, took occasion to reform the generic characters, by introducing into the diagnosis the internal structure of the frond, and by more accurately describing the fructification. Much remained still to be accomplished, and new genera founded on the reformed principles were added by Montagne and others. In 1843 Kützinger published his "*Phycologia Generalis*,"‡ accompanied by eighty anatomical plates of unrivalled excellence and beauty. In this great work many new genera were defined and illustrated, and a new system of distribution was proposed. The chief excellencies of the book are its anatomical illustrations: its faults are, the needless alteration of established names; the introduction of unnecessary glossology; and the multiplication of Orders, genera, and

* CHAR. ESSENT. Fructus uniformis: capsulæ glomerulum seminum minutissimorum sphericum includentes.

† J. Ag. *Symbolæ* in Linnæa XV. p. 1 (1841). J. Ag. "Algæ maris Mediterranei et Adriatici observationes in diagnosis specierum, et dispositionem generum." Paris, 1842.

‡ "Phycologia Generalis, oder Anatomie, Physiologie, und Systemkunde der Tange." Leipsig, 1843.

species, many of them grouping together plants but little related, and others separating nearly allied species. Still, we are indebted to Kützing for reforming many of the old genera left untouched by earlier writers. I regret that in his more recent "*Species*"* he has pursued the deforming, rather than the reforming course, introducing innumerable false species, further subdividing genera, and even placing the same species in two or more widely separated genera.

I turn with pleasure to the work of a very different writer, Prof. J. G. Agardh, whose "*Species,† Genera, et Ordines Algarum*, now in course of publication, places him, for accurate analysis, careful description, original conception, and just views of system, far above any other author who has devoted his attention to the Algæ. In his former works he had sketched out the system which he has now more fully developed, has fortified by the examination of a very large number of species, and remodelled where alterations were necessary. The primary distribution into Orders is based on the structure and development of the *sporiferous nucleus*, which affords excellent discriminative characters. In the generic groups minute attention is paid to the anatomy of the frond, the position and partition of the tetraspores, the minor structure of the conceptacle, &c. The result, I trust, will be to place the systematic arrangement of the Algæ on a better and firmer foundation than it has yet stood. I have carefully gone over, with the dissecting knife and the microscope, much of Prof. Agardh's ground, and though I do not follow him in *all* the changes he has introduced, the points where we differ are few and unimportant, and open to future consideration. With the *principles* advocated in his system I fully coincide; I differ merely in a few cases where it seems to me, perhaps incorrectly, that natural affinity has been mistaken.

I take this opportunity to record the expression of my best thanks to those kind correspondents and friends in America who continue to supply me with specimens. Since the publication of the first part, I have received from Captain NICHOLAS PIKE of Brooklyn an important contribution of Californian Algæ; from DR. BLODGETT of Key West a second interesting series of Floridan Algæ, containing some new forms; from MR. HOOPER a parcel from the North-eastern States, containing several not previously sent; and from MR. CALVERLEY, Algæ of New York Harbour, &c. These and other contributions will be found duly noted under each particular species in the body of the work; and should any novelties reach me before the publication of the third fasciculus, they shall be inserted in a supplement. Persons in America wishing to assist me with further specimens are requested to send parcels addressed to Dr. William H. Harvey, Trinity College, Dublin, to the care of Messrs. Abraham Bell and Son, 25, Park Row, New York; or to J. Van Voorst, Publisher, 1, Paternoster Row, London.

W. H. H.

TRIN. COLL. DUBLIN,
November 24th, 1852.

* *Species Algarum*, auctore F. T. Kützing, Lipsiæ, 1849.

† "*Species, Genera et Ordines Algarum*, auctore J. G. Agardh." Lund, 1848-1852.

SYNOPSIS OF THE ORDERS OF RHODOSPERMEÆ.

Series 1. DESMIOSPERMEÆ, J. Ag. *Sporiferous nucleus* (either naked, immersed in the substance of the frond, or lodged in hollow conceptacles) consisting of tufted spore-threads attached to a basal, parietal, or central placenta. Single spores formed in each cell of the spore thread, or only in the terminal cell.

1. *Nucleus lodged in an external, ovate or spherical conceptacle.*

* *Placenta in the base of the hollow conceptacle. Spores pyriform or obconic, formed in the terminal cell of the spore threads.*

I. RHODOMELACEÆ. *Frond* articulate or furnished with an articulated polysiphonous axis; the surface areolated. *Spore-threads* simple. *Tetraspores* seriated in the ramuli, or in podlike receptacles.

II. LAURENCIACEÆ. *Frond* inarticulate, solid, or tubular and septate; the surface cells minute. *Spore-threads* simple or paniculate. *Tetraspores* irregularly scattered through the ramuli.

** *Placenta in the base of the hollow conceptacle. Spores roundish or elliptical, in moniliform strings; all the cells of the spore-thread gradually changed into spores.*

III. CORALLINACEÆ. *Frond* calcareous (its cells secreting carbonate of lime). *Spore-threads* separating at maturity into four spores.

IV. SPHÆROCOCOIDEÆ. *Frond* cartilaginous or membranaceous. *Spore-threads* separating at maturity into many spores.

*** *Placenta axial, or suspended by filaments in the cavity of the external or half immersed conceptacles.*

V. GELIDIACEÆ. *Frond* inarticulate, cartilaginous or horny, opaque; the axis (at least) formed of elongated, confervoid filaments.

2. *Nucleus not lodged in a hollow conceptacle.*

* *Nuclei contained in wart-like excrescences.*

VI. SPONGIOCARPEÆ. *Frond* cartilaginous (cylindrical) almost wholly composed of confervoid filaments closely set in firm gelatine. *Nuclei* numerous in each wart, globose. *Spores* obconical, radiating from a central point.

VII. SQUAMARIÆ. *Fronde* lichenoid, horizontally expanded and rooting from the under surface, cartilaginous or membranaceous. *Spores* arranged in moniliform strings within the wart.

** *Nuclei immersed in the frond.*

VIII. HELMINTHOCLADIÆ. *Fronde* gelatinous, or gelatino-membranaceous (cylindrical) almost wholly composed of confervoid filaments set in loose gelatine. *Nuclei* spherical, formed of branching, moniliform spore threads issuing from a central point.

*** *Nuclei naked, involucrate.*

IX. WRANGELIACÆ. *Fronde* filiform, monosiphonous, articulate or corticated with small cells. *Spores* pear-shaped, formed in the terminal cells of branching spore-threads.

Series 2. GONGYLOSPERMEÆ, J. Ag. *Sporiferous-nucleus* (either naked, immersed in the substance of the frond, or lodged in hollow conceptacles) subglobose, either simple or formed of many *nucleoli*. Numerous *spores* congregated without order within a hyaline, mucous or membranaceous periderm (or mother-cell).

* *Fronde inarticulate, flat or cylindrical, compound.*

X. RHODYMENIACÆ. *Nucleus* lodged in globose *conceptacles*; *spores* developed within the cells of moniliform, branching filaments issuing from a centre; at length conglobated without order.

XI. CRYPTONEMIACÆ. *Nucleus* either lodged within a *conceptacle* or sunk in the frond; *spores* developed within solitary or aggregated detached mother-cells; at length conglobated without order.

** *Fronde filiform, articulate, monosiphonous; the articulations naked, or covered by a cortical layer of small cellules.*

XII. SPYRIDIACÆ. *Nucleus* lodged in an external, closed cellular pericarp, compound, consisting of many *nucleoli*, each formed by the evolution of paniculately branched spore threads; *spores* at length conglobated without order.

XIII. CERAMIACÆ. *Nucleus* (a *favella*) naked or involucrate, simple; containing *spores* conglobated without order within a hyaline membranous periderm (or mother cell), developed externally.

ORDER I.—RHODOMELACEÆ.

Harv. Man. Ed. 2, p. 75. Rhodomeleæ, J. Ag. in Linn. XV. p. 23. Alg. Medit. p. 116. Endl. Gen. 3rd Suppl. p. 44. Harv. Ner. Austr. p. 9; J. Ag. Sp. Gen. and Ord. Algarum, 2, Syn. p. xi. Rytiphleæ, Dne. Class, p. 62, also part of Ceramiæ, Chondrieæ, Thamnophoreæ, and Anomalophylleæ, Dne. l. c. Dasyeæ, Polysiphoniæ, Chondrieæ (in part), Botryocarpeæ (in part), Amansiæ, Rytiphleæceæ, Carpoblepharideæ (partly) and Claudiæ, Kütz. Phyc. Gen. p. 414-451.

DIAGNOSIS. Red or brown-red or purple seaweeds, with a leafy or filiform, areolated or articulated frond, composed of polygonal cells; the inarticulate filiform species having an articulated axis composed of cells radiating round a central cell. *Sporiferous nucleus* contained in ovate or urceolate, perforate conceptacles; *spores* pyriform, formed in the terminal cell of unbranched, tufted spore-threads radiating from a basal placenta. *Tetraspores* generally seriated, lodged either in distorted ramuli or in proper receptacles (*stichidia* or *sporophylla*).

NATURAL CHARACTER. *Root* either a simple disc, or accompanied by creeping fibres; sometimes, in densely tufted filiform kinds, the primary fronds are prostrate, attached by lateral discs issuing along them at intervals, the secondary ones or branches erect. *Frond* very variable in habit, either leaflike or filiform; or rarely formed into an anastomosing net-work. In the numerous forms found in various parts of the world all gradations between a perfectly developed, nerved, expanded leaf, and a capillary, articulated filament, finer than human hair, may be traced. In the flat, leaf-like species, the frond is sometimes (as in *Odonthalia*) thick, opaque, with minute surface cells, and either destitute of midrib or obsoletely ribbed; sometimes (as in *Amansia*) it is delicately membranaceous, translucent, composed of regular twelve sided cells of equal length, arranged in transverse lines. Similar varieties occur in the cylindrical fronds, some of which are opaque, with small surface cells (*Alsidium, Acanthophora, Rhodomela*); others (as many *Polysiphoniæ*) are pellucidly articulate. This latter character, in several *Polysiphoniæ*, distinguishes all parts of the frond at all ages; in others only obtains in the young frond, or in the younger branches and ramuli of older fronds. In such the articulations are gradually coated over by successive rows of smaller cells of unequal size and shape, and can only be discovered by making cross and longitudinal sections of the stems. A cross section being made, an articulated axis composed of several cells disposed like the spokes of a wheel round a central cell may be

detected in all the plants of this order, and affords a mark by which they may generally be recognised when not in fruit. The growing ends of the branches and ramuli are clothed with articulated, mostly dichotomous, monosiphonous hairs or *ramelli*, and sometimes the whole surface of the frond is thickly covered with them. In most cases they are deciduous, falling away soon after the point from which they spring becomes fully developed, but sometimes (as in *Dasya*) they are persistent, either remaining unchanged, or, (in the section *Stichocarpus*) eventually becoming polysiphonous and changing into ramuli.

Considerable uniformity prevails throughout the Order in the structure of the organs of fructification. The conceptacle in all is of the form technically called *ceramidium*, that is, an ovate or urceolate hollow case, pierced by a terminal pore, and containing a tuft of spore-threads radiating from a basal, more or less elevated placenta. These conceptacles are formed at the ends or sides of the branches or ramuli, and are always transformations of shortened ramuli, or of the apices of branches. The *spores* are pear-shaped, tapering greatly to the base, and are formed singly from the terminal cells of the spore-threads. The *tetraspores* in all cases, so far as I am aware, are tripartite or unequally triradiate—three of the sporules only being visible at either face. They are never equally dispersed through the frond, and only in a few cases lodged in its unaltered ramuli. Most usually they are produced in little ovate or lanceolate, pod-like *receptacles* called *stichidia*, developed either from the midrib, the disc, or the margin of the leafy species; or formed within the axils of the ramuli; on the ends of the branches; or even on the permanent hairs (as in *Dasya*) that clothe the surface. The distinctive generic characters often depend on the occurrence, the form, or the position of the *stichidia*. *Antheridia* have been found in several *Polysiphoniæ*, *Rhodomelæ*, *Dasyæ*, &c. They occur in the form of minute pod-like bodies, resembling the *stichidia* in shape, but much smaller, filled with exceedingly minute granular cells, and are usually of a pale yellow colour. They are mostly developments of the dichotomous hairs that crown the growing ends of the branches.

The order *Rhodomelaceæ*, though including within its limits many brilliant Algæ, contains a large proportion of darker and more soberly coloured species. It takes its name from one of the genera (*Rhodomela*) which is noted for changing from *red* to *black* during the process of drying, and very many others have similar properties. In *Odonthalia* the growing frond is blood red, while the dried is dark vinous purple. Many rosy or purplish leafy kinds change to dull brown. Brown again, of various depths and shades, is the proper colour of several *Polysiphoniæ*; while others of that genus, though equally brown when dry, are a pure crimson or purple when growing. In so large a genus all hues of red, as may be supposed, are found, and are more or less lost or preserved in drying. The genus *Bostrychia* is remarkable for the depth and dulness of its purple colour, the only varieties being tinges of green, or of black or very dark brown. *Dasya* among the American genera shines out in greatest lustre, its soft fronds (as in *D. elegans*), clothed with a rich fleece of rosy purple; a colour which is preserved or even heightened in the drying specimen.

None of the North America genera of this order are peculiar to the coasts of

this continent, and most are widely scattered. *Amansia*, *Alsidium*, *Acanthophora* and *Digenia* are either tropical or subtropical. *Odonthalia* is confined to the colder regions of the Atlantic and Pacific, and to the circum-polar Ocean. Perhaps its most southern limit in Europe is the Isle of Man (lat. 54° 20'), while in America it extends from the Arctic Coast at least to Halifax Harbour (lat. 44° 35'). *Rhodomela* is distributed in high northern and southern latitudes. There is a species (*R. concinna*, Hook. and Harv.) at the southern extremity of the New Zealand group, closely related to *R. floccosa* of our north-west coast; and others occur at the Falkland Islands and Cape Horn. *Rytiplæa* is for the most part subtropical, but some of its species on the West Coast of Ireland reach to lat. 55°. *Polysiphonia* and *Dasya* may be said to be cosmopolitan. Of the former, between two and three hundred species have been described, probably a third too many. Several of these are found in the Eastern and Western Hemispheres, as well as in parallel climates north and south of the line. *P. fastigiata* is a very constant parasite on *Fucus nodosus*, wherever that grows. *P. nigrescens*, under one or other of its forms, prevails along the Atlantic shores; and *P. urceolata* and *formosa* are equally spread abroad. *Dasya elegans*, so abundant from Long Island Sound to Florida, has an equally wide range in Southern Europe; and a closely allied species, *D. villosa*, abounds in Van Dieman's Land. It is remarkable that *D. coccinea* so common on the shores of Europe has not yet been found in America, and that the North American species most nearly related to it has been brought from Puget's Sound, on the Pacific coast.

SYNOPSIS OF THE NORTH AMERICAN GENERA.

* *Fronde flat, pinnatifid.*

- I. AMANSIA. Translucent, distinctly midribbed, membranaceous; the membrane formed of large, hexagonal cells, disposed in transverse rows.
- II. ODONTHALIA. Opaque, obsolete midribbed, thickish, composed of minute cells; those of the surface very minute, irregularly polygonal.
- ** *Fronde filiform, inarticulate; the surface cells minute, of irregular form, and irregularly placed (not in transverse lines). Ramuli similar to the rest of the frond in structure.*
- III. ALSIDIUM. Laxly cellular; the *ramuli* short, spinelike, transversely striate. *Stichidia* axillary, tufted, fusiform.
- IV. ACANTHOPHORA. Laxly cellular; the *ramuli* spinelike, opaque. *Stichidia* (formed in swollen *ramuli*) subglobose, thorny, sessile.

- V. CHONDRIA. Laxly cellular ; the *ramuli* clubshaped, much attenuated at their insertion. *Tetraspores* lodged in the *ramuli*.
- VI. RHODOMELA. Densely, cellular ; the *branches* and filiform *ramuli* opaque, not transversely striate. *Tetraspores* in the terminal, filiform *ramuli*.
- VII. RYTIPHLEÆA. Densely cellular with an articulated axis ; the *ramuli* (at least) transversely striate or subarticulate. *Tetraspores* in the terminal, fusiform *ramuli*.
- *** *Fronde* filiform, inarticulate, opaque. *Ramuli* articulate, longitudinally multistriate.
- VIII. DIGENIA. *Ramuli* subsimple, quadrifarious, densely imbricated.
- **** *Fronde* filiform, either partially or wholly articulate, or tessellated (i. e. the surface cells coequal, arranged in transverse rows.)
- IX. POLYSIPHONIA. *Fronde*, at least the younger parts, obviously articulate ; the articulations longitudinally two or many-striate.
- X. BOSTRYCHIA. *Fronde* tessellated with quadrate or oblong, purple cells.
- ***** *Fronde* filiform or compressed, inarticulate or subarticulate, beset with byssoid, single-tubed, articulate *ramelli*, which bear the fructification. *Stichidia* fusiform.
- XI. DASYA.

I. AMANSIA. Lamour.

Fronde flat, delicately membranaceous, transversely striate, rosy purple, pinnatifid, midribbed ; the membrane formed of oblong, hexagonal cells, of equal length, arranged in zones across the frond ; the midrib slender, disappearing towards the apices. *Conceptacles* subglobose, sessile, marginal, containing a tuft of pear-shaped spores. *Stichidia* marginal, branched, containing a single or double row of tetraspores. *Antheridia* ovate, stipitate, borne on and about the inrolled apices of the lacinulæ.

A small genus of tropical or sub-tropical Algæ, resembling *Delesseria* in habit, but readily known, even without fruit, by the structure of the frond, which under a pocket lens appears to be finely striate transversely, and with a glass of greater magnifying power is seen to be composed of hexagonal cells of equal size. The membrane is thin, composed of two strata of cells, with thin walls, containing rosy endochrome.

1. *AMANSIA multifida*, Lamour. ; stem vaguely branched, obsoletely winged, bearing numerous, irregularly placed, ovate, deeply bi-tri-pinnatifid fronds, prolific from the midrib ; lacinix linear, with a very slender nerve ; lacinulæ broadly subulate, their apices strongly inrolled. *Lamour. Bull. Phil.* 1809. t. 6. *Ag. Sp. Alg.* 1. p. 192. *J. Ag. in Linnæa.* XV. p. 26. *Odonthalia multifida*, Endl. 3d. *Suppl.* p. 47. *Epineuron multifidum*, Kütz. *Sp. Alg.* p. 848.

HAB. Abundantly cast up at Key West, *W. H. H. &c.* (v. v.)

Tufts much branched. *Stems* three to four inches long, cartilaginous, naked or winged with the remains of a membranous lamina, throwing out numerous, irregularly placed, leaf-like, secondary fronds, which are sometimes distant, sometimes densely crowded, when the plant becomes an intricate, globose mass of fronds. These secondary fronds are ovate or ovato-lanceolate in outline, either pinnatifid, bipinnatifid or tripinnatifid, delicately membranaceous, their main rachis traversed by a strong cartilaginous midrib, which gradually becomes thinner and fainter upwards ; their pinnæ and pinnules marked by a very fine, depressed central line. The midribs of the larger branches are frequently prolific. The apices of all the pinnulæ are strongly rolled inwards. I have not seen fruit of either kind ; but what appear to be *antheridia* are very common (in February) crowding around the tips of all the lacinix, the usual position in Algæ of this order : they are pedicellate, ovate, filled with minute grains. *Colour* a purplish pink, becoming browner in drying, and soon fading in fresh water. The substance is rather rigidly membranaceous, and in drying the plant does not adhere to paper.

Endlicher has strangely misunderstood the affinities of this plant, by placing it in *Odonthalia*, a genus with a very different structure.

II. ODONTHALIA. *Lyngb.*

Fronde flat or nearly so, thickish, subopaque, distichously pinnatifid, obsoletely midribbed, the margin alternately toothed. *Structure* densely cellular ; the surface cells very minute, polygonal, irregular in size and form. *Conceptacles* marginal, mostly axillary, pedicellate, ovate, wide-mouthed, containing a tuft of pear-shaped spores. *Stichidia* marginal, mostly axillary, stipitate, corymbose, lanceolate, containing a double row of tetraspores.

This group, separated from *Rhodomela* by Lyngbye, has been generally received by botanists, and by all but Endlicher, with nearly the same limitation. It differs from *Rhodomela* in the nearly flattened, two-edged, broadly linear frond, the middle portion of which is thickened into a more or less evident costa ; and in the position of the fructification in axillary processes. The species have all been found in the

Northern Ocean, our American one being common to the north of Europe, and the other known species to the north-eastern shores of Asia.

1. *Odonthalia dentata*, Lyngb.; decompoundly pinnate; branches oblong, deeply pinnatifid or bipinnatifid; laciniaë alternate, linear, sharply inciso-dentate toward their truncated extremities; conceptacles and stichidia both clustered, axillary. *Harv. Phyc. Brit. t. 34 (colour incorrect)*. *Kütz. Sp. Alg. p. 846*. *Fucus dentatus*, *Linn. Turn. Hist. t. 13. E. Bot. t. 1241*.

HAB. On rocks and stones in deep water. "Shores of America," *Gmelin*. Dredged in Halifax Harbour, *W. H. H.* Arctic Coast, *Mr. Seeman*. (v. v.)

*Fronde*s 3-12 (in the Halifax specimens 4-5) inches long, decompoundly pinnatifid, the main divisions irregular, the secondary and subsequent regularly alternated, and erecto-patent. The main branches are evidently ribbed towards the base, where the marginal wing is narrow and frequently defective, and become less obviously ribbed, broader, flatter and thinner upwards. The secondary branches have an oblong or lanceolate or sometimes a flabelliform outline and are alternately pinnatifid; the lowest laciniaë short, broadly subulate, tooth-like, the upper gradually larger and alternately inciso-dentate or again pinnatifid. In the specimens with flabelliform branches the upper laciniaë are proportionably much longer and more compound, all their divisions spreading. *Axils* very obtuse. *Apices* acute. The internal structure is dense, the substance composed of innumerable small, polygonal cells, closely packed together; those of the surface exceedingly minute. *Fruit* (which I have not seen on American specimens) borne on little marginal processes either in or near the axils of the laciniaë; both conceptacles and stichidia tufted. *Colour*, when growing, a clear, full, blood-red, becoming darker and changing either to vinous purple or to brown red; when dried the tips sometimes assume a pinky tint.

The American specimens are smaller and narrower than the generality of those of British growth, but I can find no distinctive character, and have seen some from Orkney equally narrow. The *O. angustifolia*, Suhr, judging from a specimen in Herb. T. C. D., is a different species, seemingly the same as *O. Kamtchatica*, Rupr. The colour of the plate given in *Phycologia Britannica*, copied from a dried specimen, is very incorrect; when growing, this plant is of a clear, translucent red.

III. ALSIDIUM, Ag.

Frond filiform or compressed, cartilaginous, pinnately or irregularly decompound, opaque, coated with small polygonal, irregularly placed cells; *axis*

articulated, polysiphonous. *Ramuli* alternate, subulate, acute, transversely striate. *Conceptacles* inflated, solitary, with contracted and produced apertures, containing within a membranous pericarp a tuft of pear-shaped spores on simple funiculi, radiating from a basal placenta. *Tetraspores* tripartite, lodged in axillary, tufted, lanceolate receptacles (*stichidia*), irregularly seriated.

As revised by J. Agardh (Linnæa, vol. XV. p. 28.), this genus is nearly related to *Acanthophora* on the one hand, and to *Rhodomela* on the other. The species are all from the warmer parts of the ocean. I have seen only the *conceptacles* of *A. Seaforthii* and *A. Blodgettii*; and only the *stichidia* of *A. triangulare*.

1. *ALSIDIUM triangulare*, J. Ag.; frond triquetrous, between dichotomous and pinnate, much branched; branches alternate or secund, closely set throughout with minute, trifarious, bifid, trifid or multifid ramuli; *stichidia* axillary, tufted. *J. Ag. in Linnæa XV. p. 28.* *Bryothamnion triangulare*, Kütz. *Sp. Alg. p. 842.* *Physcophora triangularis*, Kütz. *Phyc. Gen. p. 434. t. 57. fig. 1.* *Thamnophora triangularis*, *Ag. Syst. Alg. p. 240.* (TAB. XIII. A.)

HAB. Abundantly thrown up at Key West. (A common West Indian species). (v. v.)

*Fron*d 6-12 inches long or more, excessively branched. *Stem* cartilaginous, cylindrical below, where it is frequently two lines in diameter, gradually becoming narrower and more compressed upwards, forking repeatedly and then irregularly divided. *Branches* scattered, triangular, with a flabelliform outline, much divided; the lesser branches alternate or secund, having shorter branchlets toward the apices. All the younger parts of the frond are set, at distances of a line or two, with minute, trifarious, mostly three pronged ramuli, not a line in length: these, as well as the younger part of the branches, appear transversely striate when examined with a pocket lens. *Conceptacles* I have not seen. *Stichidia* densely tufted in the axils of the trifid ramuli, distorted, more or less fusiform, tapering to a point, each containing three or four large tetraspores in an imperfect line. A cross section of the frond shows a small axial cell surrounded by eight *primary* cells (or *siphons*), outside which are several rows of irregularly polygonal cells, which diminish in size to the circumference. The surface cellules are very minute, so that the branches appear opaque and inarticulate. *Colour* when fresh a clear purplish pink, soon fading in the sun, and becoming reddish brown in the herbarium. *Substance* cartilaginous, very tough, and not in the least adhering to paper in drying.

PLATE XIII. A.—*Fig. 1.* A small plant of *ALSIDIUM triangulare*; the natural size. *Fig. 2,* apex of a branch with three-pronged ramuli; *fig. 3,* tuft of *stichidia* containing tetraspores, removed from the axil of a ramulus; *fig. 4,* a transverse section of the frond;—the latter figures more or less highly magnified.

2. *ALSIDIUM Blodgettii*, Harv.; frond sub-compressed below, terete above, decompound pinnate; pinnae alternate, patent, close, virgate, the lowest very long, set with short, setaceous, spinous-toothed, alternate, distichous ramuli; upper branches short and sub-simple; conceptacles pedicellate, inflated, urceolate, variously placed on the ramuli. (TAB. XV. B.)

HAB. At Key West, *Dr. Blodgett*, (No. 73.) St. Marks, Florida, *Mr. Hooper*. Apalachicola, *Capt. Pike* (v. s. in Herb. T. C. D.).

Frond of unknown length, probably a foot or more. *Branches* pinnate or bipinnate; the lowermost pinnae long, simple or again pinnate; the upper much shorter or altogether abortive, so that the apices of the branches project, like long tails, beyond the bushy part of the frond. All the divisions are very patent, the primary and secondary ones almost horizontal. The secondary (or pinnae) are distichous, about two lines apart, and are from two to three inches in length, about the thickness of hog's bristle, gradually tapering to a point. Near the base they are generally bare of ramuli, or are merely toothed, but for the greater portion of their length are set with distichous bristle-shaped ramuli, a line apart and two or three lines long. These ramuli are regularly spinoso-dentate. The *conceptacles*, which are abundant on some of my specimens, are as large as poppy-seed, inflated, thin walled, with a prominent, contracted orifice, and contain a very large tuft of pear-shaped spores. They are placed either just above the axils of the ramuli, or at their apex, or along their margin, and appear to be formed by a metamorphosis of the spinous teeth which regularly alternate, in distichous order, along all the branches and ramuli. A cross section of the stem shews a central cavity surrounded by five primary cells, outside which several large cells are interposed between the primaries and the peripheric cells. The *colour* appears to have been a clear, full red, fading to yellowish on exposure. The substance is cartilaginous, but somewhat tender, and the plant, in drying, adheres pretty strongly to paper.

For a knowledge of this very interesting plant, I am indebted to my friend Dr. Blodgett of Key West, whose name I have therefore bestowed upon it. At the time the figure and description were made, I had seen but a single specimen; but have since received numerous and beautiful specimens from Dr. Blodgett, in all important respects agreeing with that first found. Captain Pike and Mr. Hooper have communicated, from the mainland of Florida, less perfectly preserved specimens; which, notwithstanding some minor differences, I refer without hesitation to this species. I think it can hardly be doubted to belong to the same natural genus as *A. Seaforthii*, though abundantly distinct from that species.

Plate XV. B. *Fig. 1.* A branch of *ALSIDIUM Blodgettii*, the *natural size*. *Fig. 2.* apex of a branch, with toothed ramuli and conceptacles; *fig. 3.* a conceptacle and ramulus removed; *fig. 4.* spores from the conceptacle; *fig. 5.* transverse section of the stem; the latter figures more or less highly *magnified*.

IV. ACANTHOPHORA. *Lamour.*

Fronde filiform, cartilaginous, irregularly decomposed, opaque, coated with small, polygonal, irregularly placed cellules; *axis* articulated, polysiphonous. *Ramuli* densely crowded on all sides of the branches, short, spinelike, acute. *Conceptacles* urnshaped, perforate, borne on the ramuli, containing within a cellular pericarp a tuft of pear-shaped spores on simple funiculi radiating from a basal placenta. *Tetraspores* tripartite, lodged in globose receptacles (*stichidia*) formed in swollen ramuli.

A small genus composed of a few tropical or subtropical species, the distinctive characters of which are not well defined. They become very dark, often nearly black, in drying, and are readily known by their spinelike ramuli. The natural habit is nearly the same as in *Alsidium*, but the stichidia have a different origin, being here formed out of the very substance of the ordinary ramuli, and not a special axillary growth.

1. ACANTHOPHORA *Thierii*, Lamour.; irregularly pinnate or bi-pinnate, or not much branched; branches long, subsimple, tapering, beset throughout with quaquaversal, subulate ramuli, which are densely clothed with simple or trifid spines. *Lam. Ess. p. 44. Kütz. Sp. Alg. p. 858. Fucus acanthophorus, Lamour. Diss. t. 30 & 31. f. 1. Turn. Hist. t. 32. A. militaris, Lam. A. muscoides, Grev. (TAB. XIV. A.)*

HAB. "Shores of North America," *Lamouroux*. Key West, *W.H.H.* (No. 4). Key West and Conch Key, *Prof. M. Tuomey* (41, 42, 43). (v. v.)

Fronde 3-6 inches long, half a line in diameter, alternately or irregularly branched; branches sometimes closely placed, sometimes distant, erecto-patent, long, little divided, flexuous, sometimes having a few secondary branches above, beset throughout at distances of a line apart with quaquaversal, very patent, short ramuli. *Ramuli* one or two lines long, densely bristled with short, simple or trifid, broadly subulate, patent or reflexed spines. *Conceptacles* urn-shaped, with a contracted orifice, seated on the sides or tip of the ramulus, and formed out of one of its spines. A cross section of the frond shows five large primary cells surrounding a small central cavity, and a wide border of smaller irregularly angular cells, gradually diminishing in size towards the periphery, which is formed of very minute cells. No outward appearance of articulation, or transverse striæ. *Colour*, a dark, lurid purple, becoming brown or even black in drying. *Substance* cartilaginous, firm. By pressure the plant may be made to adhere partially to paper in drying.

I regret that I had not noticed the conceptacles, which I find on one of Prof. Tuomey's specimens, in time to introduce a figure of them into the plate.

My specimens agree very fairly with the figure and description of *Lamouroux*

quoted above, except that Lamouroux represents the spiniferous ramuli shorter than I find them. He received the plant on which he founds his species from "North America," but was uninformed of the exact locality where it was gathered. I have little hesitation, therefore, in adopting his specific name. Nor do I hesitate to refer the *A. muscoides*, Grev., typified by Turner's plate 32, nor the *A. militaris*, Lamour., to the same species; for though my specimens from Key West are much less copiously branched than the figures given by the authors just named, yet I find such a series of connecting links in numerous specimens from St. Croix, which I owe to Miss Dix, and specimens from Chili collected by Baron de Selding, that I cannot point out any valid difference. Some are scarcely branched, others closely pinnate or bi-pinnate, and both forms sometimes occur in the same tuft. I am not alone in this opinion, doubts of the validity of *A. muscoides* being held by Dr. Montagne, (*Nat. Hist. Cuba*, p. 43,) who has kindly sent me a specimen of his plant, and it closely agrees with some of my Key West specimens.

PLATE XIV. A. *Fig. 1*, Frond of *ACANTHOPHORA Thierii*; the natural size. *Fig. 2*, a spiniferous ramulus; *fig. 3*, cross section of the stem; the latter figures more or less magnified.

2. *ACANTHOPHORA Delilei*, Lamour.; much branched and bushy, decomposidly pinnate or irregularly divided; branches beset with long and short, sub-spiniferous ramuli, and with solitary, distant, short spines. *Lamour. Ess. p. 44*; *Kütz. Sp. Alg.*, 858; *Phyc. Gen. t. 52, f. 4*; *Fucus naiadiformis*, *Delile, Egypt. t. 56, f. 1*.

HAB. At Sand Key and Key West, *W. H. H.* (No. 3.) (v. v.)

*Fronde*s in large tufts, 4—6 inches long, one-third of a line in diameter, excessively branched from the base. *Branches* alternate or secund, rarely opposite, spreading, simple below, beset with secondary branches above. These secondary branches are often again pinnate or bipinnate with lesser ramuli of unequal lengths. *Ramuli* either naked, or having a few distant, horizontal spines, or regularly beset with alternate spines. The larger branches also are furnished with scattered, simple, solitary spines. *Substance* cartilaginous. *Colour* dull purple, or brownish, becoming very dark when dry, in which state the plant imperfectly adheres to paper.

This is a more slender and much more diffusely branched plant than the preceding, from which it is technically distinguished chiefly by the scattered solitary spines, found on all the branches in greater or less plenty. Our specimens agree in most respects with specimens from the Mediterranean, but I am not without doubts, whether the differences indicated between this plant and *A. Thierii* are valid.

V. CHONDRIA. *J. Ag. ref.*

Fronds filiform, cartilaginous, pinnately decomposed, opaque, coated with small polygonal, irregularly placed cells. *Axis* articulated, polysiphonous. *Ramuli* club-shaped, very much constricted at their insertion, obtuse or sub-acute, transversely striolate. *Conceptacles* ovate, perforate, sessile or pedicellate on the ramuli, containing, within a cellular pericarp, a tuft of pear-shaped spores on simple funiculi radiating from a basal placenta. *Tetraspores* tripartite, crowded irregularly in the club-shaped ramuli, formed from the endochrome of the radiant cells.

Fronde of a cartilaginous or subgelatinous substance, soon decomposing in fresh water, and generally closely adhering to paper in drying, filiform, more or less regularly pinnately decomposed, but not strictly distichous. *Branches*, and their subsequent decompositions, simple, virgate, attenuated at the base and apex, set with more or less abundant lateral, scattered, spirally inserted simple ramuli, which are always very much constricted at the base, and either abruptly truncate or attenuate at the apex. The surface of the frond is composed of small irregular oblong cells, through which the internal articulated axis is rarely visible, except in the ultimate ramuli of some species. This *axis* is formed of four or five large oblong cells of equal length, disposed in a radiant manner round a central cell. Some species are rosy purple, staining fresh water carmine; others in steeping give out a brown fluid of offensive odour, and stain paper a fulvous brown; others are dark purple, or tinged with green. *Conceptacles* generally on the sides of the ramuli, mostly ovate and sessile. *Tetraspores* lodged within the axial cells of the ramuli, one or more in each cell, large, irregularly crowded near the extremities.

A large genus, the species of which until recently have been arranged among the *Laurenciæ*, from which position Prof. J. Agardh has very properly separated them. Their agreement with *Laurencia* (typified by *L. pinnatifida* and its allies) is more in external habit than in structural character. They differ especially in the articulated polysiphonous axis, a character by which they are associated with the *Rhodomelaceæ*. Besides the North American species described below, I possess some imperfect specimens from Key West, which I have not been able to refer to their proper place; and probably other new species may remain to reward a diligent search on the shores of the Southern States.

1. CHONDRIA *sedifolia*; frond alternately much branched; branches patent, decomposed, beset with short, spindle-shaped, scattered or tufted ramuli much contracted at the base, and sub-acute or obtuse at the apex; conceptacles ovate, sessile on the ramuli. (TAB. XVIII. G.)

HAB. Key West, Mr. Binney, W. H. H., Dr. Blodgett, (33, 34, &c.) Prof. Tuomey, (45, 52, &c.) (v. v.)

Fronde 4-6 inches long, as thick as sparrow's quill, much branched, either with a leading stem pinnated or bipinnated with lateral, closely set, patent branches; or alternately or irregularly multifid, the branches straight or curved, spreading in all directions. *Branches* once or twice compound, sometimes nearly naked, but oftener densely clothed with ramuli about a line in length, and very much constricted at the base, acute or obtuse at the apex. *Conceptacles* ovate, wide-mouthed, sessile on the ramuli. *Tetraspores* in the ramuli of distinct plants. *Colour* a dark reddish-brown, fading to yellow. *Substance* cartilaginous, less apt to decompose, than others of the genus. In drying it adheres to paper.

Perhaps only a variety of *Ch. dasyphylla*, but the habit is very peculiar.

Plate XVIII. G. *Fig.* 1. Branch of *CHONDRIA sedifolia*, the natural size. *Fig.* 2, small portion, with ramuli and conceptacles, magnified.

2. *CHONDRIA dasyphylla*, Ag.; frond robust, elongate, alternately much branched; branches simple or decomposed, beset with short, clubshaped or topshaped, blunt ramuli, much constricted at the base. *Ag. syst. Alg. p.* 205. *Laurencia dasyphylla*, Grev.—*Harv. Phyc. Brit. t.* 152. *Kütz. Sp. Alg. p.* 853. *Fucus dasyphyllus*, Turn. *Hist. t.* 22. *E. Bot. t.* 847.

HAB. On Algæ, &c. between tide marks. Annual. Newport, Mr. Olney. Peconic Bay, Prof. Bailey, and W. H. H. Key West, W. H. H., Dr. Blodgett, (23, 24) (v. v.)

Fronde tufted, 6-12 inches long, as thick as a crow quill, cylindrical, not much attenuated upwards. *Stem* rarely parted towards the base into several branches, generally undivided, set with lateral branches which are either simple or furnished with a second or third series. *Ramuli* a quarter to half an inch long, blunt, much constricted at the base. *Colour* a purple brown, becoming duller in drying. The substance of the growing plant is firm and cartilaginous, but soon becomes flaccid in the air, and if left a short time in fresh water the ramuli fall off and the frond rapidly decomposes, tinging the water dark brown. It closely adheres to paper in drying.

The North American specimens are a little different from the common European form, most of the ramuli, though blunt, being rounded, not truncate at the top. In one of my Greenport specimens, however, I find the ramuli as abruptly truncate as in the normal condition of the species.

3. *CHONDRIA Baileyana*, Mont.; frond setaceous, much branched below; branches long and virgate, erect, subsimple, beset throughout with scattered, simple or pinnated, slender, curved ramuli which are greatly attenuated to the base and obtuse at the apex; conceptacles pedicellate, on the ramuli. *Laurencia Baileyana*, Mont. in *An. sc. nat.* 3rd Ser. Vol. 2, p. 63. (TAB. XVIII. A.) var. β . with a leading stem closely pinnated with lateral branches.

HAB. On Algæ, &c. near low water mark. Annual. A common plant in Long Island Sound. Newport, *Prof. Bailey*. New Bedford, *Dr. Roche*. Little Compton, &c. *Mr. Olney*. Seaconnot, *Mr. Congdon*. New York Harbour, *Prof. Bailey*, *Mr. Hooper*, and *Mr. Calverley*, &c. (v. v.)

*Fronde*s densely tufted, 6-8 inches long, as thick as hog's bristle, generally with a short stem soon dividing into several long, rodlike branches. *Branches* erect, 4-5 inches long, simple or once or twice compound, set at short intervals with slender ramuli, which at first are simple, and afterwards pinnulated or even bipinnulated with similar smaller ramuli. The ramuli spread to every side and are very generally curved, from a quarter to half an inch long, much attenuated to the base, somewhat narrowed upwards, but ending in a blunted, roundish point. The *conceptacles* are ovate, on little stalks rising from the sides of the ramuli; and the *tetraspores* are generally confined to the apices. *Colour*, when growing in deep water, a fine brownish purple. In fresh water it soon gives out a rose-coloured fluid which stains the paper on which the specimen is displayed, and to which it closely adheres in drying. *Substance* soft and tender.

This plant varies very much in ramification. The specimens described by Dr. Montagne appear to have been but little branched, the branches springing near the base. I have seen such, but they do not convey an adequate idea of the ordinary form, which is usually much more decomposed. Some specimens have a leading stem closely pinnated with branches; and in others the branches are bipinnate with very densely set, plumose ramuli. As a species it is almost exactly intermediate between *Ch. dasyphylla* and *Ch. tenuissima*, having the slender habit of the latter, and ramuli almost as blunt as in the former, though much more attenuated.

Plate XVIII. A. *Fig. 1.* CHONDRIA *Baileyana*, the natural size. *Fig. 2.* portion of a branch, with ramuli and *tetrasporic* fruit; *fig. 3.* apex with tetraspores; *fig. 4.* a tetraspore; *fig. 5.* ramulus with conceptacles; *fig. 6.* a conceptacle; all more or less highly magnified.

4. CHONDRIA *tenuissima*, Ag.; frond slender, terete, irregularly divided; branches long and virgate, clothed with very slender, setaceous ramuli, which taper much to the base and the acute apex. *Ag. Syst. Alg. p. 205.* *Laurencia tenuissima*, Grev.—*Harv. Phyc. Brit. t. 198.* *Alsidium tenuissimum*, Kütz. *Sp. Alg. p. 843.* *Fucus tenuissimus*, Turn. *Hist. t. 100.* *E. Bot. t. 1882.* (TAB. XVIII. F.)

HAB. Boston Bay, and New Haven, *Dr. Durkee*. Hell Gate, New York, *Mr. Hooper*, (v. v.)

*Fronde*s 4-6 inches long, about twice as thick as hog's bristle, with an undivided stem set with lateral, mostly alternate spreading branches. *Branches* simple or pinnated with a second series of similar branches, and furnished throughout with

more or less abundant setaceous ramuli from a quarter to half an inch in length and mostly simple. *Ramuli* very narrow, fusiform, tapering much to the base and to the acute apex. *Conceptacles* ovate, on the ramuli, mostly pedicellate. I have not seen tetraspores on American specimens. *Substance* cartilaginous, tender. In drying the plant adheres to paper.

Apparently rare on the American coast. The few specimens which I have seen have the essential characters of the European form, but are less luxuriant.

Plate XVIII. F. Fig. 1, branch of *CHONDRIA tenuissima*; the natural size. Fig. 2, small portion with ramuli, *magnified*.

5. *CHONDRIA littoralis*; frond robust, elongate, subdichotomous or irregularly much branched; branches flexuous, attenuated, with rounded axils; ramuli scattered or crowded, fusiform, attenuated to the base and apex, simple or pinnulated, acute. Var. β . ramuli very densely crowded, pinnate and bi-pinnate; conceptacles ovate, sessile, near the tips of the ramuli.

HAB. On the Florida Keys. Abundant at Key West, near high-water mark. *W. H. H., Prof. Tuomey, (58, 59, &c.) (v. v.)*

Tufts very large and dense, often spreading over a considerable space. *Fronde* twelve inches long or more, as thick as crow's quill or somewhat thicker below, attenuated upwards, much and very irregularly branched; the main stem once, twice or many times forked, the arms spreading widely. Sometimes two, sometimes three branches spring from each fork. *Branches* of unequal length, erect, flexuous, tapering to the apex, either nearly naked or more or less abundantly furnished with slender ramuli. The older parts are generally denuded, but in var. β . all the branches are densely beset with pinnato-multifid ramuli. *Ramuli* a quarter to half an inch long, lineari-fusiform, much attenuated at the base, curved, tapering to an acute or subacute point. *Conceptacles* ovate, sessile. *Colour* a pale yellowish fawn, with a reddish tinge. *Substance* cartilaginous, soon decomposing in fresh water. In drying it stains the paper brownish yellow.

In mere technical character this approaches *Ch. tenuissima*, but is a much larger, coarser and less regularly branched species. It abounds along the shore at Key West, after growing quite up to high water limit. It is one of the least ornamental of the genus.

6. *CHONDRIA atropurpurea*; frond robust, dark coloured, inordinately much branched; branches patent, the secondary ones, as well as the scattered ramuli tapering to the base and attenuated to an acute point; conceptacles unknown. (TAB. XVIII. E.)

HAB. Sullivan's Island, Charleston, *Prof. L. R. Gibbes, W. H. H. Apalachicola, Mr. Hooper, (97.) (v. v.)*

Fronde tufted, in our specimens about four inches high, but the full grown plant is probably much taller, as thick as sparrow's quill or somewhat thicker, irregularly branched, the branches alternate or unilateral, spreading at wide angles or nearly at right angles to the point from which they spring, curving upwards and bearing several irregularly placed, erect, secondary branches. These latter are narrow-fusiform, one or two inches long, much constricted at the base, and tapering to an acute point. They are sometimes naked, but more commonly set with small ramuli of similar shape and one to three lines in length. The colour is a dark, blackish purple. The substance is firmly cartilaginous, and in drying the plant adheres to paper.

Our specimens, gathered early in January, are evidently immature, and therefore this species must remain somewhat doubtfully characterised. I think it however essentially different from any of those described in this memoir. Its nearest affinity seems to be with *Ch. capensis* (*Harv. Ner. Austr. t. 31.*) but in the absence of more certain evidence, it would be premature to unite them. I find among Dr. Coulter's Californian plants a *Chondria* which agrees in most respects with our Charleston specimens, and may belong to the same species. But I am unwilling to confuse the subject by quoting it under this species, or unnecessarily to add to the number of species by describing it as different. I hope Prof. L. R. Gibbes, by visiting the above locality a month or two later in the season, may succeed in finding more complete specimens than we have yet procured. Among Dr. Blodgett's Key West specimens are two, (No. 27 and 29) possibly referable to our *Ch. atropurpurea*, but, for the reason just given, I forbear quoting them under it. One has large, ovate, stalked conceptacles; the other tetraspores in the ramuli.

Plate XVIII. E. Fig. 1. Branch of *CHONDRIA atropurpurea*, the natural size. Fig. 2, small portion with ramuli, slightly *magnified*. Fig. 3. longitudinal section of the stem, more highly *magnified*.

V. RHODOMELA. Ag.

Fronde filiform or subcompressed, cartilaginous, decomposed-pinnate, opaque, densely cellular within, coated with minute, polygonal, irregularly placed cells; *axis* articulate, polysiphonous. *Ramuli* filiform. *Conceptacles* ovate, pedicellate or sessile, containing within a membranous pericarp a tuft of pear-shaped spores on simple funiculi radiating from a basal placenta. *Tetraspores* immersed in the swollen, ultimate divisions of the branches, rarely in proper stichidia.

The species included in this group are natives of the cooler portion of the temperate zone, both of the northern and southern hemispheres. They are naturally

associated together by a common habit, but it is not easy to point out a clear generic character which will separate them from *Rytiphlaea* and from the more opaque species of *Polysiphonia*, from which genera they chiefly differ in their denser cellular substance and the absence of all appearance of articulation in any part, even the youngest, of the frond. In a young state, or when the frond is in active extension, the apices of the branches are clothed with dichotomous fibrils, resembling in structure, and no doubt analogous to, the ramelli of *Dasya*; but these fibrils are fugacious, as in *Polysiphonia*, &c.

Of the North American species, three belong to the Pacific, and three to the Atlantic Coast.

1. RHODOMELA *Larix*, Ag.; frond robust, terete, alternately branched; branches long, subsimple, densely clothed with quaquaversal, tufted, inflexed, subulate ramuli; stichidia attenuate, among the clustered ramuli. *Ag. sp. Alg.* 1, p. 376. *Lophura Larix*, Kütz. *Sp. Alg.* p. 850. *Fucus Larix*, Turn. *Hist. tab.* 207.

HAB. Pacific Coast from the shores of the Arctic Sea (*Seeman*) to Monterey, abundantly. *Coulter! Tolmie! Wilkes! Garry! &c.* Discovered at Nootka Sound by *A. Menzies, Esq.* (v. s. in Herb. T. C. D.)

Frond 6-14 inches long or more, terete, the thickness of a crowquill, undivided to the height of two or three inches, thence upwards much branched. *Branches* alternate, 4-6 inches long, simple, or bearing in the upper half several secondary branches, and, occasionally, in luxuriant specimens, a third set. The lower part of the stem is commonly bare, or clothed with the broken stumps of old branches, but all the younger parts of the frond are densely covered on all sides with spirally disposed tufts of short, inflexed, subulate ramuli, two or three lines in length. These ramuli spring from very short or abortive lateral branchlets on which they are inserted one above the other, but so near together as to appear fascicled. Sometimes the axis of the fascicle is a little lengthened and then the ramuli appear scattered, but are still very closely placed. Judging from dried specimens the ramuli are laterally compressed, shaped like the blade of a knife. The false *stichidia* are formed from the inner or upper ramuli of the fascicles, and are generally found on such specimens as have the axis of the fascicles a little lengthened. They are more slender than ordinary ramuli, and of greater length, but scarcely less opaque: the *tetraspores* are small. *Conceptacles* ovate, crowding at the base of the tufted ramuli, being formed from the inner ones of the fascicles. *Substance* coarse, between coriaceous and cartilaginous. In drying the plant becomes almost black, and does not adhere to paper.

2. RHODOMELA *floccosa*, Ag.; stem filiform below, compressed above, alternately branched; branches spreading, subsimple, pinnated throughout with short, alternate, distichous, fasciculato-multifid, compressed ramuli; stichidia lanceolate, formed

from the ramuli ; conceptacles ovate, terminal. *Ag. Sp. Alg.* 1, p. 376. *Lophura floccosa*, *Kütz. Sp. Alg.* p. 850. *Fucus floccosus*, *Turn. t.* 8, *Esper t.* 100.

HAB. Pacific coast at Port Trinidad, lat. 41° 12', *Mr. Menzies*. Sitcha, *Ruprecht* ! Nootka Sound, *Barclay* ! Monterey, *Dr. Coulter*. Off the west coast, lat. 32°, *Lieut. Wood*, H.M.S. "Pandora." (v. s. in herb. T. C. D.)

*Fron*d 5–10 inches long, filiform below, soon compressed and becoming more compressed toward the extremity, twice as thick as hogs' bristle, with a leading stem which is once or twice pinnated in its upper half with lateral, alternate, erectopatent branches. *Branches* distichous, subsimple, sometimes with a second series from their upper half, regularly beset throughout with alternate, distichous, multifid branchlets, one or two lines in length. These branchlets are alternately decomposed, their lowest ramulus simple and subulate, those over it again and again compounded ; each ultimate division of the frond slender, subulate, acute, incurved. *Conceptacles* ovate, usually terminating the compound multifid branchlets, being formed from their last developed ramuli. *Stichidia* lanceolate, apiculate, formed of the inner or upper ramuli of the branchlet, and containing a double row of tetraspores. *Colour* in the dry state dark brown or black ; probably red brown when recent. *Substance* rigid. It does not adhere to paper in drying.

A smaller and slenderer plant than the preceding, with distichous ramification and a more developed axis to the multifid branchlets. It is closely related to *R. subfusca*, but the habit is peculiar, and the compression of the frond an obvious character.

3. RHODOMELA *pilulifera*, *Grev.* ; frond robust, cartilaginous, terete or compressed, decomposed ; branches distichous, alternate, distant, not much divided ; ramuli few, scattered, subulate, the lowest short and spinelike, the upper somewhat filiform ; conceptacles very large, globose, terminal or sessile near the ends of the branches. *Grev. Hist. Alg. Brit.* p. li. *Sphærococcus pilulifer. Ag. syst.* p. 236. *Fucus pilulifer* or *globulifer*, *Turn. Hist. t.* 236.

HAB. Nootka Sound, 1778, *A. Menzies, Esq.* (v. s. in Herb. Menzies.)

*Fron*d 6 inches long or more, twice or thrice as thick as hog's bristle, irregularly decomposed, but not much branched ; branches distant, alternately divided twice or thrice, the penultimate divisions somewhat virgate, either naked or with a few distant, short, spinelike, alternate, distichous ramuli below, and several larger and more filiform subulate ramuli in their upper half. Branches and ramuli compressed when dry, but becoming nearly terete when moistened. *Substance* very opaque and rigid. Structure as in *R. subfusca*. *Conceptacles* larger than poppy-seed, spherical, terminating the branches or sessile near the ends of the ramuli. *Colour* very dark.

Turner rightly refers this species to the neighbourhood of *R. subfusca*. Indeed, conceptacles apart, it is not easy to distinguish it from the battered, winter condi-

tion of that variable plant. Turner describes the frond much more compressed than I find it in the specimen preserved in Mr. Menzies' Herbarium. A cross section after expansion shows the branches to be nearly cylindrical.

4. *RHODOMELA subfusca*, Ag.; frond filiform, much branched; the branches irregularly divided, clothed with pinnated branchlets, and subulate, simple, scattered or subfasciculate ramuli; pinnules subulate, terete; conceptacles subsessile; tetraspores in the somewhat swollen, (but neither moniliform nor attenuated) terminal ramuli (in summer), or in proper branching stichidia issuing irregularly from old stems (in winter.) *Ag. Sp. Alg. vol. 1. p. 378.* *Harv. Phyc. Brit. t. 264.* *Lophura cymosa*, Kütz. *Sp. Alg. p. 850.*

HAB. On rocks and stones near low water mark. Halifax, *W. H. H.*; Boston, *Dr. Durkee!* Lynn, *Mrs. Estes!* Boar's Head, New Hampshire, *Capt. N. Pike!* Newport, Rhode Island, *Prof. J. W. Bailey!* Staten Island, New York. (v. v.)

Fronde tufted, 6-12 inches long, quarter to half a line in diameter at base, filiform, attenuated upwards, much branched and bushy. *Branches* alternate, distichous or subspirally inserted, the secondary ones decomposed, about bipinnate; tertiary branches furnished in the lower half with simple, alternate, sub-distant, subulate ramuli; above furnished with more compound, pinnulate or multifid ramuli, which are densely crowded about the ends of the branches. *Conceptacles* ovate, nearly sessile (not seen on American specimens). *Tetraspores* contained in the terminal, subulate or slightly fusiform, terminal ramuli, solitary or in pairs, not wider than the places where they occur. *Colour*, a dark, brownish red, becoming much darker in drying. *Substance* cartilaginous, somewhat rigid. In drying, the plant adheres, under pressure, to paper, but not with much force.

In winter the smaller branches fall away, leaving a few naked stems, and at that season tetraspores are frequently found in little, lateral, accessory stichidia, emitted without order by the broken branches. In spring, these denuded plants put forth a profusion of pinnato-multifid branches, being much more bushy than plants of the first season.

My Halifax specimens are very robust. The rest are of the ordinary form so common in Europe.

5. *RHODOMELA gracilis*, Kütz.; frond flaccid, ultra-setaceous below, soon divided and then excessively branched and bushy, decomposed pinnate; the branches setaceous below, capillary above, repeatedly divided alternately; penultimate ramuli distant, dichotomo-multifid above the middle, attenuate; conceptacles pedicellate, somewhat racemose; tetraspores in the attenuated, moniliform, terminal ramuli. *Lophura gracilis*, Kütz. *Sp. Alg. p. 850.* *Rhodomela subfusca (in part) Ag. l. c. supra.* *Lyngh. Hyd. Dan. t. 10. fig. B. C. Tab. XIII. C.*

HAB. Prince Edward's Island, *Dr. Jeans*. Halifax, *W. H. H.* Boston Harbour, *Mr. G. B. Emerson*. Plymouth, Massachusetts, *Prof. J. W. Bailey*. (v. v.)

Fronde from four to ten or twelve inches long, divided a little above the base into a multitude of slender stems, about twice the diameter of hog's bristle below, but soon attenuated and reduced to a hair-like fineness. *Stems* many times decompound in an alternate or secund order, spuriously dichotomous by the occasional suppression of a branch; the axils distant, rounded. Secondary *branches* long, and about bipinnate; the pinnæ distant, simple below, alternately or subdichotomously multifid beyond the middle. Ultimate *ramuli* capillary, very much attenuated, and tipped with a pencil of slender, dichotomous fibrils. Sometimes the ramuli are densely crowded at the ends of the branches, sometimes not so. *Conceptacles* broadly ovate, on short stalks, racemose along the terminal ramuli, very abundant on fertile plants. *Tetraspores* in pairs, immersed in the slender ultimate ramuli which then become beaded by the bulging out of the tetraspores, which are much broader than the places where they occur. *Colour* a brownish red, becoming dark brown in drying. *Substance* very soft and lubricous. In drying, this plant adheres closely to paper.

Allied to *R. subfusca*, with which Agardh unites it, but differing in being of very much softer substance, more bushy and decompound, and especially in the large size of the tetraspores, causing the beaded appearance of the fertile ramuli. I have very numerous specimens from Dr. Jeans, presenting several varieties. Some to the naked eye have the aspect of *Polysiphonia Brodiaei*, for which they may readily be mistaken without microscopic examination; others resemble *Pol. violacea* outwardly. All adhere with great closeness to paper, and must have been very lubricous when fresh.

PLATE XIII. C. *Fig. 1.* Upper portion of a dichotomo-multifid branchlet of RHODOMELA *gracilis* with tetrasporic fruit; *fig. 2,* moniliform apex of one of the ultimate ramuli of the same; *fig. 3,* a tetraspore; *fig. 4,* a conceptacle; *fig. 5,* transverse section of a branch; all the figures more or less *magnified*.

6. RHODOMELA *Rochei*; frond setaceous, flaccid, rosy red, terete, decompound, pinnate, distichous; lesser branches bipinnate; pinnæ naked below, pinnulate beyond the middle; pinnules fastigiate, bifid or multifid at the tips, and copiously fibrilliferous; conceptacles racemose, on longish stalks. (TAB. XIII. B.)

HAB. New Bedford, Massachusetts, *Dr. M. B. Roche and Mr. C. Congdon*. Yellow Hook, New York, *Mr. Walters and Mr. Hooper*. (v. s. in Herb. T.C.D.)

Fronde four to eight inches long, setaceous at base, attenuated upwards and at length capillary, divided from the base into many decompoundly pinnate branches or secondary stems. Lesser branches alternate or secund, distichous, patent, one to three inches long, bipinnate or tripinnate, oblong in outline, obtuse and fastigiate. *Pinnæ* naked for the lower half, pinnated above, the pinnulæ spreading and bifid,

trifid or multifid at the tips, so that the tips appear to the naked eye as if capitate, and dark coloured. At a later period, this character is lost by the lengthening out of the cloven tips into new ramuli. *Conceptacles* on longish stalks, abundant on the ultimate ramuli, converting them into racemes. *Tetraspores* unknown to me. Abundant dichotomous fibrils clothe the ends and sides of the ultimate ramuli. *Colour* a fine red, communicating a rosy tinge to the paper on which the plant has been dried, and to which it closely adheres. *Substance* flaccid.

I am disposed to keep this beautiful plant separate from *R. gracilis*, to which, in its soft substance and slender stems, it is most nearly allied. It differs in being still more slender, of a brighter colour, with more distichous habit. The pinnated branching is much more definite than in either *R. gracilis* or *R. subfusca*. The name is given in compliment to Dr. M. B. Roche of New Bedford, from whom I first received it, and to whom I am also indebted for many other beautiful specimens of Algæ.

VI. RYTIPHLÆA. Ag.

Fronde filiform or compressed, decomposed pinnate, transversely striate, areolated; the axis articulated, composed of a circle of large, tubular, elongated cells of equal length, surrounding a central cell; the periphery of one or more rows of small irregularly shaped cells. *Conceptacles* ovate, pedicellate or sessile, containing a tuft of pear-shaped spores on simple funiculi radiating from a basal placenta. *Tetraspores* contained in the terminal fusiform ramuli or in proper stichidia, in a single or double row.

The structure of the frond in this genus is very similar to that of the opaque and inarticulate portions of several *Polysiphonia*, in which the articulated axis, composed of symmetrical cells radiating round a central cavity, is coated externally with numerous rows of cells irregularly shaped and placed; of these the inner ones are large and often empty, the outer gradually smaller and more constantly containing bags of coloured matter. The difference between the genera is almost wholly technical, *Polysiphonia* having at least its younger portions destitute of the peripheric layer of cells, and *Rytiphlæa* having these parts coated, though less perfectly than the other portions. The transversely striate appearance of the *Rytiphlæa*, which is best seen with a common pocket lens, arises from the nodes of the enclosed articulated axis being visible through the coat of peripheric cells. Of course, this appearance is most obvious in the younger parts, where the cellular coat is less dense. The species of *Rytiphlæa* are few, and mostly tropical or sub-tropical.

1. *RYTIPHLEA?* *Baileyi*; frond compressed, areolated, irregularly branched; branches closely bipinnate; pinnæ alternate, nearly equal, patent; pinnulæ subulate, subarticulate, the lowermost simple, the upper ones sometimes cloven, all slightly inflexed.

HAB. Monterey Bay, California, *Prof. Bailey.* (v. s. in Herb. T.C.D.)

Frond compressed, inarticulate, two or three inches long, half a line in diameter, divided near the base into several branches, which are closely bi-tripinnate throughout. *Pinnæ* not two lines asunder, very patent, half an inch to an inch long, compressed, closely pinnulated with subulate slender ramuli, the lowermost of which are simple and subdistant, the upper frequently again compounded, being pinnulated with a third series of ramuli. *Ramuli* acute, transversely striate and subarticulate, with hexagonal cells of nearly equal length and breadth. *Antheridia* oblong, crowding round the tips of the ramuli. Stem and branches perfectly inarticulate, areolated with polygonal cells of irregular shape and size. *Colour*, when dry, a dark purplish brown. *Substance* rigid. It does not adhere to paper.

Allied to *R. complanata*, but the surface cells are of larger size, and the ramuli more evidently articulated. Indeed, except for the habit, which is that of a *Rytiphlea*, this plant might be placed in *Polysiphonia*.

VII. DIGENIA. *Ag.*

Frond filiform, rigidly horny, irregularly branched, inarticulate, densely cellular, the surface cells minute; branches densely clothed on all sides with rigid, hairlike, subsimple, articulated, longitudinally striate ramuli. *Conceptacles* (unknown). *Tetraspores* lodged in the swollen ramuli.

The single species for which this genus has been set apart, though common in the Mediterranean, the Red Sea, the Indian Ocean, and in the warmer parts of the Atlantic, is still imperfectly known, its conceptacular fruit having hitherto escaped notice. In assigning it a place among the *Rhodomeleæ*, the structure has alone guided us; the internal anatomy of the stem and branches being nearly similar to that of the same parts in *Rhodomela*; while the ramuli are formed something on the type of those of a *Polysiphonia*, or perhaps more nearly still on those of a *Bostrychia*. The longitudinal striæ of the internodes do not consist of a single elongated cell, as in *Polysiphonia*, but of a string of cells.

DIGENIA simplex, *Ag. Sp. Alg.* 1. p. 388. *Digenia Wulfeni*, *Kütz. Phyc. Gen. t.* 50. f. 2. *Sp. Alg.* p. 841. *Conferva simplex*. *Wulf. Fucus Lycopodium*, *Turn. Hist. t.* 199. (TAB. XIII. D.)

HAB. Abundant at Key West, *W. H. H. &c.* Key Biscayne, *Prof. Tuomey*, (No. 61. 62).

Fronde 4-8 inches long, as thick as crow's quill, irregularly dichotomous or alternately branched; the branches either simple or bearing near the summit a second series of lesser branches; sometimes very bushy. The lower parts of the stem are generally bare, but the upper half and all the branches are very densely clothed on all sides with shaggy, setaceous ramuli, from a quarter to half an inch in length. These ramuli are filiform, simple or slightly branched, articulate, the internodes about as long as broad, coated with small cells arranged in many longitudinal lines. A cross section of a ramulus shows a central tube with two or more series of radiating cells set round it. I have not found fruit on my specimens. *Colour* when quite fresh a dark brownish red, becoming brown in drying and dirty white after exposure to the sun. *Substance* very rigid and horny, tough. In drying, the plant does not in the least adhere to paper.

A very coarse, shaggy plant, apt to be infested with numerous vegetable and animal parasites, particularly corallines. It is very difficult to find specimens free from extraneous growth, or having the ramuli perfect. In our figure the parasites are omitted.

Plate XIII D. *Fig. 1.* *DIGENIA simplex*, the natural size. *Fig. 2.* Some ramelli, springing from a fragment of the stem; *fig. 3.* portion of a ramellus; the two latter figures more or less highly magnified.

VIII. POLYSIPHONIA. Grev.

Fronde filiform, rarely sub-compressed, articulate (at least the younger parts, the older having an articulate axis); internodes of the stem (or axis) composed of numerous, tubular, elongated cells of equal length, radiating round a central cell, and generally containing endochrome. *Conceptacles* ovate or urceolate, containing a tuft of pearshaped spores. *Tetraspores* imbedded in the distorted, ultimate ramuli.

An immense genus inhabiting all regions from the Polar basin to the equator; very variable in size and external habit—some species being two to three feet in

length, others not more than as many tenths of an inch ; some dichotomous, others pinnated—some distichous and fern-like, others with a bushy or arborescent character ; some of cobweb delicacy, lubricous and excessively flaccid, soon decomposing, others robust, rigid or tough, of strong enduring substance ;—some of a brilliant rosy red or crimson, others (and the greater number) varying through all the graver shades of red-brown, brown, and purple ; some inhabiting the deep sea, others occurring only near high water mark or far up the estuaries of tidal rivers. Plants of such varied aspect and habit could not have been brought together by the universal consent of botanists, among whom there has never been much difference of opinion respecting the just limits of this genus, if they had not some obvious bond of union in an essential, easily seen, and important common character. This is found in the structure of the stem in the articulated species, and of the axis of the stem in species which appear to be partially inarticulate ; the dissepiments being hid by the growth of a thin or thick layer of epidermal cells round the stem or branches. In such species, the proper structure of the genus may generally be seen, without dissection, in all the younger parts, as in the upper branches and ramuli. The species simplest in structure have the internodes or *articulations* of the stem and branches composed of four large cells containing endochrome or colouring matter, placed crosswise round a small, central, empty cavity, as shown in section at Pl. XVI. B. fig. 7. When viewed laterally, internodes of this structure may exhibit either two cells, or one cell and two half cells, appearing to the eye as three, the middle one twice the breadth of the others. Such stems are said to be four-tubed, or bi-tri-striate. In some species which are of this character small cells (*secondary* cells) are formed external to the four *primaries*, and alternating with them, as shown in Pl. XVII. A. fig. 6, and B. fig. 7 ; and in others, as at Pl. XVI. A. fig. 4, a thick epidermal layer of small cells surrounds the *primary* tubes, and such stems become apparently inarticulate, the *articulation* being concealed beneath the coat of small surface cells, as at fig. 5. By turning to the figures, the gradual complication of a stem of four primary tubes will be readily understood ; and the same occurs where there are more primaries than four, as at Pl. XVI. D. fig. 5, Pl. XVII. C. fig. 3, which latter figure shows the commencement of secondary tubes in a polysiphonous stem. The stem and branches of all the species are formed on one or other of these models, the number of primary tubes being sometimes as many as twenty-four.

In studying the species, it is absolutely necessary to make cross sections of the stem in order to be able to count the number of primary tubes in each internode ; for though the exact number is not of specific importance in the polysiphonous species, where we find the same species varying in different specimens from 12 to 20 tubes, yet it is essential to determine whether there be only four, or more than four ; and, generally speaking, the species with fewest tubes are most constant to their number. A little practice will enable the student to make the necessary sections with the help of a small-bladed knife and a botanical simple microscope, for which may be substituted a watchmaker's eyeglass. A small piece of a stem or branch, say a quarter of an inch long, is firmly held by the finger of the left hand upon a slip of glass under the lens, while thin slices, the thinner the better, are cut

from it. These wheel-like slices, floated in a drop of water, may then be placed under the compound microscope and examined. In slicing dried specimens, it is best to cut the stem, if possible, before it be moistened; as a thinner and cleaner cut can then be made, and the risk avoided of the too rapid decomposition from the fresh water. When the cells refuse to resume their proper shape on remoistening, a drop of muriatic acid will frequently, but not always, expand them.

Nearly 300 species of *Polysiphonia* are to be found described in various books,—Kützing has collated 248 in his latest work. Of these, perhaps one-third are false species, founded either on solitary or on insufficient specimens. The whole require a careful revision and examination of the original materials. As in all large genera, it will be found that some species are very constant to certain characters, while others are so variable that it is nearly impossible to limit them within a short specific phrase. Of this last character are many *Polysiphoniæ*, and the knot of difficulty has too often been cut by splitting such species into several, a practice which, once admitted, leads to continual dismemberment. I shall endeavour to avoid unnecessary division in defining the American species.

SUBGENUS 1. OLIGOSIPHONIA. Primary tubes, four only. (Sp. 1—17.)

* *Stem visibly articulate throughout, with pellucid dissepiments.* (Sp. 1—13.)

1. POLYSIPHONIA *urceolata*, Grev.; filaments rigid, setaceous, full-red, much branched, loosely bundled; branches subdichotomous, furnished with short, alternate, patent or recurved decompound ramuli; internodes four-tubed, those of the branches 3-5 times longer than broad, of the ramuli very short; conceptacles stalked, urn-shaped, with a projecting narrow orifice; tetraspores in the ultimate ramuli. *Grev. Fl. Edin. p. 309. Harv. Phyc. Brit. t. 167. Kütz. Sp. Alg. p. 824. β. patens*; with the lateral ramuli more numerous, strongly recurved, or revolute. *P. patens, Grev. Kütz. l. c. Conferva patens, Dillw. t. G.*

HAB. Arctic Sea Coast, *Dr. Sutherland!* Prince Edward's Island, *Dr. Jeans!* Halifax, *W. H. H. Longbranch, New Jersey, Miss Morris.* β. at Monterey, California, *Dr. Coulter!* (v. v.)

Tufts large, bushy and dense. *Fronde*s from 6 to 8 inches long, or more, twice the diameter of human hair, decompoundly branched, generally without a leading stem; the branches alternate or subdichotomous; lesser branches subdistant, alternate or unilateral, multifid. *Internodes* in the middle part of the filament 4-6 times as long as broad, in the branches 2-3 times, in the ramuli very short. *Tubes* 4, broad, with very narrow interspaces. *Conceptacles* urnshaped, with a prominent, contracted orifice, shortly stalked, scattered over the lesser branches and ramuli. *Tetraspores* wider than the places where they occur, immersed in the ramuli in a single row. *Colour* when growing a clear blood-red, becoming dark reddish brown or even black in the herbarium. *Substance* rather rigid, not lubricous. It does not adhere strongly to paper in drying.

β . has a more evident leading stem, with long, subsimple branches set with lateral, multifid, secondary branches about an inch in length, whose divisions are closer together than in the common form. The ramuli, especially the lower ones, are remarkably patent, squarrose, or even revolute. The conceptacles, abundant, on some of Dr. Coulter's specimens, are of the ordinary form, so characteristic of this species.

2. *POLYSIPHONIA formosa*, Suhr; filaments very flaccid, capillary, full red, much branched, branches subdichotomous, long, flexuous, furnished with scattered, spreading, alternate, attenuate, more or less compound ramuli; internodes four-tubed, those of the branches 5-10 times longer than broad, of the ramuli short; conceptacles stalked, urn-shaped, with a projecting, narrow orifice; tetraspores in the ultimate ramuli. *Suhr, Bot. Zeit.* 1831. p. 709. *Harv. Phyc. Brit. t.* 168. *Pol. Hooperi*, *Bailey MSS. Conferva stricta ? Dillw. t.* 40.

HAB. Prince Edward's Island, *Dr. Jeans!* Boston Bay, *Miss E. H. Brewer!* *Dr. Durkee!* New Bedford, *Dr. Roche!* Fort Hamilton and other spots in New York Bay, *Messrs. Walters!* *Hooper!* *Pike!* *Congdon!* *Calverley!* &c. (v. v.)

Tufts dense, very flaccid. *Filaments* finer than human hair, 4-8 inches long, very much branched, decompound, without obvious leading stem, alternately or subdichotomously divided, the penultimate branchlets multifid, and the ramuli frequently secund, attenuate, subulate. In some specimens, when carefully opened out, a leading stem set with alternate decompound branches may be more or less distinctly traced. The lowermost divisions of each branch are generally simple and filiform, the upper ones longer, gradually more compound, alternately pinnated in their upper half. *Apices* frequently multifid and subcorymbose. *Internodes* of the stem 5-10 times as long as broad, of the branches 3-4 times, of the ultimate ramuli very short. *Tubes* 4, broad, with narrow interspaces, and broadish, transparent dissepiments. *Conceptacles* generally stalked. *Colour* when growing, a fine, clear red, becoming darker in the herbarium, and sometimes changing to brown. In fresh water the plant soon gives out a rosy tint. It adheres very closely to paper in drying.

Except in the more slender filaments, softer and more lubricous substance, and rather longer internodes, this species does not differ from the preceding. These characters, which are obvious in the extreme forms of either species, gradually disappear when a great number of specimens from different localities are examined and compared together, and I fear that *P. formosa* can only be regarded as a beautiful variety of *P. urceolata*. Be this as it may, it seems to be the same as Dillwyn's *Conferva stricta*, a name which has many years priority to that here adopted, but which is applicable only to the immature state of the frond. I cannot distinguish *P. Hooperi*, *Bail.* from the ordinary form.

3. *POLYSIPHONIA Havanensis*, Mont.; filaments short (one to three inches long), dull reddish-brown, very soft and lubricous, densely tufted, rising from creeping filaments, byssoid, four-tubed, pellucidly articulate, alternately decomposed, much branched; secondary branches subdistant, often secund; ramuli filiform, fibrilliferous; internodes in the lower part of the stems once or once and a half as long as broad, in the larger branches 4-5 times, in the smaller 2-3 times, and very short in the ramuli; conceptacles . . . ? tetraspores large, subsolitary in the ramuli. *Mont. Nat. Hist. Cubæ*, p. 34, t. 5, fig. 3. *Kütz. Sp. Alg.* p. 818.

HAB. On chalky rocks, near high water mark. Very abundant at Key West in February, *Dr. Wurdeman* (30), *W. H. H.*, *Professor Tuomey* (1). (v. v.)

Tufts very dense, soft and gelatinous, 1, 2, or 3 inches high. *Filaments* rising from matted fibres, much finer than human hair, excessively branched in a manner between dichotomous and alternate. Branches very irregularly divided, repeatedly decomposed, their apices not fastigate, the ultimate ramuli either simple or filiform, or more or less cleft at the apex. Branches and ramuli erecto-patent. *Internodes* having the nodes slightly swollen, four-tubed, pellucidly jointed, variable in length; in the lower part of the stem and branches usually very short, scarcely longer than their breadth, in the upper parts gradually longer, but differing greatly in different specimens; in some pretty uniformly twice or at most thrice as long as broad, in others frequently four or five times their breadth, or even of greater length; in the lesser branches and ramuli about twice as long as broad. *Tetraspores* of large size, mostly solitary, sometimes in pairs, much wider than the ramuli in which they are imbedded. *Colour* a deep reddish brown, varying in intensity. In drying, the plant adheres to paper, and gives out a brownish liquid in fresh water.

I am perhaps incorrect in referring my specimens, gathered within eighty miles of Havana, to the *P. Havanensis* of Montagne; but yet, after having inspected a specimen of Dr. Montagne's plant, notwithstanding the differences it shows, I am afraid to propose mine as distinct. The chief differences which strike me are in the internodes, which are uniformly shorter in the Cuban specimen, though not so short as shown in the figure above-quoted. On the Key West specimens I find considerable variation. In the smaller and younger ones the internodes are uniformly short, while in the more luxuriant the internodes of the branches are frequently several times longer than broad; those of the lower stem and upper ramuli being short. Dr. Montagne's specimens appear to me to be undeveloped; mine are of various ages. I hope some algologist may investigate the question at Havana, where alone it can be satisfactorily settled.

4. *POLYSIPHONIA subtilissima*, Mont.; filaments short (2-4 inches long), rising from creeping filaments, densely tufted, dull purplish brown, not gelatinous, capillary or byssoid, articulate, alternately decomposed; lesser branches multifid,

attenuate, of unequal height; ramuli filiform; internodes four-tubed, about once and half as long as broad, shorter in the ramuli. *Mont. in An. Sc. Nat. 2d Ser. vol. xiii. p. 199. Kütz. Sp. Alg. p. 804. β. Westpointensis*; more slender and delicate.

HAB. Jackson Ferry, New York, *Mr. Walters and Mr. Hooper!* Little River, Newburyport, *Capt. Pike!* β. at West Point, on the Hudson, 60 miles from the sea, *Prof. J. W. Bailey!* (v. s. in Herb. T. C. D.)

Tufts dense, jagged, (not fastigiata), 2-4 inches high. *Filaments* very slender, capillary or byssoid, tetragonal, rising from a mat of rooting and creeping fibres, erect, alternately multifid. The main stem rises about half an inch before it branches; thence upwards it throws out several lateral branches, which are simple below, alternately multifid above, the ultimate divisions attenuate, erect or erectopatent, of unequal height, and simple or bifid at the point. The *internodes* in the lower part of the frond are as long as broad, in the branches once and a half as long, and in the ramuli very short. *Apices* often fibrilliferous. The filaments are four angled, and a cross section shows four large tubes surrounding a small cavity. *Colour* a blackish purple, brighter toward the tips. *Substance* flaccid, but not in the least gelatinous. In drying, the plant, notwithstanding its delicacy, does not strongly adhere to paper.

This species was first discovered on the shores of Cayenne, from which locality Dr. C. Montagne has kindly sent me one of his original specimens. This I have compared with those above described, and find them to agree in all respects. The West Point plant, which was first found by Prof. Bailey several years ago, and which has been acknowledged by Dr. Montagne to belong to his species, differs from the Cayenne variety in being of still greater tenuity; a difference which we should naturally anticipate from its place of growth, nearly at the extreme limit of marine vegetation in a tidal river. I have not seen fructification of either kind on any of the specimens.

5. *POLYSIPHONIA secunda*, Mont.; filaments minute (a quarter to half inch) rising from creeping fibres, which are either arched or prostrate, throwing out numerous erect, secund, filiform, subsimple branches; internodes four-tubed, rather longer than their breadth. *Mont. Nat. Hist. Cubæ, p. 33, t. 5, fig. 2. Kütz. Sp. Alg. p. 804.*

HAB. Parasitical on other Algæ. At Key West, often growing on *Digenia simplex*. *W. H. H. (v. v.)*

Tufts spreading over the surface of the plant on which they grow; in my specimens about a quarter inch in height. *Filaments* prostrate, creeping by means of discs issuing from the under surface, throwing up from their upper surface numerous filiform, simple, erect, secund branches. In older specimens these are often deflected or arched, and a second series of similarly secund branches spring from

them, which occasionally have one or two short ramuli. I have not seen greater composition. *Internodes* very short in the prostrate filaments, about once and half as long as broad in the erect branches, appearing three tubed on the latter view, and found by cross section to be square, composed of four large tubes surrounding a rhomboid cavity. *Colour* a dull, dark reddish brown. *Substance* rather rigid. It does not adhere firmly to paper in drying.

This species sometimes intertwines so densely among the ramelli of *Digenia* as to form with them a dense entangled mat, in which other parasites then take root. I have also seen it at Key West on *Laurenciae*. Montagne's Cuban specimens grew on *Sargassum*.

6. *POLYSIPHONIA breviararticulata*, Ag. tufts dense; filaments rather rigid, tetragonal, rising from a mat of creeping fibres, erect (3-5 inches long), as thick as hog's bristle, not much branched; main stem simple, or once or twice forked, somewhat naked below, beset above with numerous virgate, very erect primary branches, set at intervals with several very slender secondary branches, which are naked below and alternately multifid above; internodes uniformly shorter than their diameter in all parts of the frond, swollen at the nodes; conceptacles ovate, sessile; tetraspores in distorted terminal ramuli. *Ag. Sp. Alg.* 2, p. 92. *Kutz. Sp. p.* 815. *P. physarthra*, *Kg. l. c.*, 815. (TAB. XVI. B.)

HAB. Abundant on maritime rocks, near highwater mark, at Key West, *W. H. H.* (No. 19), *Dr. Blodgett* (No. 57), *Dr. Wurdeman* (No. 15 and 16.) Vera Cruz, *Liebman* ! (v. v.)

Tufts 3-6 inches high, dense. *Filaments* as thick as hog's bristle, sometimes nearly unbranched, sometimes thrice or four times parted subdichotomously, bare of branches and ramuli below, more or less furnished with alternate branches above. *Branches* but little divided, long and virgate, erect, furnished with several slender secondary branches, of greatly less diameter than the part they spring from. These are simple and naked in their lower half, and alternately multifid above. *Apices* abundantly fibrilliferous when young. *Articulations* in all parts of the frond much shorter than their diameter, visible to the naked eye and then appearing with opaque nodes; under the microscope pellucid, with very wide quadrate tubes and transparent interspaces. A cross section of the stem is square, with four wide tubes surrounding a small central cavity. *Conceptacles* ovate, sessile on the sides of the multifid ultimate ramuli, which on fertile specimens are shorter and more closely branched. *Tetraspores* in the tips of the ramuli. *Colour* a dull reddish brown. *Substance* rigid, not closely adhering to paper.

The Key West specimens agree with one from Vera Cruz mentioned above, but are rather more robust than the Mediterranean form, and more furnished with lateral ramuli. I had at first thought them different, and may perhaps have distributed a few specimens under the MS. name *P. littoralis*, which I gave at Key West to this plant, from its profuse abundance along the shore, near high water

mark. My specimen of *P. physartha*, Kütz. is very imperfect, but it scarcely seems specifically different from *P. breviarticulata*, as here understood.

Plate XVI. B. *Fig. 1.* Tuft of *POLYSIPHONIA breviarticulata*; the natural size. *Fig. 2.* portion of a secondary branch, with its slender multifid tertiary; *fig. 3.* apex of a branch, with *conceptacle*; *fig. 4.* apex in which tetraspores are imbedded; *fig. 5.* base of the stem, to show the manner of rooting; *fig. 6.* roots; *fig. 7.* transverse section of the stem: all the latter figures more or less highly *magnified*.

7. *POLYSIPHONIA Binneyi*, Harv.; filaments rather rigid, setaceous, alternately decomposed, much branched; branches elongate, spreading, of unequal length, twice, thrice, or oftener compounded, and at length resolved into capillary, multifid ramuli; nodes swollen, pellucid; internodes four-tubed; those of the stem and branches once and half or twice as long as broad, of the ramuli shorter than their breadth; tetraspore of small size, subsolitary in distorted terminal ramuli. β . stem and branches plentifully beset (as if proliferously) with slender, simple, or multifid capillary, lateral ramuli.

HAB. Key West, *W. H. H.* β . at Key West, *Mr. Binney! Prof. Tuomey*, (3)
W. H. H. Apalachicola, *Mr. Loundsbury*. (v. v.)

Fronde 2-4 inches high, as thick as hog's bristle, with an ovate outline in the spread of the branches. *Stem* subsimple, closely set throughout with lateral spreading branches, the lowest of which are long, the rest gradually shorter. These primary branches are either subsimple, or twice or thrice alternately decomposed, each series of lesser branches gradually more slender, till the frond is resolved into capillary ramuli. In β . both stem and branches emit on all sides lateral, simple and hair-like, or multifid ramuli, half an inch long, much more slender than the internodes from which they spring, very irregularly placed, often much crowded, and often laxly scattered. The nodes of the stem and branches are swollen; they are pellucid to the very base of the frond. Internodes of the main divisions at least once and half as long as broad, but generally rather more; those of the younger parts uniformly short. *Tubes* four, very broad. *Colour* a deep brown. *Substance* very tough, long resisting the action of fresh water. It very imperfectly adheres to paper in drying.

Our var. β . has a rather different aspect, owing to the profusion of lateral ramuli. It seems, however, to be analogous to similarly proliferous states of various *Ceramia*, &c.

This species is nearly allied to *P. breviarticulata*, but is a more slender plant, with more compound and patent branches, and the internodes of all the principal divisions are uniformly of greater length. In ramification it more nearly resembles *P. Olneyi*, which has however a totally different substance.

8. *POLYSIPHONIA fracta* ; filaments irregularly tufted or bundled together, capillary, rather rigid, divaricately much branched, subdichotomous ; branches distant, spreading at wide angles, beset with scattered, spinelike, horizontal short ramuli ; internodes four-tubed, about equal in length and breadth in all parts of the frond.

HAB. Key West, *W. H. H.* (18), *Dr. Blodgett* (42). (v. v.)

This forms loose, squarrose tufts or bundles. The filaments are rather coarser than human hair, gradually but not greatly attenuated upwards, and irregularly much branched, the main stems dividing subdichotomously. The forkings are distant and spreading, irregularly subdivided. All the branches issue at wide angles, and the larger ones are furnished with numerous, scattered, horizontally patent, thornlike ramuli, about a line in length. The substance is rather rigid. *Colour* a reddish brown. *Stem* square, four-tubed, and dissepiments pellucid in all parts of the frond. It imperfectly adheres to paper in drying.

This has the aspect of *P. subulifera*, but a very different structure. In the characters of the internodes it agrees with *P. breviarticulata*, but differs in the more slender frond and the disposition of the branches and ramuli. *Dr. Blodgett's* specimen is more flaccid than those I collected in February, more densely branched, with the apices fibrilliferous, characters probably dependant on the state of development.

9. *POLYSIPHONIA echinata* ; frond setaceous, rigid, dichotomous ; branches distant, widely spreading, or divaricate, not much attenuated, articulate, four-tubed, beset on all sides with minute, spinelike, horizontal, subulate, simple or bifid ramuli, internodes shorter than their breadth.

HAB. Key West, *W. H. H.* (22). (v. v.)

*Fronde*s three or four inches long or more, as thick as hog's bristle or somewhat thicker, subdichotomously divided ; all the divisions spreading at very wide angles. The forkings are from half an inch to an inch apart, the terminal branchlets generally an inch in length. All the younger parts, at least, are beset at intervals of half a line with minute spinelike ramuli, half a line in length, directed toward all sides, and issuing nearly at right angles with the branch. The articulations are visible in all parts of the stem and branches, uniformly shorter than their breadth, with very wide tubes and swollen dissepiments. The substance is tough and rigid, the membrane of the walls thick, and not readily recovering shape after having been dried. *Colour* a dark brown. It imperfectly adheres to paper.

This resembles *P. fracta* in its ramification, but is much more robust, and the ramuli are more copious, shorter, more compound, and more equally inserted on all sides of the branches.

10. *POLYSIPHONIA hapalacantha*; densely tufted, soft and very flaccid; filaments setaceous and corticate below, much attenuated and articulate upwards, the terminal divisions almost byssoid, sub-dichotomously decompound, fastigiata, the lower axils patent; upper branches less regularly forked; all the branches furnished with minute, simple, scattered, spinelike, quadrifarious ramuli, and copiously clothed with byssoid (deciduous) fibres; articulations in all parts of the frond about as long as broad, four-tubed, those of the larger branches with supplementary cellules.

HAB. Key West, *Dr. Blodgett!* (v. s. in Herb. T. C. D.)

Filaments four or five inches long, branched from the base in a more or less regularly dichotomous order, the lower forks pretty regular, the upper, by the frequent suppression of an arm, subalternately decompound. The filaments are greatly attenuated upwards, the lower parts being thicker than hog's bristle, the upper branches much finer than human hair. *Axils*, especially the lower ones, patent. *Spine-like*, simple ramuli, one or two lines in length, and spreading to all sides, are freely scattered over the segments at distances of a line or two. Our specimens are copiously fibrilliferous. The articulations are uniformly short; those of the upper divisions marked with two broad tubes, those of the lower successively coated with secondary cells, but not obliterated. *Colour*, when dry, a Vandyke brown. *Substance* very soft. It closely adheres to paper.

11. *POLYSIPHONIA Gorgonice*; filaments subsolitary, short (an inch high), flaccid, flabellately branched, irregularly dichotomous below, alternately decompound above, attenuated, all the divisions rather patent; ramuli of unequal length (not fastigiata); internodes near the base very short, in the larger divisions once and half as long as broad, in the smaller about twice as long as broad, four tubed; dissepiments pellucid; conceptacles globose, on short stalks, abundant.

HAB. Parasitical on various corals. Key West, *W. H. H.* (25) *Dr. Blodgett*, 40. (v. s. in Herb. T. C. D.)

Filaments rising from discoid bases, scattered, rarely somewhat tufted, an inch high, subsetaceous below, rapidly diminishing in thickness upwards, forking at two or three lines from the base, and afterwards twice or thrice forked, the upper divisions irregularly multifid and attenuated to a byssoid fineness. All the divisions are patent and the branches open out like a fan in water. The dissepiments are pellucid in all parts. The internodes four-tubed, and four-angled; those in the lower part of the stem shorter than their breadth, of the branches once and half to twice as long as broad, in the ultimate ramuli very short. *Conceptacles*, which are plentifully borne on some specimens, globose, but depressed vertically or oblate, very full of spores, on short pedicels of the lesser branches or subsessile. *Colour* a pale ochrey brown, darker towards the tips. *Substance* soft and flaccid. It adheres to paper in drying. This is a very pretty little species, distinct from any of

the North American ones. I found it on the purple, whip-like Gorgonia so common at Key West.

12. *POLYSIPHONIA Olneyi*, Harv.; tufts dense, silky, flaccid, purple-brown; filaments capillary below, byssoid above, decomposed, excessively branched; branches very patent or divaricate, many times compounded, gradually attenuated, more or less beset with scattered, slender, spinelike ramuli; articulations very variable in length, in the larger branches from two to six times, in the lesser branches and ramuli once and half to twice as long as broad; conceptacles ovate, sessile; tetraspores in distorted ramuli. *Harv. in Olney's List of Rhode Island Plants, Proceed. Prov. Frank. Soc., Apl. 1847. (TAB. XVII. B.)*

HAB. On *Zostera*, &c. Halifax, *W. H. H.* Nantucket, *Dr. Durkee.* Providence, Rhode Island, (1846) *Mr. S. T. Olney.* Greenport, Long Island, *Prof. Bailey and W. H. H. (v. v.)*

Tufts from three to five inches long, dense, soft and silky. *Filaments* as thick as human hair, or sometimes twice as thick at the base, where they are also of a firm substance; soon becoming thinner, and passing off above into excessively fine, byssoid ramuli, much branched from the base without regular order; the branches many times compounded by alternate or unilateral ramification. *Branches* more or less furnished with lateral spinelike, scattered ramuli, from a line to a quarter inch in length. The lower divisions of the stem and branches are very patent, sometimes widely divaricating, the upper more erect, with narrower angles. A cross section of the stem, or of one of the larger branches near the base, shows four large primary tubes surrounding a central cavity, and four secondaries of small size alternating with them. The *internodes* are very variable in length in different specimens; those of the stem and larger branches are frequently not more than twice as long as broad, but are sometimes four or even six times their length; those of the lesser branches and ramuli are more uniformly short. *Conceptacles* ovate, abundantly scattered over the lesser branches. *Colour* a rich purple brown, more or less intense. *Substance* soft and lubricous. It adheres very closely to paper in drying.

This species has many characters in common with the following, but is a more slender plant, much softer and more lubricous in substance, with longer internodes, longer, more filiform and much less abundant ramuli, &c. It must be allowed, however, that most of these characters are variable. The length of the internodes is particularly so, the first specimens which I received from Mr. Olney, and on which I founded the species, having them uniformly short; while others, collected in the same locality, but at a different season, have them often of the great length shown at fig. 5.

Plate XVII. B. *Fig. 1*, a frond of *Polysiphonia Olneyi*, removed from the tuft, the *natural* size. *Fig. 2*, part of a branch from the same; *fig. 3*, a small portion of the branch with ramulus; *fig. 4*, part of a branch from another specimen; *fig. 5*, one of the longer internodes from the same; *fig. 6*, a conceptacle; *fig. 7*, transverse section of the stem; the latter figures more or less *magnified*.

13. POLYSIPHONIA *Harveyi*, Bail. ; tufts globose and bushy ; filaments rather rigid, setaceous, divaricately much branched ; branches alternately decomposed, very patent, often angularly bent, set throughout with more or less numerous, short simple, or forked, spinelike ramuli ; internodes short in all parts of the frond, once or twice as long as broad in the branches, much shorter than their breadth in the lesser divisions and ramuli, four-tubed ; dissepiments pellucid ; conceptacles broadly ovate near the tips of the branches ; tetraspores in distorted ramuli. *Bail. in Sillim. Journ.*—(Tab. XVII. A.)— β *arietina* ; very squarrose, the ramuli strongly revolute and curled. *Pol. arietina*, *Bail. MS.*

HAB. On *Zostera* and other marine plants. Boston Bay, *Dr. Durkee, Mrs. Mudge, Mr. Girard, etc.* Abundant in Long Island Sound ; Stonington, *Prof. Bailey* (1846) ; Greenport, Long Island, both varieties, *Prof. Bailey and W. H. H.*

This forms globose, squarrose, loose tufts, which do not collapse, when lifted from the water, if the plant be quite fresh. *Filaments* often, but not always, as thick as hog's bristle at the base, attenuated upwards, excessively branched and bushy ; the branches dividing repeatedly without much order, alternate or secund, widely spreading, often much divaricated. Lesser branches variable in number and in subdivision, sometimes very few and little divided, sometimes numerous. *Ramuli* generally very abundant, half a line to a line long, spinelike, simple or forked, subulate, very patent, sprinkled irregularly over all the branches, large and small. *Internodes* generally very short in all parts of the stem and branches, but variable in length in different specimens and at different ages. Those of the lower part of the stem show, on a cross section, four primary and four small secondary external tubes. Those of the branches are sometimes shorter than their breadth, sometimes twice as long ; in the latter case the coloured tubes are often spirally twisted. The pellucid integument of the filament is thick, and the nodes are generally swollen. *Conceptacles* broadly ovate, usually placed near the ends of the branches. *Tetraspores* of small size, in distorted ramuli. *Colour* a very dark, purplish brown. *Substance* firm, rigid. In drying, the plant adheres, but not firmly, to paper.

β is smaller, and still more squarrose, with its spinelike ramuli strongly recurved or rolled back like a "ram's horn." I think, however, that I have traced it, through numerous specimens, into the ordinary form. Sometimes the frond is much more densely branched than our figure, taken from one of the original specimens, shows. The obvious characters of the species are the abundant thornlike ramuli and short joints.

This plant is common in various places in Long Island Sound. While dredging with Professor Bailey in Peconic Bay, our exclamations of delight on hauling up some specimens of it attracted the notice of one of our boatmen, who took up a handful of what we seemed so eagerly hoarding, but immediately threw it down with a "Pooh ! that's what we call 'nigger-hair.'"

Plate XVII. A. *Fig. 1*, frond of POLYSIPHONIA *Harveyi*, the natural size. *Fig. 2*, apex of a branch ; *fig. 3*, ramulus with tetraspores ; *fig. 4*, a tetraspore ; *fig. 5*,

portion of a branch, with ramuli and a conceptacle ; *fig. 6*, transverse section of the stem ; all the latter figures more or less highly *magnified*.

** *Stem and larger branches inarticulate, more or less completely coated with small, irregular cellules. Ramuli articulate. (Sp. 14—17.)*

14. *POLYSIPHONIA ramentacea*; stem robust, dendroid, inarticulate, internally four-tubed, irregularly much branched ; branches spreading on all sides, alternately divided ; lesser branches rod-like, simple, set throughout with numerous, short, setaceous, spine-like, simple or forked, articulate ramuli ; internodes of the ramuli shorter than their breadth, marked with two or three quadrate cells ; conceptacles ovate, borne near the tips of the ramuli. (TAB. XVI. A.)

HAB. On corals, &c. Key West, *W. H. H., Dr. Blodgett.* (v. v.)

Root discoid. *Stem* solitary, four or five inches high, twice or thrice as thick as hog's bristle, gradually attenuated upwards, soon forking, and afterwards repeatedly divided in an irregularly alternate manner, the whole system of branches forming a tree-like frond. The larger branches spread towards every side, and are furnished with numerous lateral, secondary branches, scattered or crowded, and either simple or having another series of similar branches, all tapering to a fine point. The stem and branches are alike beset, at distances of half a line or less, with slender, simple or forked, bristle-shaped, quadrifarious ramuli, a line or two in length. These ramuli are pellucidly articulate, the articulations exceedingly short, with sub-quadrate tubes. The stem and branches are opaque, tessellated with small irregular cells ; a transverse section showing four primary tubes, with an external coating of greater or less thickness formed of small cells. *Conceptacles* ovate, small, sessile near the tips of the ramuli. *Antheridia* ovato-lanceolate, densely tufted at the apices of the ramuli. *Colour* a dull reddish brown, darkening in drying. *Substance* cartilaginous, but soft. In drying, it adheres pretty closely to paper.

Of this apparently rare species, I collected only a solitary specimen during my visit to Key West. It is abundantly unlike any other North American species, but nearly allied to *P. flexella* of the Mediterranean. My specimen, however, differs from any that I have seen of *P. flexella*; it recovers better after having been dried, the articulations of the ramuli are more distinct, and the byssoid fibres far less copious.

Plate XVI. A. *Fig. 1.* *POLYSIPHONIA ramentacea*; the *natural* size. *Fig. 2*, apex of a branch ; *fig. 3*, portion of a ramulus ; *fig. 4*, transverse section of a branch ; *fig. 5*, lateral view of a small portion of the same, to show the surface cells ; the latter figures more or less highly *magnified*.

15. *POLYSIPHONIA elongata*, Grev. ; stems robust, cartilaginous, irregularly branched, decomposed, best, especially toward the end of the branches, with slender, closely set, alternately multifid ramuli, which taper to the base and apex ; articu-

lations of the stem and branches areolated with small, irregular cells, more or less obsolete; of the ramuli once and a-half or twice as long as broad, marked with numerous (secondary) tubes and small cells; primary tubes four. *Ag. Sp. Alg. vol. 2. p. 82. Kütz. Sp. Alg. p. 828. Harv. Phyc. Brit. t. 292 and 293.*

HAB. Boston Harbour in various places, rare? Lynn Beach, *Dr. Durkee.* Germantown, *Miss E. H. Brewer.* (v. v.)

Root a large scutate disc. • *Fronde*s mostly solitary, 6-12 inches long, cartilaginous, firm, as thick as packthread at the base, gradually attenuate upwards, decom- poundly branched in a manner between dichotomous and alternate; the branches sometimes bare of ramuli, long and twiggy; and sometimes emitting, especially from their upper half, broad pencils of multifid, rosy or blood-red flaccid ramuli. Internodes obscurely visible in all the older parts of the frond, distinctly marked in the ramuli alone, about once and half as long as broad, sometimes a little longer, netted over with irregularly shaped, polygonal cells. A cross section shows four primary tubes of a large size, protected externally by several rows of irregularly placed cells, which are gradually smaller to the circumference. *Conceptacles* ovate, scattered over the branches. *Tetraspores* in the distorted tips of the flaccid ramuli. *Colour* red-brown in the stem, rosy or blood-red in the ramuli. In drying, the stem scarcely adheres to paper, except after strong pressure, but the ramuli, when present, adhere very closely.

A most variable plant in aspect. Specimens of the first year's growth have a very few flaccid ramuli scattered along the twiggy branches. In winter these, as well as the ends of the branches, fall away, leaving a truncated or somewhat pollarded frond. In the following spring, such as survive throw out a profusion of byssoid and multifid ramuli, which are peculiarly abundant and dense round the wounded parts.

16. POLYSIPHONIA *fibrillosa*, Grev.; pale straw-colour or brownish; stems inarticulate, opaque, marked with sinuous veins, robust, alternately branched; branches spreading, resembling the stem, but less opaque, articulated near the ends, sub-simple, thickly set with very slender, articulated, finely divided, short ramuli, whose tips are copiously fibrilliferous; internodes of the ramuli, rather longer than broad, bi-tri-striate; primary tubes four, in the stem coated with a thick layer of cells; conceptacles ovate; tetraspores large, in the terminal ramuli. *Ag. Sp. Alg. vol. 2. p. 78. Kütz. Sp. p. 827. Harv. Phyc. Brit. t. 302.*

HAB. Newport, Rhode Island, *Prof. Bailey.* Lynn, Massachusetts, and Peconic Bay, *Mr. Hooper.* (v. v.)

Tufted. *Stems* once or twice as thick as a hog's bristle, alternately much branched, the lateral branches spreading irregularly on all sides, repeatedly com- pound; the main stem and principal and lesser branches opaque and inarticulate,

coated with oblong, sinuous, irregular cells. The smaller branches are gradually resolved into alternately multifid, articulated ramuli. *Internodes* of the ramuli about as long as broad, or a little longer. A cross section of the stem shows four primary tubes, surrounded by many rows of cells, smaller gradually to the circumference; the four secondary tubes (alternating with the primaries) large. Ends of the branches and ramuli with abundant byssoid fibrils. *Conceptacles* broadly ovate, sessile. *Colour* a dull, pale red brown. *Substance* soft, soon decomposing. In drying, it adheres very closely to paper.

This scarcely differs from the following except in the duller colour, less divided ramuli, and shorter internodes. This is the plant published as *P. Brodiaei* in Prof. Bailey's list. I have examined his specimen and find but four primary tubes in the stem; not six, as in *P. Brodiaei*.

17. *POLYSIPHONIA violacea*, Grev.; brownish red or purple; stem inarticulate, marked with irregular cells, robust, alternately branched, decomposed; branches quadrifarious, repeatedly divided, bushy or feathery, the ultimate ramuli exceedingly slender, alternately multifid, fibrilliferous; internodes of the ramuli bistriate, two to four times as long as broad; primary tubes four, in the stem coated with a thick layer of cells; conceptacles ovate, stalked or sessile; tetraspores in swollen submoniliform ramuli. *Ag. Sp. Alg. vol. 2, p. 76. Kütz. Sp. Alg. p. 826. Harv. Phyc. Brit. t. 209.*

β flexicaulis; stem and branches more slender than common, angularly bent, excessively divided, the lesser divisions very patent and frequently secund; internodes of the ramuli rather longer than usual.

HAB. On *Zostera*, &c., frequently in deep water, beyond tide marks. Penobscot Bay, Maine, *Mr. Hooper*. Boston Bay, *Mr. G. B. Emerson, Dr. Durkee, Capt. Pike*. New Bedford, *Dr. Roche, Mr. Congdon*. Seaconnot, *Mr. Congdon*. *β*. Prince Edward's Island, *Dr. Jeans*. Profusely common in Halifax harbour in July, *W. H. H. (v. v.)*

Subsolitary, or loosely tufted. *Stem* 6—12 inches long, or more, as thick or twice as thick as hog's bristle below, gradually attenuated upwards, simple or but slightly divided, set throughout with lateral, spirally inserted branches, the lowest of which are longest, the rest gradually shorter upwards. *Branches* elongate, bearing a second or third series of similar but shorter branches, the last of which are alternately multifid, and resolved into excessively slender, finely divided ramuli, the minute division of which, in luxuriant specimens, gives the plant a feathery aspect. The stem and larger branches are opaque, marked with numerous, irregularly shaped, veiny cells, without apparent articulation, the nodes being hidden under the cellular coat. The lesser branches and ramuli are pellucidly articulate, the internodes of the former being three or four times, of the latter about twice as long as broad. *Conceptacles* generally pedicellate. *Colour* varying from brown to purple, often becoming brighter after the plant has been dried. *Substance* of the

stem cartilaginous, but tender ; of the branches and ramuli very flaccid, soft and lubricous. It adheres most closely to paper in drying.

Var. β , which I dredged in great profusion at Halifax harbour, where, in July and August, it is one of the most characteristic plants, is often two feet long or more, and excessively and almost intricately branched. The main stem and branches are remarkably flexuous, bent from side to side in a zigzag manner, and their lesser divisions are very frequently secund. Except in these characters, which I do not think of specific importance, this variety does not differ from the ordinary form.

SUB-GENUS 2. POLYSIPHONIA. Primary tubes more than four. (Sp. 18—28.)

18. POLYSIPHONIA *variegata*, Ag. ; tufts dense, brownish purple or greenish ; filaments setaceous and rigid below, capillary above, dichotomo-multifid, the lower axils very patent ; branches somewhat zigzag, elongated, furnished with lateral, capillary, very flaccid, multifid, purple ramuli ; internodes near the base shorter than their breadth, once and half to twice as long as broad in the branches and ramuli, three banded ; tubes six ; conceptacles ovate, short-stalked. *Ag. Sp. Alg.* 2. p. 81. *J. Ag. Alg. Medit.* p. 129. *Harv. Phyc. Brit.* t. 155.

HAB. On *Zostera*, &c. Annual. Massachusetts Bay, *Dr. Durkee, Mr. Pike.* Peconic Bay, *Prof. Bailey* and *W. H. H.* Several places in Long Island Sound. New York, *Mr. Hooper, Calverley, &c.* Sullivan's Island, Charleston, *Prof. Gibbs, W. H. H. &c.* (v. v.)

In fine tufts. *Filaments* as thick as hog's bristle below, capillary and byssoid above, two to ten inches long, dichotomous below, repeatedly forked, alternately or irregularly decompound above ; the lower divisions spreading with very wide angles and subdistant, the upper gradually more erect. In some specimens the whole frond has a flabelliform outline and is pretty equally dichotomo-multifid, none of the pencils of ramuli crowding on each other ; in others the principal stems are a few times divided, nearly flexuous or zigzag, and alternately set with pencils of closely dichotomous, crowded, subfastigate ramuli. *Internodes* visible to the base of the frond, and, except near the base where they are very short, pretty regularly once and half or twice as long as broad, showing three tubes on the lateral view, and a circle of six (rarely seven) round a small central cell, when cut across. No secondary tubes except toward the base of old stems. *Apices* attenuate, with very short joints. *Colour* a dark, purple brown or blackish purple, becoming a brighter purple after having been dried. The substance is soft and lubricous, but not very gelatinous, and the plant adheres closely to paper in drying. *Conceptacles* broadly ovate or subglobose, widemouthed, pedicellate, scattered over the branches.

This plant, though in some respects variable, has a peculiarity of aspect which

renders it, after it has once been seen, easily recognised in the several varieties it assumes. It is the only species yet found in Charleston Harbour, where in January and February it is very abundant. It extends north as far as Boston, where it is a summer plant. In Europe it is a characteristic Adriatic species, and is found along the Atlantic coast as far as the south of England.

19. *POLYSIPHONIA parasitica*, Grev. ; filaments slender, rigid, full red, decom-pound-pinnate, distichous ; branches bi-tri-pinnate ; pinnules closely set, alternate, erecto-patent, awl shaped, acute ; internodes about as long as broad, about four-banded ; dissepiments hyaline, wavy ; tubes about eight ; conceptacles ovate, on short stalks ; tetraspores immersed in swollen pinnules. *Grev. Fl. Edin. p. 309. Harv. Phyc. Brit. t. 147. Ag. Sp. Alg. 2, p. 103. Kütz. Sp. Alg. p. 803.*

HAB. Providence, Rhode Island (fide Sp. in Herb., Hooper).

One to three inches high, distichous, repeatedly pinnate. *Colour* when growing a clear lake-red, becoming brownish in drying. It imperfectly adheres to paper.

Apparently a rare species in America. I have only seen a solitary specimen in the collection of Mr. Hooper of Brooklyn. It is a beautiful plant resembling a miniature *Ptilota* in outward aspect.

20. *POLYSIPHONIA Pecten Veneris* ; small (1-2 inches high), capillary, alternately branched ; branches flexuous, sometimes many times compound, spreading or reflexed ; lesser branches pectinated on one side with secund, bristle-shaped, short ramuli, issuing from every node ; internodes nine or ten tubed, about once and half as long as broad, those of the ramuli shorter ; tetraspores immersed in the ramuli ; conceptacles ovato-rostrate, on long peduncles ! Var. *a.* much branched, the comblike branches strongly recurved. (Tab. XVI. C.) Var. *β.* less branching, the comblike branchlets elongate, straight or nearly so. (Tab. XVI. D.)

HAB. On small Algæ and corallines. Key West, *W. H. H. (20). Dr. Blodgett, (70).* Pine Islands, *Prof. Tuomey (26).* (v. v.)

Filaments decumbent at base and creeping, then erect, capillary or subsetaceous, much branched, distichous. *Branches* alternate, flexuous, spreading at wide angles, repeatedly divided, the successive divisions usually secund. All the lesser branches and portions of the branches and stem are furnished, at intervals of less than a quarter of a line, with secund, subulate, or bristle-shaped ramuli about a line in length, so that each penultimate branchlet with its ramuli resembles a miniature comb. These little combs in the larger and more branching specimens are generally strongly reflexed, the ramuli curving in an opposite direction. A transverse section of the stem shows nine or ten tubes. The internodes are rather longer than

broad in the ramuli, and once and half to twice their breadth in the branches. *Conceptacles* ovato-urceolate, acuminate, or produced at the orifice into a long beak, borne on peduncles longer than themselves, often twice as long, originating on the principal branches of the frond, and more than twice the diameter of the ordinary ramuli. *Tetraspores* immersed in the ramuli. *Colour* a brown red of variable intensity; in old specimens the branches are sometimes colourless while the ramuli are strongly coloured. *Substance* soft. It adheres, but not very strongly, to paper in drying.

The smaller and less branching specimens resemble *P. obscura*, but are much more delicate; the larger are quite unlike any other North American species. Since our figure was prepared I have received from Dr. Blodgett specimens bearing conceptacles. These are very curious, shaped like those of *Dasya elegans*, and borne on still longer peduncles.

PLATE XVI. C. *Fig. 1.* POLYSIPHONIA *Pecten Veneris*; the *natural* size. *Fig. 2.* part of a branch *magnified*; *fig. 3.* ramulus, with tetraspores, more highly *magnified*. D. *Figs. 1 and 2,* var. β . the *natural* size. *Fig. 3,* part of a branch; *fig. 4,* small piece of the same and ramulus with tetraspores; *fig. 5,* cross section of a branch; the latter figures more or less *magnified*.

21. POLYSIPHONIA *exilis*; filaments densely tufted, creeping, afterwards ascending or suberect, furnished with a few distant, secund, unequal, filiform ramuli; internodes shorter than their breadth in all parts of the frond; tubes nine; tetraspores in the ramuli.

HAB. Key West, W. H. H. (24) *Dr. Blodgett*, (v. v.)

Densely tufted. *Filaments* matted together at base and there attached by lateral rooting fibres; afterwards ascending or sub-erect, about an inch in length or rather more, ultra-capillary, generally simple, furnished at short intervals with numerous very unequal, secund ramuli, long and short often indiscriminately ranked together, the ends of the filaments generally bare. *Internodes* very short, about half as long as broad, with pellucid dissepiments. A cross section shows nine tubes. *Tetraspores* in distorted ramuli. I have not seen conceptacles. *Colour* a dark brown red, becoming much browner in drying. *Substance* coarse and rather rigid. It imperfectly adheres to paper in drying.

Allied to *P. obscura*, Ag.; but more robust, and yet with fewer and broader tubes. I also collected at Key West one or two specimens of a *Polysiphonia* nearly allied to this, differing in being less robust, less branching, having longer internodes and a rather brighter colour. As the specimens are not in a very good state, I am unwilling to give them a name at present, and thereby add to the sufficiently numerous list of bad species in this genus.

22. *POLYSIPHONIA atrorubescens*, Grev. ; filaments setaceous, erect, sparingly or much branched, dark red, somewhat rigid ; branches long, alternate, very erect, alternately decomposed, naked or furnished with short, simple or multifid, scattered, acute ramuli, which taper to the base and apex ; internodes of the branches twice or thrice as long as broad, of the ramuli shorter than their breadth, twelve tubed, the tubes frequently spirally twisted ; conceptacles broadly ovate or sub-rotund, sessile, tetraspores in the ramuli. *Ag. Sp. Alg. vol. 2. p. 64. Harv. Phyc. Brit. t. 172. Pol. Agardhiana, Grev. Scot. Crypt. H. t. 210. Conferva atrorubescens, Dillw. t. 70.*

HAB. Little Compton, *Dr. Durkee*. Longbranch, New Jersey, *Miss Morris*, (v. v.)

Stems densely tufted, two or three inches long in our American specimens, as thick as hog's bristle, irregularly branched, not much tapered upwards ; branches long and virgate, sub-simple, very erect, here and there furnished with a few alternately multifid ramuli, which taper to the base and apex, and are thus spindle-shaped. Larger specimens are often more compound. *Internodes* about twelve tubed, twice as long as broad in the branches, shorter in the ramuli and toward the base of the stem, multistriate, the tubes very frequently, but not always, spirally twisted. *Conceptacles* broadly ovate, wide-mouthed, sessile near the ends of the ramuli. *Tetraspores* of large size, in the distorted ramuli. *Colour* when growing, a full deep-red, changing to reddish-brown in the herbarium. *Substance* rather rigid. It does not strongly adhere to paper in drying.

Miss Morris's specimens are in fruit, of both kinds, and have all the usual characters of the European plant, from which they differ merely in being less luxuriant. Dr. Durkee's are not fully grown, and the tubes are straighter than usual. I see no sufficient reasons for doubting that both belong to the same species.

23. *POLYSIPHONIA Californica*; flaccid, capillary, densely tufted ; filaments dividing near the base into subsimple, elongate, flexuous branches, which are naked below, and set with short, alternate, secondary branches above ; secondary branches pinnate or bipinnate, the pinnules tapering to the base and apex ; internodes many-tubed, those of the branches nine or ten times, of the ramuli about twice as long as broad.

HAB. Golden Gate, California, *Captain N. Pike*. (v. s. in herb. T. C. D.)

Densely tufted. *Filaments*, so far as I can judge from the imperfectly extricated specimens before me, divided near the base into several long branches. These branches are four or five inches long, simple or nearly so, flexuous, capillary, bare of lesser branches below and furnished above, for two thirds of their length, with lateral, secondary branches from a quarter inch to an inch in length, and at distances apart varying from nearly an inch to one or two lines ; the lowest most distantly placed. The simplest of the lateral branches are naked for more than half their length and pinnated in the remaining portion ; the more compound are

similar but bipinnate, each of their pinnae being naked below and pinnulate above. The pinnules are very erect and taper to the base and apex. The tubes in the specimen examined are nine or ten in the stem. The internodes are distinctly visible in all parts of the frond; those of the main branches are very many times longer than broad, and have the tubes often spirally twisted; those of the smaller branches and pinnae are uniformly short, once and a half to twice as long as broad; and those of the pinnules are about as long as their breadth. The substance, though tenacious, is very flaccid. The colour, probably full red in the recent plant, is a dark red brown in the dried specimen. In drying, it does not adhere very closely to paper.

This is allied in many respects to *P. atrorubescens*, from which it differs in tenuity and in general aspect, as well as in the much greater length of the internodes of the larger branches. These latter characters connect it with *P. tenuistriata* of the Southern Ocean, and perhaps future observations may oblige us to unite it to that species; but at present we have not evidence to warrant our doing so.

24. *POLYSIPHONIA nigrescens*, Grev.; frond robust, rigid and rough with broken branches below, flaccid much branched and bushy above; branches alternate, decom-pound pinnate; ramuli distant, elongate, awl-shaped, alternate, the upper ones pinnulate near the tips; internodes of the branches rarely shorter than their breadth, often once and half to twice or four times as long as broad, multistriate; tubes from twelve to twenty; conceptacles ovate, sessile or nearly so. *Ag. Sp. Alg.* 2, p. 69. *Kütz. Phyc. Gen. t. 50, f. 4. Sp. Alg. p. 813.*

Of this most variable plant I have received the following forms from America :—
fucoides; robust, excessively branched and bushy; branches sub-spirally inserted, many times pinnated, the lesser branches sub-bipinnate, fastigiate and sub-corymbose; pinnules naked below, pinnulate above; internodes of the branches once and half to twice, of the ramuli once and half as long as broad; tubes of the stem varying from twelve to twenty. *Pol. nigrescens*, *Harv. Phyc. Brit. t. 277. P. fucoides*, *Grev. Edin. p. 308. Conferva fucoides*, *Dillw. t. 75. E. Bot. t. 1743.*

β. affinis; robust, elongate, repeatedly pinnate but rather laxly branched, the principal branches naked below, decom-pound pinnate above; the lesser branches somewhat fastigiate and corymbose; internodes of the branches three or four times, of the ramuli once and half to twice as long as broad; tubes 15-16. *Pol. affinis Moore; Harv. Phyc. Brit. t. 303.*

γ. plumosa; stem setaceous, undivided, pinnated with lateral, alternate or secund, sub-distant, decom-pound branches; branches lanceolate in outline, three or four times pinnate, plumose, the apices not fastigiate; ramuli very slender, erecto-patent; internodes of the branches 2-4 times, of the ramuli once and half to twice as long as broad; tubes seventeen or eighteen.

δ. gracillima; stem setaceous, undivided, pinnated with capillary elongate

- branches ; branches bi-pinnate, both pinnæ and pinnules distant, very slender and irregularly placed ; internodes of the branches 4-8 times, of the pinnules twice or thrice as long as broad ; tubes twelve.
- ε. *tenuis* ; stem setaceous, decompose-pinnate ; branches sub-distichous, ovate in outline, 3-4 times pinnate ; the pinnæ and pinnulæ patent and rather distant, not fastigiata ; internodes of the pinnæ 3-4, of the pinnules 2-3 times as long as broad ; tubes fifteen.
- Var. ζ. *Menziesii* ; setaceous, alternately branched, distichous ; branches virgate, bi-pinnate ; pinnæ sub-distant, pinnulæ subulate, the lowermost squarrose or revolute, simple, the upper erecto-patent, simple or alternately multifid ; internodes of the branches twice or thrice as long as broad, of the ramuli shorter than their breadth ; tubes twelve or thirteen.
- η. *disticha* ; stem setaceous, decompose-pinnate, distichous ; branches bi-tripinnate, with a subdefined, oblong or ovate outline, the pinnæ and pinnulæ remarkably patent ; internodes of the pinnæ rather shorter than their breadth, of the pinnules as long as broad ; tubes eleven or twelve.
- θ. *Durkeei* ; robust, compressed, decompose-pinnate, distichous ; branches with a definite, oblong outline, bi-tripinnate ; pinnæ naked at base, pinnulate above, pinnules erect ; all the internodes much shorter than their breadth. *Pol. Durkeei*. *Harv. MSS.* (TAB. XVII. C.)

HAB. In rock pools between tide marks, and in deep water, attached to rocks and shells, &c. Perennial. Var. α. *Sitcha*, *Barclay* ! Prince Edward's Island, *Dr. Jeans*. Nahant, *W. H. H.* Newburyport, *Miss Townsend*. Staten Island, *Prof. Bailey*. Red Hook and Fort Hamilton, *Messrs. Hooper, Pike, Walters, &c.*, *W. H. H.* β. Halifax, *W. H. H.* γ. New Bedford, *Dr. Roche*. δ. Yellow Hook, New York, *Mr. Walters*. ε. Ship Anne Point, *Messrs. Walters and Hooper*. Boston Bay, *Capt. Pike*. New Bedford, *Dr. Roche*. ζ. West Coast, *A. Menzies, Esq.* (1788). η. Newport, *Mr. Olney*. Long Island Sound, *Capt. Pike*. Fort Hamilton, *Messrs. Hooper, Walters, Congdon*. θ. Germantown, *Dr. Durkee*. New Haven, *Dr. Durkee and Mrs. Babcock*.

Some of the above varieties are so unlike the normal form of this species (our var. α. *fucoides*), that were there not intermediate states they might readily pass for distinct species. The number of tubes in the stem is extremely variable in different specimens, even where there is no other difference. In some I have found them as few as eleven, in others as many as eighteen ; the more common numbers being twelve and fifteen. The length of the internodes is more constant in the several varieties, when the penultimate divisions of the frond are compared. The best general marks for the species are its decompose, pinnate branching, penultimate ramuli, naked below and pinnulate above the middle, and many tubed internodes of moderate length.

Var. α. *fucoides*. *Stems* 6-12 inches long, as thick or twice as thick as hog's bristle, rigid below, flaccid above, many times decompose ; the lesser branches very dense and bushy, of equal length ; the ultimate ramuli very erect, fastigiata,

crowded toward the ends of the branches. *Conceptacles* scattered on the ramuli. *Internodes* seldom more than twice as long as broad, often shorter. *Tubes* 12-13-15 18-20 in different specimens. Lower part of the stem somewhat opaque, partially coated with surface cells. *Colour* a blackish purple. *Substance* tough. A common North American form.

Var. *β. affinis*. *Stems* 12-18 inches long, thicker than hog's bristle, more distantly branched than var. *α*, with the branches more naked in their lower half. This variety, which I believe always grows in deep water, beyond tide marks, is further remarkable for the greater length of internodes of the stem.

Var. *γ. plumosa*. *Stems* 8-10 inches long, as thick as hog's bristle, undivided, but set throughout at short distances with lateral branches, the lowest of which are longest, the upper gradually shorter, giving the general frond a pyramidal outline. These branches are lanceolate in outline, slender, and many times pinnated, the decompound ramuli being capillary and almost byssoid. *Internodes* of the lesser branches thrice or four times as long as broad; opaque towards the base of the stem. *Colour* a purplish brown. *Substance* soft and flaccid. In drying, all parts, except the base of the stem, adhere closely to paper.

Var. *δ. gracillima*. *Stem* 8-10 inches long, scarcely as thick as hog's bristle below, capillary above, laxly set with distantly pinnated, slender, capillary branches. *Ramuli* but slightly compound. *Internodes* of the branches very long; from five to six or eight times as long as broad, of the lesser branches shorter. Of this variety I have seen but a solitary specimen, which is so unlike the ordinary state of the species, that I had at first considered it specifically distinct; but it seems, on closer examination, to be intermediate between the preceding and following forms. The great length of the internodes is, however, a striking peculiarity.

Var. *ε. tenuis*. *Stem* 6-10 inches long, as thick as hog's bristle, attenuated upwards, decompound pinnate; branches closely set and three or four times compounded, the pinnæ and pinnulæ sometimes subdistichous, sometimes spirally spreading. *Internodes* of the branches 4-5, of the pinnæ 3-4, of pinnules thrice as long as broad. *Colour* a blackish brown. *Substance* flaccid, but not lubricous. In drying, it does not strongly adhere to paper. Not an uncommon American form. It has the aspect of var. *α*, but is much more slender, and has much longer internodes.

Var. *ζ. Menziesii*. *Stems* 3-4 inches high, as thick as horse hair, distantly branched; branches alternate, virgate, naked below, or with a few distant squarrose or revolute simple ramuli, bipinnate above, narrow oblong in circumscription, distichous. *Pinnæ* half an inch long, the lowest pinnulæ frequently recurved or curled, the upper erectopate. *Tubes* 13. *Colour* dark brown. Characterised by the squarrose or revolute ramuli. The specimens described are marked "*Rhodomela floccosa*" in the Menziesian Herbarium. A specimen of the true *R. floccosa*, which was first discovered by Mr. Menzies, is fastened on a separate sheet. Our plant is much smaller and more slender, and the microscopic analysis very different. Though peculiar as a form, I do not think it can be separated by essential characters from *P. nigrescens*.

Var. *η. disticha*. *Stem* as thick as hog's bristle, 4-6 inches long, distichously

branched ; the main stem and branches somewhat angularly bent. All the divisions patent, and all the internodes short. *Substance* rigid. *Colour* very dark. This variety is readily known by its patent, distichous branches, rigid substance, and internodes uniformly shorter than in the preceding forms, with which it seems to connect the following.

Var. *θ. Durkeei*. *Stem* 2-3 inches high, thicker than hog's bristle, compressed (?), distichously branched, repeatedly pinnate ; the main stem either simple or forked, with several lateral branches. *Branches* definitely circumscribed, round-topped, bi-tripinnate, the pinnæ a line asunder, patent ; pinnules subulate and erect. *Articulations* visible in all parts of the frond, and uniformly much shorter than their diameter. *Colour* a dark brown. *Substance* rather rigid. This plant, which I first received from Dr. Durkee of Boston, is so unlike many of the preceding varieties, particularly those called *plumosa* and *gracillima*, that few persons, on a mere inspection of a solitary specimen, would suspect them to belong to the same species ; and when first I examined Dr. Durkee's specimen I regarded it as specifically distinct, and hoped it might be allowed to bear his name. A more extended reference to other specimens from various quarters now induces me to consider it a very extreme form, in which the characters of the var. *disticha* are exaggerated.

Plate XVII. C. *Fig. 1.* *POLYSIPHONIA nigrescens, var. Durkeei* ; the natural size. *Fig. 2,* part of a branch and ramulus ; *fig. 3,* cross section of a branch ; both magnified.

25. *POLYSIPHONIA Woodii*; stem robust, flexuous, strongly compressed, distichously branched, decompound-pinnate; pinnæ (or primary branches) distant, patent, tri-quadrupinnate, the pinnules pinnato-multifid; ultimate ramuli subulate, incurved; internodes in all parts of the frond very much shorter than their diameter, many striate, with pellucid dissepiments, those of the stem with two (!) axes of radiation; tetraspores in a single row in the ramuli.

HAB. On the Pacific Coast, in lat. 38° 12', Lieut. Wood (1846). Golden Gate, California, *Capt. N. Pike* (1851). (v. s. in Herb. Hook. et T. C. D.)

Frond (in the largest specimen seen by me) about 5 inches long, twice as thick as hog's bristle, compressed, somewhat zigzag, distichously branched ; the branches half an inch asunder, alternate, patent, one to two inches long, nearly equal, decompound pinnate, their primary pinnæ half an inch long, about three or four times pinnately parted, all the laciniaë alternate. The ultimate ramuli are subulate, acute, incurved, not a line in length. Every part of the frond is exactly distichous. The internodes are visible throughout with the help of a pocket lens, and are much shorter than their breadth, about ten striæ or tubes being visible on a lateral view in the ramuli, and a greater number on the larger branches. All the interspaces are pellucid ; in the stem only are the internodes partially coated with secondary cellules. A transverse section of the stem is a long ellipse, having two axes (or foci) round which the tubes radiate, a structure which I have never seen in any

other species. *Conceptacles* unknown. *Tetraspores* of large size, forming a single row through the centre of the ultimate ramuli. *Colour* a brownish red. *Substance* soft, but not soon decomposing. In drying, the plant adheres closely to paper.

A very remarkable species, abundantly different from any other North American one known to me. I wish it to bear the name of Lieut. Wood, R. N., who, while cruising in the Pacific Ocean in H. M. S. "Pandora," collected several interesting Algæ, which he communicated to Sir Wm. J. Hooker, in whose Herbarium I have examined them. I have recently received from Mr. N. Pike of Brooklyn a Californian specimen agreeing in all characters with Lieut. Wood's original one.

26 *POLYSIPHONIA dictyurus*, J. Ag.; filaments tufted (1-2 inches high) capillary, rather rigid, sparingly branched; branches virgate, simple, set throughout with short, pinnato-multifid, squarrose, quadrifarious ramuli, which are densely crowded toward the ends of the branches; internodes visible throughout, many-tubed, much shorter than their breadth. *Kütz. Sp. Alg. p. 838.*

HAB. Pochetti, Pacific Coast of the Mexican Republic, *Liebman!* (v. s. in Herb. T. C. D.)

Stem short, with a few lateral branches. *Branches* 1-2 inches long, laxly clothed below, very densely set above with short pinnato-multifid ramuli one or two lines in length; the lowest of which are shortest and subsimply pinnate, the upper longer and more compound, their pinnules once or twice forked or irregularly multifid. *Tubes* about twelve in the stem. *Colour* under the microscope a dull brown. *Substance* rigid. It does not adhere to paper in drying.

27. *POLYSIPHONIA thyrsigera*, J. Ag.; "two inches high, tufted, becoming very black in drying, rigid; branches setaceous, virgate, above densely clothed with curved acute, cymose or racemose, tetraspore-bearing ramuli (*Carpoclonia*, Kütz.); internodes of the branches thrice as short as broad, ten-tubed, of the fruit-bearing ramuli twice as short." *Kütz. Sp. Alg. p. 838.*

HAB. La Guayra, Mexico, *Liebman.*

I have not seen this plant, for which I adopt Kützing's description, slightly altered.

27. *POLYSIPHONIA verticillata*, Harv. ; filaments short, creeping, setaceous, sparingly branched; branches erect, densely beset on all sides with simple, incurved, acute ramuli; articulations many-tubed, much shorter than their diameter in the branches, rarely as long as broad in the ramuli; tubes ten or twelve. *Harv. in Bot. Beechey, p. 165 Kütz. Sp. Alg. p. 839.*

HAB. California, *Capt. Beechey*. (v. s. frustulum in Herb. T. C. D.)

One to two inches high, with the aspect of a *Cladostephus*, or perhaps more nearly resembling *Rhodomela larix* in miniature. The ramuli, though very densely set on all sides, imbricate, and crowded round the ends of the branches, are scattered, not whorled. The articulations are on a close examination clearly visible in the branches as well as the ramuli, but, owing to the opacity of the substance, only after long steeping the dry plant. The internodes are uniformly very short, the tubes broad.

I regret that I can throw little additional light on this imperfectly known plant, of which I possess merely one or two minute fragments. These are different from any North American specimens I have seen, but seem nearly allied to *P. dictyurus*. The specific name *verticillata* conveys an incorrect idea.

28. POLYSIPHONIA *fastigiata*, Grev. ; tufts globular, fastigate; filaments rigid, setaceous, of nearly equal diameter throughout, many times dichotomous; axils patent; internodes shorter than their diameter, many-tubed, with a dark central spot; tubes sixteen to eighteen. *Ag. Sp. Alg. Vol. 2, p. 67. Kütz. Sp. Alg. p. 809. Harv. Phyc. Brit. t. 299. Conferva polymorpha, Linn. Dillw. Conf. t. 44. E. Bot. t. 1764.*

HAB. Parasitical on *Fucus nodosus* and *F. vesiculosus*. Common on the East Coast from Halifax to New York. Golden Gate, California, *Capt. Pike*, (v. v.)

Tufts globose, one or two inches in diameter, dense. *Filaments* rigid, dark-brown, excessively branched from the base, the main branches and their primary divisions dichotomous, with wide axils, the ramuli less regular in ramification, and often alternately multifid. All the apices are of nearly the same length, giving the tuft an appearance of having been clipped all round like a thorn bush. The internodes frequently show, besides their longitudinal bands, a dark central spot, which is the coloured bag of the axial cell seen through the outer walls. *Conceptacles* ovate, somewhat acuminate, sessile near the ends of the branches, often two or more close together.

This species, though named *polymorpha* by the earlier writers on Algæ, is very constant to its characters, and if once seen, can hardly be mistaken for any other. It is very constantly found on *Fucus nodosus*, wherever that common littoral plant grows; and more rarely on *F. vesiculosus*. *Capt. Pike's* specimens from the Pacific coast are identical with Atlantic-grown individuals.

IX. BOSTRYCHIA, *Mont.*

Fronde dull purple, filiform, branched, inarticulate (or sub-articulate with very

short internodes), tessellated with quadrate cells; axis tubular, articulated, surrounded by one or more concentric series of oblong coloured cells, which are successively shorter toward the circumference; surface cells quadrate. Ultimate *ramuli* frequently monosiphonous. *Conceptacles* ovate, terminal, containing a tuft of pear-shaped spores. *Tetraspores* contained in fusiform, terminal stichidia, in a double row.

A very natural and now pretty extensive genus, consisting of small Algæ of similarly amphibious habits, and all of a dull, blackish or livid purple colour. It is difficult to distinguish some of them by a definite character from *Dasya*, and others from *Polysiphonia*; others again have been placed in *Rhodomela*. They rarely grow in the open sea. Their favourite localities are near high water mark, often in places where they are seldom submerged, or in brackish water, as the estuaries of rivers; and some grow even in perfectly fresh water, in mountain streams far removed from the sea. The same species, as in the case of *B. vaga* of Kerguelen's Land, may occasionally be traced from the rocks and stones about high water mark, to a considerable distance inland.

The typical species are inarticulate, but are beautifully dotted with large square cells arranged in transverse lines, several cells in each band. Such transverse bands are evidently of the same nature as the many-tubed internodes or articulations of *Polysiphonia*, the difference being one of degree, and not of kind, and consisting in the very short and minute cells of the *Bostrychia* compared to the elongated tubular cells of the *Polysiphonia*. In other species, as our *B. rivularis*, the cells of the stem are longer, and the ramuli are almost articulated, the lower parts pluri-striate, their ends unipunctate or monosiphonous. Yet this species cannot be naturally separated from *B. radicans*, *B. Hookeri*, &c. which are of the typical structure; nor yet again, as I think, from *B. Tuomeyi*, which, were there no such connecting links, would probably be placed in *Dasya*. Again, *B. calamistrata* is in all respects, except in the structure of its ramuli, an orthodox species of *Bostrychia*; but by these single-celled ramuli it is associated with the aberrant *B. Tuomeyi*.

SUB-GENUS 1. EUBOSTRYCHIA. Peripheric cells in several concentric rows (as seen in a cross section of the stem).

1. BOSTRYCHIA *Montagnei*; frond ultrasetaceous, opaque; main stems three or four times pinnated, strongly reflexed or arching backwards; pinnæ distichous, close together, horizontally patent, recurved, the terminal ones often secund; pinnules capillary, pinnulate or bipinnulate, dotted, inarticulate, their tips alone unipunctate, surface cells quadrate; apices inflexed; stichidia elongate, acuminate. (TAB. XIV. B.)

HAB. On the mangrove stems, at high water mark. Key West, *W. H. H.* Bahia Honda, *Prof. Tuomey* (9). (v. v.)

*Fronde*s in large, bushy tufts, three to four inches long. *Stems* thicker than hog's bristle, gradually attenuated upwards, undivided, strongly arched or deflected backwards; in the lower half, generally thorny with the remains of broken branches set one to two lines apart; in the upper half, closely set with distichous, alternate, nearly horizontal branches. *Branche*s bi-tripinnate, the lowermost shorter and less compound, the middle ones longest, the upper short and usually bent in pairs to one side, and thus (falsely) secund. *Stems* and *ramuli* opaque, inarticulate; the stems dotted with many rows of small, quadrate, pellucid-bordered cells, the ramuli dotted with similar but fewer cells, and the extreme tips consisting of a single row of cells. A cross section of the stem shows a minute central cavity surrounded by many rows of small cells, each containing a small purple endochrome. I have not seen conceptacles. *Stichidia* are common, and are formed in the ramuli; they are linear-lanceolate and acuminate and contain a double row of tetraspores. *Colour* a brownish purple, varying in intensity. *Substance* rigid. The plant does not adhere to paper in drying.

This forms large tufts on the stems of mangrove trees at various places near Key West, and probably occurs in similar situations among the other reefs and keys. It invests the stems up to the very limit of high water mark, and is consequently left dry for many hours each tide; and then strongly resembles collapsed fronds of *Hymenophyllum Tunbridgense*.

The specific name is imposed in honour of Dr. Camille Montagne of Paris, the well known author of many works on Cryptogamia, and who first defined this genus. *B. Montagnei* is one of the largest and handsomest species with which I am acquainted, and I have much pleasure in dedicating it to my learned friend.

Specimens of a strangely metamorphosed variety of this plant, said to have been collected at Valparaiso, have been communicated to me by Mrs. Tyers of Bristol (England). In this variety or monstrosity, several of the secondary branches (or primary pinnæ) are resolved into a system of capillary, subdichotomous, excessively divided branches, two to three inches long. This completely alters the aspect of the plant, and these feathery specimens might pass for a different species, were it not that, on the same stem, some branches retain their proper character.

Plate XIV. B. *Fig. 1.* *BOSTRYCHIA Montagnei*, the natural size. *Fig. 2.* portion of a branch, with pinnæ; *fig 3,* a pinnule and a stichidium, on opposite sides of the branchlet; *fig. 4,* transverse section of the stem; more or less highly magnified.

2. *BOSTRYCHIA calamistrata*, Mont.; stem subcompressed, inarticulate, dotted, alternately branched; branches distichous, subhorizontally patent, oblong, circumscribed, bi-tripinnate; pinnæ closely set, dotted; pinnulæ capillary, multifid, involute, articulate, single-tubed; articulations rather longer than broad; conceptacles ovate, terminating the dotted pinnæ; stichidia similarly placed (on different individuals) spindle shaped, incurved. *Mont. Nat. Hist. Cuba, p. 36, t. 4, fig. 1. Harv. Ner. Austr. p. 68. (var. repens). (TAB. XIV. C.)*

HAB. On mangrove stems, and on logs about the wharf, at Key West, *W. H. H.* (No. 7). Pine Island, *Prof. Tuomey* (10^b.) (v. v.)

Stems 1-2 inches high, as thick as hog's bristle, alternately branched; branches an inch long, horizontally patent, simple or once or twice divided, distichous, closely bi-tri-pinnate. The lower parts of the stem are generally beset with short, spine-like, broken branches, the remains of earlier growth; the upper parts, as well as the main branches and their divisions, closely beset with very slender, alternate, patent, simple or multifid, inflexed or involute, capillary ramuli. The stems and branches and the primary pinnæ are solid, inarticulate, and dotted with quadrate cells; the pinnulæ and their divisions articulate, formed of a single series of oblong cells, once and half or twice as long as broad. A cross section of the stem shows a small central cavity surrounded by numerous rows of coloured cells. *Conceptacles* ovate, terminating the primary pinnæ, containing a tuft of pear-shaped spores. *Stichidia* spindle shaped, terminal, curved, acuminate. *Colour* a brownish purple. *Substance* cartilaginous, rigid. It does not adhere to paper.

Our specimens agree with those received by Dr. Montagne from Cuba. They differ from the plant described in *Harv. Ner. Austr.* as above quoted, in being erect, and destitute of root-like discs.

Plate XIV. C. *Fig. 1.* *BOSTRYCHIA calamistrata*, the natural size. *Fig. 2,* apex of a branch, with conceptacles; *fig. 3,* a conceptacle and ramulus; *fig. 4,* spores; *fig. 5,* small portions of the ramulus; *fig. 6,* cross section of the stem; *fig. 7,* a stichidium; all more or less highly magnified.

SUB-GENUS 2. STICTOSIPHONIA. Peripheric cells in a single row

3. *BOSTRYCHIA rivularis*; stems an inch high, rising from creeping filaments, capillary, bipinnate; pinnæ distichous, alternate, patent, inarticulate, tessellated with subquadrate cells; pinnulæ subdistant, simple or forked, attenuate, marked with about two rows of oblong cells; peripheric cells seven or eight; conceptacles ovate, terminating the lowest pinnæ, which are then abbreviated and bare of pinnules. (TAB. XIV. D.)

HAB. Isle of Shoals, *Mr. Pike*. Hellgate, New York, *Mr. Hooper*. On *Spartina glabra*, and on the Palmetto logs in the Ashley and Cooper Rivers, Charleston, *Prof. Bailey and W. H. H.*, also found by *Prof. Bailey* in the St. John's River, Florida. (v. v.)

Fronds an inch high or less, slender, spreading over the logs in wide patches, rising from a mat of creeping fibres, attached here and there by discs. *Stems* somewhat flexuous, erect, pinnate or bipinnate, or in luxuriant specimens sub-tripinnate. *Pinnæ* alternate, distant, spreading, laxly pinnulate. *Pinnulæ* also patent, subulate, sometimes again compounded. The whole frond is tessellated with quadrate or oblong cells arranged in longitudinal rows, the ramuli having about two rows, the larger

divisions three or four. A cross section of the stem shows seven or eight cells surrounding a central cavity. *Conceptacles* borne on the ends of shortened branches. I have not seen stichidia. *Colour* a dull brownish purple. *Substance* rigid. It does not adhere to paper in drying.

This plant is abundant in estuaries of rivers in Carolina and Florida, and probably in other Southern States. The only other specimens I have seen were given me by Capt. Pike of Brooklyn, having been collected by him in July, 1848, at the Isle of Shoals (lat. 43°); and by Mr. Hooper, collected at the estuary of the Hudson. I have not heard under what circumstances Capt. Pike's plant grew, whether in open sea or estuary. There is no appreciable difference in ramification between it and the Carolinian specimens.

Plate XIV. D. *Fig. 1.* *BOSTRYCHIA rivularis*, growing on a piece of wood; the *natural* size. *Fig. 2*, two erect stems, rising from a creeping filament; *fig. 3*, pinna and portion of a stem; *fig. 4*, cross section of the stem; *fig. 5*, conceptacle; all *magnified*.

4. *BOSTRYCHIA Tuomeyi*; frond capillary (small), irregularly divided; branches erecto-patent, not much branched, articulato-tessellate, four-tubed and subquadrangular, rough with broken ramuli below, densely clothed with very slender, inflexed, alternately branched, single tubed ramuli above; cells of the ramuli once and half to twice as long as broad. (TAB. XIV. E.)

HAB. On rocks. Pine Islands, Florida, *Prof. Tuomey*. (10). (v. s. in Herb. T. C. D.)

Fronds tufted, about inch and half high, capillary, irregularly divided into numerous, erecto-patent, simple or forked branches. Lower part of the stem and branches naked, or beset with the spine-like remains of broken ramuli; the upper and younger parts densely clothed with inflexed, very slender, slightly branched ramuli. The stem and branches are tetrasiphonous, four large coloured cells surrounding a central cell; and when viewed laterally appear articulate, the internodes shorter than their breadth and marked with three tubes. The *ramuli* are formed of a single string of cells. *Colour* a dark lurid purple. *Substance* rather soft. In drying, it adheres pretty firmly to paper.

I have seen no fructification, and the generic relations are therefore at present doubtful, the structure of the frond being that of a *Polysiphonia* with very short internodes. Still it seems to me to range naturally in the present group, from the other species of which it chiefly differs in having very few (four) cells in the peripheric stratum. The ramuli are of precisely the same structure as those of *B. calamistrata*, and the colour is that blackish purple so characteristic of this genus.

I bestow the specific name in compliment to Prof. Tuomey, of the University of Alabama, to whom I am indebted for an interesting collection of Floridan Algæ.

TAB. XIV. E. *Fig. 1*, *BOSTRYCHIA Tuomeyi*; the *natural* size. *Fig. 2*, apex of a branch; *fig. 3*, small portion of a branch, to show the cellular structure; *fig. 4*, cross section of the same; *fig. 5*, a ramellus; *fig. 6*, small portion of the same; all more or less highly *magnified*.

X. DASYA. *Ag.*

*Fron*d filiform or compressed, branching, opaque or rarely articulated, having a polysiphonous, articulate axis, coated externally with accessory cells. *Branches* beset with, or resolved at their ends into slender, single-tubed, confervoid, articulate ramelli. *Conceptacles* ovate, acuminate, sessile or pedicellate, affixed to the compound branches, and containing a tuft of pear-shaped spores. *Tetraspores* in lanceolate stichidia (or transversely banded, pod-like receptacles) formed on the confervoid ramelli.

A large and considerably diversified genus, occurring in both hemispheres. As here understood, it is chiefly characterised by the confervoid, jointed ramelli, issuing from a compound, polysiphonous, but mostly opaque and outwardly inarticulate frond; and the lanceolate, pod-like receptacles of tetraspores, borne by the confervoid ramelli, out of whose branches they are formed. The ramelli are of the same structure as the articulated fibres which clothe the ends of the young branches in *Polysiphonia*, *Rhodomela*, etc. but in those genera they are mostly colourless, very fugacious, and have no connection with the tetrasporic fructification; in *Dasya*, on the contrary, they are persistent, containing coloured cells, and finally originating the tetrasporic fructification. In the former cases they accompany the early development of the branches only, in the latter they are characteristic of the species at all ages. In *Bostrychia* the stichidia are borne by the compound branches, and in *Polysiphonia* the tetraspores are dispersed through slightly modified and distorted polysiphonous ramuli.

In the *Nereis Australis* (p. 58) I have grouped the species under five subgenera, four of which are represented on the North American coasts: viz.

SUBGENUS 1. *COMPOSTEIA.—*Fron*d more or less distinctly articulated, especially in the upper branches, decompound-pinnate, distichous; the lesser branches dichotomous, resolved at the apices into dichotomo-multifid, confervoid ramelli.

1. DASYA (COMPOSTEIA) *Gibbesii*; stem compressed, areolate, inarticulate, with a central line of short, transverse striæ (nodes of the axial tube), distichously branched, decompound-pinnate; branches bi-tripinnate, with an obovate outline; pinnules subarticulate, dichotomous, their terminal divisions resolved into dichotomous, single-tubed, fastigiate, confervoid ramelli; articulations of the ramelli twice

* This subgenus (misspelled *Campsotela*) is strangely misunderstood by Kützing in his "Species Algarum," p. 797—only two out of the fifteen species which he enumerates agreeing with the character. His first species is a *Callithamnion*; his 3rd, 5th, 10th, are *Rhodonemata*; his 9th a *Wrangelia*; his 11th, a *Stichocarpus*; 12th, a *Lophothalia*; and 14th and 15th, *Bostrychia*. The name given to this uncombed assemblage is *Eupogonium*.

as long as broad ; apices bluntish ; stichidia lanceolate-acuminate, on the lower forks of the ramelli. *Polysiphonia Gibbesii*, Harv. MSS. in *Herb. Gibbes*. (TAB. XV. A.)

HAB. At Key West, abundant. Dr. Wurdeman, Prof. Tuomey (27), W. H. H. (8), &c. (v. v.)

Root a small disc. *Fronde* tufted, 4-8 inches high, half a line to nearly a line in diameter in the middle, and tapering to the base and apex, distichously much branched. *Stem* undivided, slightly zigzag, naked for an inch or more above the base, thence upwards furnished at intervals of about half an inch with several alternate branches, much narrower than the part from whence they spring, the lower ones long, and again compounded, the upper gradually shorter. *Branches* in circumscription obovate, fastigate, round-topped, twice or thrice pinnated ; the pinnules dichotomous, with rounded angles, their ultimate divisions resolved into single-tubed, many times dichotomous ramelli. The stem and branches are compressed, coated with polygonal cells, inarticulate, with a medial row of minute dark coloured, transverse lines, a quarter of a line apart and visible to the naked eye, or with a pocket lens. These lines are the nodes of the central tube of the axis of the frond. The pinnules are cylindrical and articulate, polysiphonous and somewhat veiny in their lower parts, few-tubed in the upper, and at length passing into the single-tubed ramelli. The *stichidia* are numerous on the lower forks of the ramelli ; several on the same ramellus ; they are pedicellate, oblongo-lanceolate, acuminate, and contain a triple series of large tetraspores. *Conceptacles* unknown. *Colour* a purplish lake, growing darker and browner in drying. *Substance* of the stem and branches cartilaginous, of the ramelli soft and tender. In drying, the plant adheres pretty firmly to paper.

A beautiful species, unlike any other North American one, but allied to *D. Gunniana* and *D. Laurenciana* of Tasmania, from both which, however, it is abundantly distinct. The name is given in honour of Prof. Lewis R. Gibbes of Charleston, from whom I received the first specimen of this and several other interesting Algæ of Florida.

Plate XV. A. *Fig. 1.* *DASYA Gibbesii* ; the natural size. *Fig. 2,* apex of a lesser branch with terminal ramelli and stichidia ; *fig. 3,* a stichidium ; *fig. 4,* a tetraspore ; *fig. 5,* portion of a ramellus ; *fig. 6,* part of the stem, to show surface cellules, and medial, dark striæ ; *fig. 7,* longitudinal section of the same through the smaller diameter ; *fig. 8,* transverse section ; all more or less magnified.

SUBGENUS 2. RHODONEMA. *Frond* inarticulate or rarely articulate, cylindrical, irregularly branched ; branches more or less completely clothed on all sides with dichotomous, single-tubed, confervoid ramelli. *Stichidia* glabrous.

2. *DASYA* (RHODONEMA) *elegans*, Ag. ; frond very soft and flaccid, soon decomposing ; stem robust, inarticulate, elongate, alternately decomposed ; branches filiform, of unequal length, undivided, all the younger parts clothed with byssoid,

purple-lake, dichotomous ramelli ; articulations of the ramelli many times longer than broad ; conceptacles urnshaped, on long pedicels, rising from the branches ; stichidia linear-lanceolate. *Ag. Sp. Alg.* 2, p. 117. *Kütz. Sp. Alg.* p. 796. *Rhodomena elegans*, *Mert.*

HAB. Growing on other Algæ, on woodwork, rocks, &c. from low water mark to the depth of several fathoms. Annual. Nantucket, *Dr. Durkee*. Greenport. Providence, *Prof. Bailey and Mr. Olney*. Very common in New York Harbour from Hellgate to Red Hook, *Messrs. Bailey, Hooper, Walters, Pike, Congdon, Calverley, &c.* Charleston, *Prof. Gibbes, W. H. H.* Key West, *Prof. Tuomey, Dr. Blodgett, W. H. H.* (v. v.)

Root discoid. *Stems* from six inches to one, two, or three feet long, varying in diameter from the thickness of hog's bristle to that of a crowquill, or in the larger specimens from one to two lines in diameter, softly cartilaginous when quite fresh, but soon becoming very flaccid, either quite simple or divided below into a few secondary stems, and set throughout the whole length with numerous lateral branches, spreading on all sides. The branches are very irregularly placed, sometimes widely scattered, sometimes densely crowded ; alternate or subopposite, or even fascicled ; they are simple, patent, virgate, either destitute of lesser branches, or furnished with very numerous, short lateral branches, so that the general frond is sometimes but slightly divided and sometimes very bushy. All the larger and smaller branches and the main stem when young are densely clothed with exceedingly slender, bright purple, soft, confervoid ramelli. These *ramelli* are from two to four lines long, dichotomous, a few times distantly forked, with the terminal lacinia very long and filiform, but not tapering to the apex ; the apical cell being very blunt. The articulations of these ramelli are of great length. *Conceptacles* abundantly scattered along the branches, on long stalks. *Stichidia* attached to the ramelli, one or more on each ramellus near its base, very slender, lanceolate, acuminate, containing a double or triple row of tetraspores. *Colour* in all parts a brilliant purple lake, well preserved in drying. *Substance* soon decomposing in fresh water. In drying, the plant adheres most closely to paper.

There are two principal forms ; one, which grows in deep water, has very long simple branches, destitute of laterals ; the other, which grows within tide marks, is short and bushy, with abundant secondary branches. The European forms of this plant do not essentially differ.

3. *DASYA (RHODONEMA) ramosissima* ; stem cartilaginous, tough, inarticulate, robust, attenuated and flaccid upwards, much branched ; branches several times alternately decompound, denudate ; ultimate divisions setaceous, subarticulate, more or less completely clothed with dichotomous ramelli ; their apices incurved, attenuate ; articulations three to five times as long as broad. *Var. a* ; frond naked, except the tips of the ultimate branches, which are crowned with a dense tuft of

ramelli. Var. β . more densely branched and bushy, with shorter branches, and more diffused, more copious, and much attenuated ramelli.

HAB. At Key West, *W. H. H.* (9, 10). (v. v.)

Fronde six to twelve inches long or more, as thick as sparrow's quill below, much attenuated upwards, divided near the base into several principal branches or stems, which are excessively decompound and bushy; each set of lesser branches springing along the sides of the primary branches irregularly. The ultimate branches are from half an inch to an inch long, not so thick as hog's bristle, imperfectly jointed, the internodes areolated with irregularly formed cells, and about as long as broad; they are sometimes naked except at the extremity, but are more usually clothed beyond the middle with densely crowded ramelli. These ramelli are from a quarter line to a line in length, of much greater diameter than those of *D. elegans*, erectopotent, dichotomous, their divisions generally arched inwards and tapering to a point. The axils are all narrow. The articulations very variable in different individuals, sometimes only about as long as broad, sometimes 3-5 times as long. A cross section of a small branch shows five primary tubes, surrounded by numerous external cells, smaller to the circumference: in the larger branches and stem the external border of cells is proportionably thicker and denser. I have only seen immature *stichidia*; they are linear oblong, and subacute, on the first or second forks of the ramelli. *Colour* a brownish red or purplish brown, becoming much darker in drying. *Substance* tough and tenacious, but very soft. This plant bears immersion in fresh water for some time without injury, and in drying adheres strongly to paper.

4. *DASYA* (RHODONEMA) *mollis*; robust, very soft and flaccid, alternately much branched, bushy; branches inarticulate, twice or thrice compounded, their ultimate divisions short; all the younger parts clothed with confervoid ramelli which are laxly scattered on the larger and densely imbricated on the smaller branches; ramelli patent, dichotomous, from a robust base much attenuated, and very slender; axils wide; lower articulations short and cellular, upper four to six times as long as broad, single tubed; *stichidia* oblong-acuminate.

HAB. Key West, rare. *W. H. H.* (14). (v. v.)

Fronde 2-3 inches high, as thick as sparrow's quill, irregularly much branched, bushy, often wider in the spread of the branches than the height of the stem. The stem in my specimens divides a short distance above the base into three or four main divisions, which spread subhorizontally, fork irregularly, and are decompoundly once or twice divided: the branches alternate, or irregular, of unequal length, long and short indiscriminately mixed. All the branches and their divisions are hirsute with squarrose, patent ramelli, laxly scattered over the older

parts, crowded on the younger, and very dense toward the extremities. These ramelli are about a quarter of a line long, their lower forkings much thicker than the upper, which are rather suddenly attenuated and very slender, the terminal divisions much prolonged. The lower articulations of the ramelli are about as long as broad, sub-opaque and multicellular; the upper cylindrical, 4-6 times as long as broad. A cross section of the stem shows five large primary tubes and five alternate secondaries, surrounded by small cells. *Stichidia* near the base of the ramelli, one on each, sessile, oblong-acuminate, very acute, containing a triple row of tetraspores. *Substance* exceedingly soft and tender. *Colour* pale red, rosy toward the tips. It closely adheres to paper.

A smaller plant than *D. ramosissima*, with more slender ramelli. The external habit and the substance are more those of a *Dudresnaia* than of a *Dasya*.

5. *DASYA* (RHODONEMA) *mucronata*; robust, elongate, cartilaginous, inarticulate, decomposed; branches several times alternately divided, denudate, their extremities and the smaller branches densely clothed with squarrose, rigid, confervoid ramelli; ramelli robust, patent, dichotomous, their axils wide and divisions divaricating, their apices remarkably mucronate; articulations twice as long as broad, dissepiments slightly contracted.

HAB. Abundant at Key West, *W. H. H.* (11). (v. v.)

Root a spreading disc, sometimes half an inch in diameter. *Stems* one or more from the same base, six to eight inches long or more, as thick as crowquill below, attenuated upwards, simple or once or twice divided, bare of branches for an inch or two above the base; thence upwards furnished with numerous scattered or crowded, alternate or irregular lateral branches. These branches are about as thick as hog's bristle, 4-5 inches long, the lowest longest, and are furnished with one, two, three, or more series of similar lateral branches, all of which spread at wide angles; the penultimate ones short. The larger branches are generally denuded in full grown plants, but all the younger portions are clothed on all sides with ramelli, which are particularly dense toward the extremities. These *ramelli* are scarcely half a line long, rather rigid, standing on the branches at right angles, and are many times regularly dichotomous, with divaricating branches. The terminal cell of each segment of the ramellus is very small, subulate and acute, forming a mere *mucro* to the large oblong cell immediately below it. The articulations are uniformly about twice as long as broad. A transverse section of a branch shows five large primary tubes, surrounded by a wide band of small cells. The colour of the stem and branches is a dull brownish red, of the ramelli brighter and more rosy. The *substance* is firmer and more rigid than in most others of this genus. In drying, it does not adhere strongly to paper.

This species is frequently infested by parasites. It is one of the largest and coarsest of the subgenus, and readily known, on microscopic examination, by the mucronate ramelli.

6. *DASYA* (RHODONEMA) *Wurdemanni*, Bail. ; capillary, of small size, (an inch high), once or twice forked ; secondary branches alternate or secund, arched, articulate, hirsute with squarrose ramelli ; ramelli very patent, many times dichotomous, sub-rigid, their divisions divaricating, apices acute, articulations once or twice as long as broad. (TAB. XV. C.) var. β . *dichotoma* ; more regularly dichotomous, with shorter and straighter secondary branches.

HAB. Abundant on Algæ and corals, at Key West. *Dr. Wurdeman, W. H. H.* (15). (v. v.)

This forms small, roundish, dense, fastigate tufts, or often is entangled among the branches of the Algæ which it infests.

The *stems* are an inch or two high, about as thick as coarse human hair, once or twice forked, and then alternately or secondly branched. The secondary branches are very frequently secund, erect, arching inwards, with the ends inrolled, and are beset throughout with ramelli which are short and subdistant below, gradually longer and more densely set above, and also longer and more numerous on the outer than on the inner side of the curved branch. These ramelli stand almost at right angles on the branch, are several times forked, with very wide axils and divaricated segments, and their articulations are seldom more than twice as long as broad. The stem and branches are obviously jointed, the internodes few-tubed with pellucid nodes, but I have not been able to determine the number of tubes, whether four or five, owing to the very imperfect absorbent powers of the dried cells. The *colour* is a dull red, inclining to brown. The *substance* is somewhat rigid, not at all lubricous. In drying, the plant adheres pretty firmly to paper.

β . is a little different in aspect, the stem being more regularly dichotomous, the secondary branches shorter and straighter, and the ramelli more equally distributed. It somewhat resembles some weak-growing forms of *D. arbuscula*, to which *D. Wurdemanni* is certainly allied, although perfectly distinct.

The specific name was bestowed by Prof. Bailey in honour of the late Dr. Wurdeman, who first detected this curious little species, and to whom we are indebted for an interesting series of Key West Algæ.

PLATE XV. C. *Fig. 1*, *DASYA Wurdemanni*; the *natural* size. *Fig. 2*, some branches; *fig. 3*, portion of a branch, with ramellus; the latter figures *magnified*.

SUBGENUS 3. LOPHOTHALIA. *Fronde* articulate or opaque, four-tubed, virgate, alternately branched ; branches naked or clothed with simple or pinnated, single tubed, confervoid ramelli. *Stichidia* rising from the branches, hirsute with ramelli.

7. *DASYA* (LOPHOTHALIA) *Tumanowiczi*, Gatty ; stem cartilaginous, opaque, robust, attenuated upwards, alternately decompound ; branches elongate, setaceous, their divisions capillary, set with short spine-like branchlets, and imperfectly articulated ; internodes once and half as long as broad, coated with polygonal cells ;

branchlets articulate; ramelli few, near the ends of the branches, sub-simple or pinnate; stichidia lanceolate, clothed with ramelli (formed in the rachis of a pinnated ramellus). *D. chordalis*, Harv. in Herb.

HAB. Key West, W. H. H. (12), Dr. Blodgett (59 and 75). West Indies, Mr. Tumanowicz. (v. v.)

Root scutate, with lateral, branching fibres. Stem 6—12 inches long or more, as thick as sparrow's quill at base, tapering upwards and capillary above, cartilaginous and tough below, very flaccid above, much branched; dividing near the base into several principal branches or secondary stems, which are repeatedly compound in an irregularly pinnate manner. The primary division sometimes, from repeated suppression of parts, appears dichotomous; sometimes several of the secondary branches are secund, and in other specimens crowded together and almost tufted. The secondary branches are about as thick as hog's bristle, several inches long, simple or having a second or third series of similar thread-like branches, beset at short intervals with minute, spine-like, subulate ramuli. These latter are readily seen with the help of a pocket lens, but not very obvious without one, and are articulate, each consisting of four or six four-tubed internodes of equal length and breadth. The main stem and larger branches are opaque, coated with irregular cells; the younger branches imperfectly jointed, the internodes areolated with irregular polygonal cells, and about once and half as long as broad. A transverse section of a small branch shows four primary and four alternate secondary tubes, and about eight small superficial cells; a section of the stem still exhibits the four primary tubes, but the external coat is very wide and dense. Single tubed ramelli are irregularly scattered on the younger parts of the branches, as well as on the spine-like ramuli, from whose axils they often issue; they are slender, pinnate, sometimes bi-tri-pinnate, the pinnae very erect; and the articulations 3-4 times as long as broad. Stichidia are formed from the swelling of the upper portion of the rachis (or jugament) of these ramelli, and are densely clothed with the pinnules; they are moniliform, and contain a string of tetraspores. When the transformation is incomplete, the stichidium appears as if borne on the end of the rachis, but sometimes almost the whole ramellus is converted into fructification. Colour a fine clear red. Substance tough but soft. In drying, the plant adheres closely to paper.

I have received a West Indian specimen of this plant from Mrs. Gatty, at whose request I give it the name of the gentleman from whom she received it, Mr. Tumanowicz, a Pole now resident in England, and a most ardent student of marine botany. I believe I have already distributed some specimens under the MSS. name *chordalis*, which I now lay aside.

8. DASYA (LOPHOTHALIA ?) *lophoclados*, Mont.; stem setaceous, irregularly dichotomous, sub-articulate; branches divaricating, decompound, their ultimate divisions articulate; all the younger parts of the frond densely clothed with sparingly

branched, alternately divided, straight, hairlike ramelli; internodes of the stem about once and half as long as broad, of the ramelli many times longer than their diameter; fruit unknown. *Mont. An. Sc. Nat.* 1842, p. 254. *Polysiphonia lophocladus*, Kütz. *Sp. Alg.* p. 834.

HAB. Floating in the sea near Key West, *Prof. M. Tuomey* (No. 6). (v. s. in Herb. T. C. D.)

Stems 3-4 inches long or more, as thick as hog's bristle, attenuated upwards, several times irregularly forked, the divisions widely spreading with very obtuse angles, the lesser branches more and more irregularly forked, the ultimate ones alternately divided. The lower parts of the stem are subopaque; the larger branches generally exhibit more or less definite veiny internodes, and the smaller branches are clearly articulate, their internodes once and half as long as broad, thinly coated with minute cells. A cross section of a branch shows four large primary tubes, four secondaries and several external cells. The ramelli are very slender, about a line long, or a little longer, straight, erectopate, spreading on all sides and abundantly clothing the lesser divisions of the frond; they are less frequent on the larger branches, and altogether wanting in the lower parts. They are not much branched, between alternately pinnate and dichotomous, their branches simple, very long and straight. The articulations toward the base of the ramellus are twice or thrice as long as broad, in the middle part 8-10 times their diameter. The colour of the stem is brownish, that of the ramelli a purple lake, browner in drying and greenish in decay. The substance is soft and delicate. In drying, it adheres closely to paper.

I have compared my specimen with a fragment of Dr. Montagne's Haytian one, and they seem of the same species. The fruit is not known, but the habit is that of *Lophothalia*, and should this subgenus ever rank as a genus, this species ought to be called *L. Montagnei*.

SUBGENUS 4. STICHOCARPUS. *Frond* more or less obviously articulate, many-tubed, crimson-lake, decompound-pinnate, distichous, the ultimate pinnules (ramelli) single-tubed, simple, subulate.

9. DASYA (STICHOCARPUS) *plumosa*, Bail. and Harv.; frond inarticulate, compressed, two-edged, distichously bi-tripinnate; the pinnæ elongate, pinnules short, both alternate and densely beset with distichous, often opposite, straight, simple or forked, single-tubed ramelli; articulations of the ramelli thrice as long as broad. *Bail. and Harv. in Bot. Expl. Exped.*

HAB. Puget's Sound, *Capt. Wilkes*. (v. s. in Herb. Sm. Inst.)

A single imperfect specimen of this plant is all that I have seen. The fruit is unknown; the habit is that of a *Ptilota*, but a cross section of the stem shows the

structure peculiar to *Dasya*. The frond is probably several inches long, with an ovate outline, twice or thrice pinnate; the pinnæ elongate, and pinnules short. Both pinnæ and pinnules are closely bordered with distichous, opposite, articulate, confervoid ramelli. *Colour* a clear carmine.

ORDER II.—LAURENCIACEÆ.

Harv. Man. Br. Alg. Ed. 2, p. 95. Laurenciæ, Hook. fil. and Harv. Lond. Journ. vol. IV. p. 539. Chondriæ in part J. Ag. Alg. Medit. p. 67. Harv. Ner. Austr. p. 75. J. Ag. Sp. Alg. vol. 2, Syn. p. x. Lomentariæ, Endl. 3d Suppl. p. 42. Mont. Pol. Sud. Crypt. p. 122. Part of Chondriæ, Chondrosipheæ and Champiæ, Kütz. Phyc. Gen. pp. 435, 438, 439. Part of Chondriæ, Champiæ and Polysiphoniæ, Kütz. Sp. Alg. pp. 849, 861, 842. Lomentariæ (partly), Lindl. Veg. Kingd. p. 25.

DIAGNOSIS. Rose-red or purple seaweeds with a terete or compressed, rarely flattened, inarticulate or constricted and chambered branching frond composed of polygonal cellules. *Sporiferous-nucleus* contained in external, ovate or globose conceptacles; *spores* pearshaped or obconical, sessile or formed in the terminal cells of unbranched or paniculate, tufted spore-threads. *Tetraspores* immersed in the branches and ramuli of the frond, scattered without order among the surface cells.

NATURAL CHARACTER. *Root* either a simple disc, or a mat of branching fibres. *Frond* mostly terete, rarely compressed, more rarely flattened, mostly destitute of midrib, preserving nearly the same breadth throughout, decomposidly branched; the branches generally repeatedly pinnated, opposite or alternate, rarely whorled or tufted; sometimes, but very rarely, dichotomous. In the first suborder the frond is solid, inarticulate and opaque, of a firmly cartilaginous substance, wholly composed of polygonal cells packed together round a central cell into a honey-combed structure, the innermost cells being largest, those towards the surface gradually smaller, and the superficial very minute. Sometimes the axial cells form an articulated single-tubed axis; and sometimes several longitudinal filaments run through the centre of the stem, like an immersed rib. In the second suborder the branches at least are hollow, constricted at intervals, and furnished at the constrictions with transverse diaphragms which divide the cavity into separate chambers, filled with a watery mucus, through which a few confervoid filaments, connecting the diaphragms are dispersed.

The *conceptacles* are of two forms, either globose and destitute of pore, bursting open at maturity; or ovate, furnished with a terminal pore through which the ripe spores are discharged. These conceptacles are either formed in the hollowed apex

of abbreviated branches or ramuli, or they are sessile on the sides of the branches. Their *sporiferous nucleus* exhibits considerable modification in the different genera. In the *Bonnemaisoniæ* the spores are properly pear-shaped, rounded at the apex, and tapering at the base into a very slender spore-thread or funiculus of which the spore is the enlarged and fertile terminal cell. These spore-threads are always unbranched; in some species very short, in others long, and either rising in a tuft, from the base of the cavity, or from a cellular basal placenta, which occasionally fills up a considerable part of the cavity and is divided into several lobes. In the *Lomentariæ* the spores are more properly obconical than pear-shaped, truncate at the apex and tapering but slightly at the base. In *Lomentaria* (*Chylocladia* of British writers, not of Agardh) where they taper most to the base, they are nearly sessile, radiating from a central point and closely packed together into a spherical nucleus. In *Champia* they are sometimes shortly obconical, and sometimes ellipsoidal or oblong, and are borne on a much-branched, confervoid placenta, each spore being formed in the terminal cell of one of the branches. Yet these two genera are so similar in aspect and in the structure of the frond that many species of the latter have by most authors been referred to the former.

The *tetraspores* (known only in *Laurencia*, *Lomentaria* and *Champia*) are *tripartite*, that is, formed of four pieces of unequal size so placed together that three only are visible on a front view, and are dispersed without order either through all the branches, or through the smaller ramuli, where, in some cases, they are collected in a sub-defined cluster near the apices. In this character is found the chief technical distinction between the *Bonnemaisoniæ* and the *Rhodomelaceæ*. The *Lomentariæ* are additionally known by the peculiar structure of the frond and the differences, indicated above, in the sporiferous nucleus.

The colour of the frond in this order is considerably varied in the different genera, and even in the same species under different circumstances. *Bonnemaisonia*, *Delisia*, and *Asparagopsis* (*Lictoria*) are of a most beautiful rosy pink; *Lomentaria* and *Champia*, when in good order, are a purple lake, sometimes reflecting rainbow hues; but their colours are fugacious and, when the fronds grow in sunny places, they very frequently are either greenish, yellowish or nearly colourless. The proper colour in most *Laurenciæ* is a lurid purple, in some brown-red; but light and exposure in shallow water call forth every shade of red, orange and yellow, and sometimes green, the same frond often being variegated with two or more of these tints. Almost all decompose rapidly in fresh water, especially if again moistened after having once been dried.

The substance of the frond is either cartilaginous or gelatinoso-membranaceous. The taste insipid or somewhat pungent. *Laurencia pinnatifida*, the *Pepper Dulse* of the Scotch, was or is eaten as a salad in parts of Scotland (*Lightf. Fl. Scot. p. 954*). According to Dr. Lindley, a large portion of what is now sold in the shops as *Corsican Moss* is *Laurencia obtusa*, which perhaps has equal virtues with the real *Helminthochorton*.

This order, though small, is widely dispersed, being represented under one form or other in almost every sea. *Laurencia* is peculiarly cosmopolitan in its distribution, and its common forms, *L. pinnatifida*, *obtusa*, &c. are found in the most oppo-

site regions of the ocean of both hemispheres. *Champia* (as here understood) is equally sporadic. *Lomentaria ovalis* is a native of the Pacific and Atlantic oceans. *Bonnemaisonia* is European; *Cladhymenia* and *Delisia*, Australian.

The natural limits of the order are variously understood by botanists, and I have the misfortune to differ from Prof. J. Agardh in my opinion on the subject. He admits two suborders, *Spongiocarpeæ* and *Solierieæ*, which do not appear to me to associate naturally with the other genera. *Spongiocarpeæ*, consisting of the remarkable genus *Polyides*, has a structure of frond and of fructification widely different from that of either of the suborders here retained, and also, in my judgment, from that of any other Desmiospermatous Order. The *Solierieæ*, consisting of *Solieria* and *Eucheuma*, appears to me to associate more naturally with *Hypnea*, and to connect that genus in some degree with *Gelidium*. I formerly admitted *Chrysymenia* and *Chylocladia*, J. Ag., and *Thysanocladia*, Endl. but the different structure of the nucleus in these genera, as has been well pointed out by Agardh, compels me to remove them elsewhere. Yet so similar in habit are some of the species of *Chylocladia* to some *Lomentariæ*, that almost all authors have confounded them. The presence of diaphragms in the frond is no certain test of a *Lomentaria*, as appears by *Chylocladia articulata*, whose sporiferous nucleus is identical with that of *Ch. clavellosa*.

SYNOPSIS OF THE NORTH AMERICAN GENERA.

SUBORDER 1. BONNEMAISONIÆ, J. Ag. *Frond* solid. *Conceptacles* ovate. *Spores* pear-shaped, on simple spore-threads.

I. LAURENCIA.

SUBORDER 2. LOMENTARIÆ. *Frond*, at least the branches, hollow, constricted at intervals and divided internally, by transverse septa, into chambers. *Conceptacles* ovate or spherical. *Spores* obconic or roundish, sessile, or attached to much branched, confervoid, spore-threads.

II. CHAMPIA. *Conceptacles* ovate, with a terminal pore. *Spores* paniculate, on branching spore-threads.

III. LOMENTARIA. *Conceptacles* globose, without a pore. *Spores* sessile, or nearly so, obconical.

I. LAURENCIA, *Lamour.* J. Ag. ref.

Fronde solid, cartilaginous, terete or compressed, decompose pinnate, rarely subdichotomous, composed of two strata of cells: the medullary stratum of oblong-angular longitudinal cells, longest toward the centre of the stem; the cortical of roundish angular cells in a subsimple row. *Conceptacles* ovate, with a terminal pore, containing within a cellular pericarp a dense tuft of pearshaped spores on simple funiculi radiating from a basal placenta. *Tetraspores* tripartite, lodged without order in a transverse band below the apices of the ultimate ramuli. *Antheridia* collected in terminal, saucer-shaped receptacles.

Fronds generally fleshy, rarely membranaceo-gelatinous when recent, cartilaginous when dry; often livid purple, rarely a blood or rose-red colour, changing to greenish or yellowish when growing in shallow water exposed to sunshine. *Stem* and *branches* linear, terete or compressed, pinnately compound, the lesser divisions sometimes irregularly forked, or subdichotomous, distichous or branched to all sides; the branches opposite, alternate or irregularly whorled; sometimes very irregularly placed. *Ramuli* slightly constricted at the base, dilated and very obtuse at the summit; the barren ones simply clavate, the fertile often by the development of rudimentary processes tuberculated or botryoid. *Conceptacles* formed from the transformation of the ultimate ramuli, mostly ovate. *Tetraspores* always lodged beneath the ends of the simple or compound ramuli.

From this genus, restricted by the above character, are now removed all the species (as *L. dasyphylla*, *L. tenuissima* and their allies) that have an articulated polysiphonous axis running through the frond. These will be found among *Rhodomelaceæ* under the genus *Chondria*. The remainder of the Grevillian genus *Laurencia* constitute a very natural group, dispersed through most parts of the temperate and tropical oceans. Very few occur on the shores of the Northern States, but on the Florida Keys there are many common species, some of them congregating in such masses that a large per centage of the drift seaweed is composed of their broken fronds.

The species are exceedingly difficult of determination. Many intermediate varieties often connect the most opposite looking specimens, and the new species here proposed are not offered without hesitation. Indeed, in this genus, as in many others, it is often impossible to tell whether we are dealing with species or sportive forms without a very careful examination of a number of specimens, or without some knowledge of the circumstances accompanying their development.

1. *LAURENCIA pinnatifida*, *Lamour.*; frond compressed, cartilaginous, dull purple, bi-tripinnatifid, all the divisions alternate, the ultimate ones obtuse, simple or lobed. *Harv. Phyc. Brit. t. 55.* *Kütz. Sp. Alg. p. 856.* *Harv. in Bot. Beech. Voy.*

p. 164 and 408. *Fucus pinnatifidus*, *E. Bot. t. 1202.* *Turn. Hist. t. 20.* *Laurencia spectabilis*, *Post. and Rupr. p. 16!*

HAB. Monterey, California, *D. Douglas, Dr. Coulter.* (v. v.)

Root branching. *Fronde*, in the Californian specimens, 8-12 inches long, one to two lines in diameter, compressed below, becoming flatter and wider upwards, decomposed-pinnate. *Stem* dividing below into several branches, which are naked in the lower half and there entire or dentate at the margin, and closely pinnate or bipinnate above. In smaller individuals the branches are simply pinnate, the pinnæ from half an inch to an inch long, erecto-patent with rounded axils, alternate, at distances of the third of an inch apart, the upper ones somewhat opposite, crenate at the apex, the lower ones more and more pinnatifid. Fertile specimens are narrower, with subcylindrical lacinia. *Conceptacles* ovate, sessile, two or more on the ultimate lacinia. *Tetraspores* scattered toward the ends of the lacinia. *Colour* a livid purple, becoming brownish in drying. *Substance* opaque, densely cellular. It imperfectly adheres to paper.

Dr. Coulter's numerous specimens are undistinguishable from some of my West of Ireland examples, and I see no character by which *L. spectabilis* P. and R. of which I have examined an authentic specimen, can be separated from the common *L. pinnatifida*, which is well known to be very variable in size and branching.

2. *LAURENCIA virgata*, J. Ag. ; frond terete, pinnately branched ; the branches spreading to all sides, opposite or verticillate, elongate, simple, racemoso-pinnated with short secondary branches ; ramuli opposite or whorled, erect, simple or corymboso-paniculate ; the tetrasporiferous ones clavato-cylindrical. *J. Ag. Sp. Alg. 2 p. 752.*

HAB. Monterey, California, *Dr. Coulter.* (v. v.)

Dr. Coulter's specimens are about six inches high. Several stems as thick as sparrow's quill rise from a mat of branching fibres. They are generally bare of branches at the base for an inch or two, and set above with closely crowded lateral branches which are not strictly distichous in insertion. In the less divided specimens, the branches are either naked and filiform, or somewhat pinnated ; in the more compound they are twice or thrice closely pinnated, the general outline being pyramidal. The lower part of the frond is slightly compressed, its lesser divisions more and more terete, and the ultimate pinnules cylindrical, remarkably truncate, and slightly constricted at the base. *Tetraspores* are imbedded toward the ends of the ramuli. *Colour* a very dark lurid purple, becoming still darker in drying. *Substance* cartilaginous, and structure dense.

I venture to refer the Californian specimens above described to the *L. virgata* J. Ag. a species founded on individuals collected at the Cape of Good Hope. I have compared them with Cape specimens, with which they agree in most points, and I

am unwilling on slight discrepancies to multiply species in this genus. The probability of specific identity is the greater because many other Cape Algæ occur on the Pacific coast of America.

3. *LAURENCIA obtusa*, Lamour.; frond cylindrical, pinkish red or yellow, twice or thrice pinnate, the pinnæ very patent; ramuli mostly opposite (occasionally alternate or irregular) patent, short, truncate. *Harv. Phyc. Brit. t.* 148. *Kütz. Sp. Alg. p.* 854. *Fucus obtusus*, *Turn. Hist. t.* 21. *E. Bot. t.* 1201.

HAB. Florida Keys, parasitical on corals and Algæ. Key West, *W. H. H., Prof. Tuomey* (33, 40, 44, &c.) Apalachicola, *Capt. Pike* (69). Island of St. Catalina, California, *Lieut. Wood*, Brit. Navy. (v. v.)

*Fronde*s in large subglobose tufts. *Stems* as thick as sparrow's quill, cylindrical, from one to six inches long, undivided or once or twice forked, decompose pinnate. *Branches* not strictly distichous, very patent, alternate or opposite, sometimes three from the same level, bi-tripinnate. *Pinnules* opposite, alternate, or in threes, cylindrical, truncate, very patent or subhorizontal, simple or with one or two pair of secondary pinnules. *Colour* in the stem and branches generally pale waxy yellow, with a reddish tinge, in the ramuli a beautiful pinky red. *Substance* cartilaginous, firm. In drying, it adheres pretty strongly to paper.

In the Florida specimens the ramuli are very frequently alternate, as sometimes occurs in those from Europe. Perhaps the following should be considered merely an exaggerated variety.

4. *LAURENCIA implicata*, J. Ag.; frond terete, slender, much branched, between pinnate and dichotomous, subfastigiate; the lesser branches very irregular, flexuous, patent; ramuli cylindrical, alternate or secund, simple or forked, truncate, slightly clavate. (TAB. XVIII. D.) *J. Ag. Sp. Alg. 2, p.* 745. *L. Forsteroides*, *Harv. in Herb. MSS.*

HAB. Key West, *W. H. H.* (36), *Prof. Tuomey* (23, 31, 50), *Dr. Blodgett* (54, 66.) (v. v.)

Tufts globose, dense. *Fronde*s 4-5 inches high, as thick as sparrow's quill, excessively branched from the base, the branches spreading to all sides, decompose, irregularly forked, flexuous, alternately multifid above; their lesser divisions furnished with alternate or secund, cylindrical, scattered ramuli, two or three lines long, simple or forked. *Colour* a pinky red; orange or yellow in the branches, greenish on exposure and in decay. *Substance* cartilaginous. It adheres to paper in drying.

Only to be known from *L. obtusa* (of which it may be merely a variety,) by the irregular branching and much scattered, frequently secund ramuli. It seems in-

intermediate in character between *L. obtusa* and the Australian *L. Forsteri*, Grev. (*Turn. Hist. t. 77.*)

Plate XVIII. D. *Fig. 1.* LAURENCIA *implicata* ; a branch, the *natural* size. *Fig. 2,* a portion, somewhat *magnified*.

5. LAURENCIA *cervicornis* ; frond terete, robust, irregularly branched, subdichotomous ; the secondary branches curved upwards, spreading to all sides, having a few secund, cylindrical, obtuse ramuli ; axils rounded ; conceptacles broadly ovate with a projecting orifice, sessile near the tips of the ramuli. (TAB. XVIII. C.)

HAB. Key West, *W. H. H.* (31), *Dr. Blodgett*.

Tufts globose, somewhat fastigiata. *Fronde*s as thick as crow's quill, 4-5 inches long, much branched from the base, bushy, very irregular in ramification, the branches spreading widely and directed to every side, curved upwards, of somewhat equal height, making a loosely corymbose head, naked, or having along their upper side, at distances of a quarter to half an inch, several cylindrical, secund ramuli. *Ramuli* erecto-patent, obtuse, quite simple or ramulose at the tip, from a quarter to half an inch long or more. *Conceptacles* at or near the ends of the branches, partly imbedded, very broad in proportion to their length, with a projecting, acute orifice. *Colour* a dark brownish red. *Substance* rigid, scarcely adhering to paper.

Seemingly allied to *L. Forsteri*, but more robust than the strongest grown specimens of that species, and less dichotomous.

Plate XVIII. C. *Fig. 1,* a branch of LAURENCIA *cervicornis*, the *natural* size. *Fig. 2,* apex of branch, with conceptacle ; *fig. 3,* spore ; both *magnified*.

6. LAURENCIA *gemmaifera* ; fronds robust, cartilaginous, fragile, terete, flexuous, irregularly much branched ; branches patent, alternate, unequal, irregularly pinnate or bipinnate, set throughout with minute, bud-like, horizontal, scattered, spirally disposed, truncate ramuli. (TAB. XVIII. B.) β . decom-pound-pinnate, the pinnæ tolerably regular and very patent.

HAB. Florida Keys. Key West, *W. H. H.* (34), *Dr. Blodgett* (36) var. β . Key West, *W. H. H.* (30), *Prof. Tuomey* (30, 38, 53), *Dr. Blodgett* (49). (v. v.)

*Fronde*s growing in large, loose bundles, 6—8 inches long, as thick as crow-quill, shrinking in drying, much and very irregularly branched, the branches spreading toward every side, and subspirally inserted, alternately or irregularly scattered, very flexuous, having secondary branches at distances of a quarter to half an inch. These branches are of very unequal length, long and short intermixed, and are patent, with rounded angles, and much curved or arched, and sprinkled throughout with exceedingly minute, bud-like ramuli. *Ramuli* spirally disposed round the

branches, horizontal, truncate, very short, simple or tubercled, sometimes slightly longer and pinnulate. *Colour* of the branches pale red or waxy yellow. *Substance* cartilaginous and brittle. In drying, the plant shrinks much, and very imperfectly adheres to paper.

What I call var. β . differs from the normal form in being more regularly pinnate and bipinnate, with closer branches. It is also of a brighter colour, and its ramuli are sometimes expanded at the apex into perforate or umbilicate cups, and rather more compound than in var. a .

This plant grows commonly at Key West in shallow water between tide-marks on the north side of the town. I cannot refer it to any described species. It is much more robust than *L. obtusa*. Its very flexuous irregular ramification, bud-like ramuli and brittle substance distinguish it from other Key West species.

7. *LAURENCIA papillosa*, Grev.; fronds terete, cartilaginous, sub-pinnate or irregularly decomposed; branches filiform, simple, densely covered with short, quadrifarious, horizontal, simple or lobed papilliform ramuli; conceptacles ovate, sessile. *J. Ag. Sp. Alg.* 2, p. 756. *Chondria papillosa*, *Ag. Sp. Alg.* vol. 1, p. 344. *Fucus thyrsoides*, *Turn. Hist. t.* 19.

HAB. Florida Keys. Key West, *Mr. Binney, W. H. H.* (33), *Prof. Tuomey*, (54, 56, 57). (v. v.)

Fronde tufted, 4—6 inches long, as thick as a sparrow's or as a crow's quill, terete, undivided or vaguely forked, naked below, branching above. *Branches* directed every way, either distant or densely crowded, simple, one to three inches long, virgate, tubercled with close-set quadrifarious, wart-like ramuli, which in old specimens are multifid and much distorted. *Colour* a dull purple, changing to green. *Substance* firmly cartilaginous. In drying, it scarcely adheres to paper.

Somewhat variable in ramification and in size, but readily known by the densely crowded, wart-like ramuli with which the branches are completely covered. In old specimens these ramuli are much compounded, and resemble miniature heads of cauliflower.

8. *LAURENCIA scoparia*, J. Ag.; "greenish, somewhat horny; frond terete, filiform, distichously decomposed; branches irregularly set, erecto-patent, some opposite, some secund, virgate; fertile ramuli, very short, tufted at the apices of the branches, subclavate, bearing tetraspores under the truncate apices." *J. Ag. Sp. Alg.* 2. p. 746.

HAB. La Guayra, *Herb. Binder*.

"Two to four inches high, densely tufted, rigid, with the substance and nearly the habit of *Ahnfeltia plicata*. *Fronde* as thick as sparrow's quill, very much branched."

9. *LAURENCIA tuberculosa*, J. Ag. ; "rosy purple, frond compressed, distichously decomposed-pinnate ; pinnæ on a straight, excurrent rachis, alternate, patent ; the medial pinnules similar, the lower short, transformed into roundish, tuberculated warts, bearing tetraspores lodged in the tubercles." *J. Ag. Sp. Alg.* 2, p. 760.

HAB. Vera Cruz, *Liebman*.

"*Frond* 4—6 inches long, as thick as a pigeon's quill, subterete or slightly compressed, alternately and distichously bi-tri-pinnate ; rachides scarcely conspicuously flexuous, obtuse, prolonged, naked beyond the pinnæ. Primary pinnæ 3—4 inches long, secondary an inch and half."

II. CHAMPIA. *Desv. Harv. ref.*

Frond terete or compressed, branched, tubular, constricted at intervals, and furnished internally at the constrictions with transverse membranous diaphragms which divide the tube into chambers ; diaphragms connected by a few longitudinal, confervoid filaments ; walls of the frond composed of polygonal cellules, in one or many rows. *Conceptacles* ovate, with a terminal pore. *Placentæ* one or many, basal, much branched, confervoid, connected with the walls by confervoid threads, and bearing on the ends of the branches densely crowded ovoid or obconic *spores*. *Tetraspores* tripartite, scattered through the superficial cells of the branches and ramuli.

The genus now called *Champia* was founded in 1804 by Thunberg under the name *Mertensia*, a name previously given by Dr. Roth (1797) to a well-known Boragineous plant of North America. Thunberg's original species, *Ch. lumbricalis*, a native of the Cape of Good Hope, remained for about thirty years the sole member of the genus ; but recently two others, *C. compressa* from the Cape, and *C. Tasmanica* from Van Dieman's Land, have been added. These three constitute the genus *Champia* as generally understood by algologists, and as it appears restricted by Prof. J. Agardh in his *Sp. Alg. vol. 2, p. 368*. I venture now to add to them such species of *Lomentaria* of authors (*Chylocladia* of Greville and other British writers) as have ovate conceptacles furnished with a terminal pore ; because I find, on carefully examining their sporaceous nucleus, that it is formed exactly on the type of that of *Champia lumbricalis*, and not at all as in *Lomentaria kaliformis*, the type of the true *Lomentariæ*. In our *Ch. parvula* and *Ch. salicornoides* the placenta is less paniculate than in *Ch. lumbricalis*, but nevertheless is much branched, as

may readily be seen if a conceptacle from which the spores have been shed be carefully dissected. The placenta in such conceptacles will be found not unlike a bird-cage or the open net-work of a clathroid fungus, nearly filling the cavity, and connected with the surrounding walls by cross threads. This is precisely the structure in *Ch. lumbricalis*, *compressa* and *Tasmanica*, as well as in *Chylocladia affinis*, Harv. (*Ner. Austr. t. 29*), which therefore I now remove to *Champia*. *Chylocladia Novæ Zealandiæ*, Hook. and Harv., whose conceptacles are unknown, is probably also a *Champia*. The genus so constituted forms a natural group, all the species having a constricted frond divided into loculi by transverse septa. I differ with my friend Prof. J. Agardh in regard to its nearest affinities; he referring his *Champia* to the neighbourhood of his recently amended genus *Chylocladia* (founded on *Chrysomenia clavellosa* of his former writings), whilst I am of opinion that it is much more nearly connected with *Lomentaria*.

1. *CHAMPIA parvula*, Harv.; tufts globose, dense; frond irregularly branched, ramuli scattered; branches and ramuli constricted at intervals of once or twice their diameter; conceptacles scattered. *Chylocladia parvula*, *Grev. Harv. Phyc. Brit. t. 210. Lomentaria parvula*, *Zanard. J. Ag. Sp. Alg. 2, p. 729. Kütz. Sp. Alg. p. 864.*

HAB. On the smaller algæ, &c. between tide marks. Nantucket, *Miss Mitchell*. Seaconnot, Newport and Narragansett Pier, *Prof. Bailey* and *Mr. Olney*. Peconic Bay, *Prof. Bailey* and *W. H. H.* Hellgate, New York, *Mr. Hooper* and *Mr. Congdon*. Key West, *W. H. H., Dr. Blodgett (71)* and *Prof. Tuomey (38)*. (v. v.)

Tufts globose, often intricate, two to four inches in diameter. *Fronde*s as thick as sparrow's quill, very irregularly branched; the branches sometimes somewhat pinnately compounded, all or most of the divisions alternate; sometimes and more frequently several times irregularly forked below, and inordinately branched above. Branches and ramuli very patent, linear, ending in a blunt point. The main divisions are either regularly constricted and septate throughout, at intervals of once and half their diameter, or are sub-cylindrical and obsoletely constricted in the lower part; all the lesser branches and ramuli are obviously articulato-septate. *Conceptacles* scattered over the branches, very prominent, conical or ovate, thick-walled. *Colour* brownish red, purplish, or waxy yellow. *Substance* softly cartilaginous. It closely adheres to paper in drying.

A variable plant. Most of our specimens nearly agree with common European varieties. One, received from Mr. Congdon, is more pinnate than the others, and rather more robust. Another variety found by Mr. Hooper at Greenport is much more slender than usual, scarcely thicker than hog's bristle, with the constrictions obsolete, or not visible without close examination. I have British specimens nearly similar.

2. *CHAMPIA salicornoides*; frond cylindrical and inarticulate at the base, nodoso-constricted upwards, whorled with one or more sets of short moniliform, obtuse

branches ; internodes about as long as broad ; conceptacles conical, scattered. (TAB. XIX. B.)

HAB. At Key West, *W. H. H.* (27), *Dr. Blodgett* (72). (v. v.)

Root discoid. *Fronde*s two or three inches high, about a line in diameter, tufted. *Stems* at first filiform, cylindrical and solid for half an inch or more, then distended and either continued as a single articulato-constricted simple stem, or dividing into a tuft of such stems. These *upper* stems are regularly constricted at short intervals, and are thickest in the middle and gradually taper to the base and apex. *Branches* opposite or whorled, similarly constricted, the lowest longest, and in fully developed specimens furnished with a second or third series of shorter branches and ramuli. All the lesser divisions are nodose, the internodes about as long as broad. The conceptacles are conical, scattered over the ramuli, their walls very thick and the sporiferous nucleus very densely tufted. *Tetraspores* very minute, dispersed through the ramuli. *Substance* softly cartilaginous. In drying it closely adheres to paper.

This has a habit very similar to that of *Lomentaria Mediterranea*, J. Ag. with which I had at first confounded it, but it is readily distinguished by its very different conceptacles, the nucleus of which is not correctly given in our plate, *figs.* 5, 6, which were taken from a hastily examined and imperfect specimen. The structure of the sporiferous nucleus is exactly the same as in *Ch. parvula*, from which this species differs very much in ramification. I gathered very few specimens at Key West.

Plate XIX. B. *Fig.* 1. *CHAMPIA salicornoides*, the natural size. *Fig.* 2, section of a branch to show the hollow chambers and diaphragms ; *fig.* 3, branch with conceptacles ; *fig.* 4, a conceptacle ; *fig.* 5, section of the same (the contained nucleus incorrectly drawn) ; *fig.* 6, nucleus (incorrect) ; *fig.* 7, spores ; all more or less magnified.

III. LOMENTARIA. *Endl.* excl. sp.

(GASTRIDIVM, *Lynb.* CHYLOCLADIA, *Grev.* ; *Harv. Phyc. Brit. excl. sp.*)

Fronde (at least the branches) tubular, constricted at regular intervals and divided by internal membranous diaphragms into chambers filled with a watery juice and traversed by a few longitudinal confervoid filaments ; walls of the frond composed of polygonal cellules in one or many rows. *Conceptacles* spherical, without orifice : *sporiferous nucleus* globose, very dense, consisting of many obconic, sessile spores radiating from a minute basal placenta. *Tetraspores* tripartite, scattered through the superficial cells of the branches and ramuli.

The type of this genus, restricted by the above diagnosis, is *Fucus kaliformis*, Good and Woodw. (*Chylocladia kaliformis*, Grev. and of other British writers,) to which are added the other species of the Grevillean genus *Chylocladia*, which have similarly organised conceptacles. In the structure of the frond there is a very close affinity with *Champia*, but the difference in the sporiferous nuclei in the two genera is too important to admit of their union. A still greater difference in the fructification separates the reformed genus *Chylocladia*, as now understood by Prof. J. Agardh.

I adopt the name *Lomentaria* for the present genus in deference to the authority of Endlicher, Montagne, Kützing, and J. Agardh, and in order to avoid confusion in nomenclature; but it unfortunately happens that *L. articulata*, Lyngb. the plant originally called *Lomentaria* by Lyngbye, and to which he restricted his genus, must be removed from the modern genus as at present adopted by botanists. Dr. Greville, long ago (Alg. Brit. p. 114) remarked that his genus *Gastridium*, afterwards called *Chylocladia*, included *two* generic types, indicated by differences in fructification, a character which, at the time he wrote, was not considered of sufficient importance apart from others, to justify the dismemberment of the genus. One of these types, comprising *Ch. kaliformis*, *ovalis*, and others with similar fructification, constitutes the modern *Lomentaria*; the other, comprising *Ch. clavellosa*, *articulata*, and others, the reformed genus *Chylocladia*, J. Ag. Now should the spirit of genus-splitting proceed further at a future time, and *Ch. articulata*, on account of its articulated frond, be separated from the species of *Chylocladia* with tubular fronds, it must either receive a *new* name, or if its old one, *stolen* for the present genus, be restored to it, we shall have to find a name to supply the deficiency, and perhaps *Gastroclonium* of Kützing may then be applied to the group typified by *Ch. kaliformis*.

1. *LOMENTARIA ovalis*, Endl.; frond cylindrical, solid, irregularly dichotomous, naked below, above beset with simple, elliptical, or elongated and nodoso-articulate tubular ramuli. *Harv. Phyc. Brit. t. 118. Gastroclonium ovale, Kütz. Sp. Alg. p. 865.* Var. β . *Coulteri*; frond robust, livid purple, with very obtuse, obovate, simple ramuli. (TAB. XIX. A.) Var. γ . *subarticulata*, Turn.; ramuli long, linear, contracted and jointed, *Turn. Hist. t. 81, n.*

HAB. On the Pacific Coast. β . at Monterey, California, *Dr. Coulter.* γ . Nootka Sound, *Mr. Menzies*, 1787. (v. s. in Herb. T. C. D.)

In Dr. Coulter's specimens the stems are tufted, six to eight inches high or more, cylindrical, solid, thicker than crow-quill, dichotomous, flexuous with rounded axils. *Branches* erect, somewhat corymbose, sparingly divided, usually naked for the greater part of their length, densely beset near the summit with elliptic-oblong or clavate, simple, hollow, very obtuse ramuli, and here and there furnished with a few short, lateral branchlets ending in a tuft of similar bag-like ramuli. The walls of the ramuli are thick, composed of several rows of angular, coloured cellules.

Conceptacles not seen. *Tetraspores* of large size are scattered through the walls of the ramuli. *Colour*, judging from dried specimens, a dark lurid purple, turning greenish in decay. *Substance* tough, rigid when dry. In drying, it does not adhere to paper.

This is of firmer and more rigid texture and of darker colour than the ordinary European *L. ovalis*, and at one time I considered it specifically distinct. Recently I have seen and examined Mr. Menzies' Nootka specimen, which is much more like some of the dwarf English states of the species, and I am now of opinion that it is better to retain my *L. Coulteri* as a variety only.

There is much agreement in external habit between *L. ovalis* and *Chrysomenia uvaria*, but the fructification is widely different.

PLATE XIX. A. *Fig. 1*, *LOMENTARIA ovalis* var. *Coulteri*, the natural size. *Fig. 2*, a ramulus with tetraspores; *fig. 3*, small portion of a section of the wall of the same; *fig. 4*, cross section of one of the solid branches.

2. *LOMENTARIA? saccata*, J. Ag.; "Stem solid, short, densely branched, supporting obovate, vesicular ramuli attenuated at base into a slender petiole; tetraspores scattered through the ramuli; conceptacles numerous, approximate, scarcely hemispherical, inflated, sub-immersed." *J. Ag. Sp. Alg. 2, p. 738. Dumontia saccata, Grev. MS.*

HAB. California, Herb. *Greville*.

"Stems scarcely an inch high, as thick as a pigeon's quill, terete, solid, irregularly much-branched. *Ramuli* sub-heterogeneous, emerging from the branches, borne on setaceous petioli, saccate, resembling obovate, ellipsoid, inflato-tubulous bags, collapsed when dry, three to ten lines in length, and two to six in diameter. *Conceptacles* densely aggregated. *Colour* a blackish purple. *Substance* of the stem carnosocartilaginous; of the ramuli membranaceous."

This species is wholly unknown to me.

ORDER III. CORALLINACEÆ.

Corallineæ, Lamour. *Cor. Class.* p. 244. *Dne. Class.* p. 63. *Endl. 3d. Suppl.* p. 48. *Harv. Ner. Austr.* p. 92. *Lindl. Veg. King.* p. 25. *Corallineæ and Spongiteæ*, Kütz. *Phyc. Gen.* pp. 387, 385. *Kütz. Sp. Alg.* pp. 695, 699. *Corallinidæ and Nulliporidæ*, Johnst. *Brit. Lith.* p. 205.

DIAGNOSIS. Rigid, stony, 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. *Spore-threads* short, tufted in the base of encysted conceptacles, furnished with a terminal pore, simple, each thread at length separating into four *spores*.

NATURAL CHARACTER. *Root*, when manifested, an expanded, crustaceous disc, often spreading widely over the rock or shell to which it is attached. *Fronde* calcareous, effervescing strongly when thrown into acid, the cells of which it is composed secreting carbonate of lime in an organized form within their walls, and calcareous matter being also deposited on the surface of the cells and between their interstices. The whole compound frond then appears to the eye as if coated with enamel, and when broken, seems equally stony within. On maceration in acid, the rigid substance becomes soft and pliable, and sub-transparent, and the cellular tissue is obtained free from lime. The cells composing the axis or medullary part of the stem are long, slender and vertical, either closely packed together and overlapping at the ends, or disposed in filamentous series. Those which immediately surround this central layer are shorter and curved outwards, and the cells of the periphery are very minute. A longitudinal section of the stem has frequently a transversely banded appearance, from the cells of which it is composed being nearly of equal length and so placed that their ends stand on a level.

In outward habit there is considerable variety among these plants. The lowest forms of the order are simply incrustations, spreading like the least organized of the crustaceous lichens, over the surface on which they grow, and like them usually extending from a central point in successive concentric circles of growth. Some are mere films, as thin as tissue paper; others are thick and stone-like, the crust rising into prominences or sinking in depressions. The surface of the thicker crusts is very frequently papillated with conical wart-like prominences, scattered or densely aggregated. In the more advanced kinds these lengthen into cylindrical processes, and become branched, the branches often so densely crowded that little more than their ends are visible, in which case the

mass resembles a stony head of cauliflower, or some of the incrustations of similar aspect so often seen in calcareous spar caves. Others are more shrub-like or arborescent, and in others the branches become compressed, or flattened into leafy lobes. In the genus *Mastophora*, the most leaf-like plants of the Order, there is less carbonate of lime deposited than in most others, and the fronds are proportionably flexible; they are fan-shaped, with fastigate leafy laciniaë, and have a habit very similar to that of some species of *Zonaria*. All the above varieties of form are found in the sub-order *Nulliporeæ* (*Spongiteæ*, Kütz). The true Corallines or *Corallineæ* are filiform, somewhat compressed, pinnated or dichotomous, the branches composed of strings of calcareous articulations or internodes, truncated at the upper extremity and rounded at the lower, each articulation connected with that above and below it by a flexible node or joint formed of cellular tissue, in which no calcareous matter is deposited. In the majority, the calcareous internodes are separated by minute flexible nodes, often hidden under the projecting edges of the internode, and only to be seen on close examination. But in some species of *Amphiroa* the flexible node is elongate, and even occasionally longer than the calcareous internode, the branches of such species looking like a number of beads or *bugles*, distantly placed on a connecting thread. In some of these latter the surface of the node is occasionally armed with minute calcareous plates or tubercles. The form of the internode varies extremely; often in the same species; or even in different parts of the same individual, in which it is common to find the articulations of the stem, the branches and the ultimate ramuli having distinct forms. In many the internodes are cylindrical; in others oval or compressed; in others flat and with an irregular outline; but the most common forms are cordate and cuneiform, the upper angles or shoulders of the internode often extending into ears or horns.

The fructification is not perfectly ascertained, and the position and affinities of the order are therefore uncertain. It is not without hesitation that I now give the name of *four-jointed spore-threads* to the little bodies found tufted in the base of the conceptacles, and which in another place (Phyc. Brit. t. 201, 222, 252) I have figured and described as *zonate tetraspores*. If we are to judge of their nature by their *aspect*, we shall certainly, with Decaisne and other writers, regard them as *tetraspores*; but if by the position they occupy within conceptacles formed on the type of those of *Polysiphonia*, we shall pronounce them *spore-threads*. If they were not four-parted, they would very closely resemble the *spore-threads* of a *Polysiphonia*; and they occupy a place exactly similar, being transformations of the same parts of the frond, and similarly protected within conceptacles, whose form and origin are identical with those of the conceptacles in *Polysiphonia*. So that *morphologically* speaking, we are compelled to regard them as *spore-threads*. If this be their real nature, it may be worth enquiry whether the supposed *tetraspores* of *Phacelocarpus* and *Apophlœa* are not to be regarded as strings of spores, being found lodged within hollow conceptacles, to the walls of which they are attached. I am aware that other conceptacles have been described in *Phacelocarpus*, but after an examination of many specimens I have failed to detect perfect spores within them, and consequently consider them as merely abortive efforts at fructification; an

opinion rendered more probable by their *position*, which is the same as that of the fertile branchlets.

The conceptacles in the Corallineæ are either formed out of the terminal articulations of the lesser branches, as in *Corallina* and *Jania*; or on some part of the surface of the middle and lower articulations, as in *Amphiroa*. But frequently spurious conceptacles, equally furnished with spore-threads as the normal ones, sprout out irregularly from any part of the stem or branch. This I have repeatedly observed in *Corallina squamata* and *C. officinalis*, whose whole surface is sometimes densely warted with such irregular fructification.

The Corallinaceæ, under some form or other, are dispersed through most parts of the ocean, and at depths varying from the highest level of ordinary tides to many fathoms below low-water mark. The crustaceous kinds in particular abound on the stones and in shallow places, where, however, they seldom exhibit more than an expanded crust. Within the tidal limits, from the level of half-tide to low-water mark, they flourish, fruiting abundantly. Beyond the tidal limit, in water of 5, 10, 15, or even 50 fathoms in depth, they are still numerous, and frequently constitute vast banks, made up of unattached fronds heaped together without order, of which those alone on the surface of the bank are in a vegetating state. In such places, though the frond is very luxuriant, fructification is seldom formed. It is extremely probable that many of these deep-water forms, now regarded as specifically different from those found within tide marks, are merely barren varieties of the tidal species, altered by a different locality. The true corallines are very rare in the colder sea, in which alone *C. officinalis* attains a very high latitude. They are more abundant towards the tropics, and seem to be particularly numerous and beautiful on the shores of the Australian continent. As yet we can claim few within the limits of the North American Flora, but probably when the Pacific coast shall have been explored many new species will reward the collector. On the whole, the order is greatly more numerous in the Pacific than in the Atlantic Ocean.

Until recently the *Corallinaceæ*, and other calcareous Algæ, such as *Halimeda*, were confounded with the polypiferous Zoophytes, with which division of the animal kingdom they had been united by Ellis, who, nevertheless, figures the *spore-threads* of *C. officinalis* with his usual care.

SYNOPSIS OF THE NORTH AMERICAN GENERA.

SUB-ORDER 1. CORALLINEÆ. *Frond* filiform, pinnate or dichotomous, jointed.

I. CORALLINA. *Conceptacles* terminal, urceolate, simple. *Frond* pinnated.

II. JANIA. *Conceptacles* terminal or axillary, turbinate, tipped with two horn-like ramuli. (*Frond* in our species dichotomous.)

III. AMPHIROA. *Conceptacles* conical, scattered on the surface of the middle and lower articulations.

SUB-ORDER 2. NULLIPOREÆ. *Fronde* crustaceous, foliaceous or shrubby, not jointed.

IV. MELOBESIA.

I. CORALLINA, L.

Fronde filiform or compressed, calcareous, articulated, mostly pinnate. *Nodes* very short, striæform. *Conceptacles* ovate or urceolate, formed from the terminal articulation of the branches and ramuli, furnished with an apical pore, and containing in the base of the cavity a tuft of erect, pyriform or club-shaped, at length four-parted spore-threads.

1. CORALLINA *officinalis*, Lin.; decomposed pinnate; the lower articulations cylindrical, twice as long as broad; the upper slightly obconical, round-edged (not ancipital), their upper angles blunt; the ultimate ramuli cylindrical, obtuse. *Harv. Phyc. Brit. t. 222. Kütz. Sp. Alg. p. 705.*

HAB. On stones and shells. Halifax, *W. H. H.* (v. v.)

*Fronde*s two to four inches high, twice as thick as hog's bristle, distichous, decomposed pinnate. *Branches* pinnate or bi-pinnate, especially at the top, sometimes naked below, often fastigiate or corymbose, erecto-patent; pinnules mostly simple, attenuate. *Articulations* of the stem as long or twice as long as broad, sub-cylindrical; of the branches more or less cuneiform, with rounded shoulders; of the ramuli linear, cylindrical, or compressed, the terminal one either obtuse or pointed. *Conceptacles* formed either from the terminal articulation of a pinna, or from the surface of any of the articulations of the stem or branches, ovate. *Colour* dark lurid-purple when growing, becoming chalk-white when bleached.

A very variable plant, according to the depth of water at which it vegetates. It is probably common on the American shores, though I have not received it from my correspondents.

II. JANIA, *Lamour.*

Fronde filiform or compressed, calcareous, articulated, dichotomous, or (in some Australian species) decomposed pinnate. *Nodes* very short, striæform. *Concept-*

tacles urn-shaped, formed from the axillary articulation of the uppermost branches (mostly two-horned), furnished with an apical pore, and containing in the base of the cavity a tuft of erect, pyriform or club-shaped, at length four-parted spore-threads.

This genus scarcely differs from *Corallina*. The species are generally smaller and more slender, and those of North America are dichotomous, at least in the main divisions, and therefore easily known from the pinnated Corallines. Many of the Australian species of *Jania*, comprising the section *Haliptilon*, are however decomposed pinnate.

1. *JANIA rubens*, Lamour. ; frond dichotomous, fastigiata, setaceous ; articulations of the principal branches and ramuli cylindrical, about four times as long as broad. *Harv. Phyc. Brit. t. 252. Kütz. Sp. Alg. p. 709.*

HAB. At Key West, *W. H. H.* (v. v.)

Fronds half an inch to an inch high, densely tufted, many times forked, as thick as hog's bristles ; branches erect or spreading, gradually tapering to the extremities. *Articulations* cylindrical in all parts of the frond ; those near the base very short, the upper ones gradually longer ; those in the middle region from four to five times as long as broad. *Colour* a pale red.

2. *JANIA Cubensis*, Mont. ; frond dichotomous, fastigiata, setaceous, the branches naked or pinnated with short, simple or forked, opposite ramuli ; articulations of the lower branches subcylindrical, of the upper cuneate with rounded shoulders, of the ramuli cylindrical, three or four times as long as broad. *Kütz. Sp. Alg. p. 709.*

HAB. Parasitical on *Digenia simplex*, and other Algæ, at Key West, *W. H. H.*, *Prof. Tuomey* (71).

Tufts dense, an inch in height, fastigiata, often spreading widely. *Fronds* as thick as hog's bristle, dichotomously divided, the branches patent or sometimes recurved, either destitute of ramuli (when the plant is hardly to be known from *J. rubens*) or pinnellated throughout with short ramuli, one or two lines in length. *Ramuli* distichous, or three together, simple and spinelike or forked, sometimes trifurcate and now and then lengthened and pinnellated. *Articulations* in the lower part subcylindrical, the upper ones more cuneate. *Colour* a dull red.

My specimens seem to agree very closely with a small authentic specimen kindly communicated to me by Dr. Montagne.

3. *JANIA capillacea* ; minute, dichotomous, capillary, with wide axils ; branches

recurved, squarrose; articulations cylindrical, four to six times as long as broad.

HAB. Bahia Honda, *Prof. Tuomey*. (70). (v. s. in Herb. T. C. D.)

I cannot satisfactorily refer the specimen received from Prof. Tuomey to any described species. It most resembles *J. rubens* in written character, but is much smaller and more slender, having more the aspect of *J. antennina*, Kütz. from which its much longer articulations separate it.

III. AMPHIROA. *Lamour*.

Fronde terete, compressed, or flat, calcareous, articulated, dichotomous or pinnated. *Nodes* cartilaginous, more or less evident, sometimes elongate, naked or covered with tubercles. *Conceptacles* conical, wartlike, sessile on the disc of one of the articulations, furnished with an apical pore, and containing in the base of the cavity, a tuft of erect pyriform, at length four-parted spore-threads.

An extensive genus, chiefly found in the Southern and Pacific Oceans, where many of the larger and more beautiful species abound. A few occur in the Mediterranean, and in the Tropical Atlantic. There is much variety of habit among them, and Decaisne has divided the genus into four subgenera, two only of which are represented in the North American Flora. The species of the first subgenus have a habit quite peculiar, and are much more brittle than any other of the jointed Corallines. Those of the second group have the habit of *Corallina*, from which they are only to be known by the fructification.

SUB-GENUS 1. *Euamphiroa*. *Articulations* linear, elongate, terete or subcompressed. *Conceptacles* scattered, numerous.

1. AMPHIROA *fragilissima*, Lamour.; frond dichotomous, robust, attenuated upwards, very fragile; the axils wide, and branches spreading; articulations cylindrical, smooth, four or five times as long as broad. *Lamour. Cor. p.* 298. *Kütz. Sp. Alg. p.* 700. *Ellis and Soland. Cor. t.* 21, *fig. d.* (not characteristic).

HAB. Florida Keys. Key West, *W. H. H.* (v. v.)

Fronde 2—3 inches high, very fragile, as thick as sparrow's quill below, gradually

attenuated upwards, many times dichotomous, the articulations below the fork bifid at the apex, each lobe running out into the commencement of the arms of the forks. *Axils* wide. *Branches* divaricate. *Articulations* cylindrical, smooth, not swollen at the extremities, the nodes very short, indicated by a line only. *Colour* livid purple, fading to dirty white.

An exceedingly fragile species, of which it is almost impossible to preserve more than broken fragments.

2. *AMPHIROA debilis*, Kütz.; frond setaceous, dichotomous, fastigiate, very fragile; branches divaricating; articulations many times longer than broad, cylindrical, thickened at each extremity; conceptacles numerous, subsecund. *Kütz. Sp. Alg. p. 700.*

HAB. Florida Keys. Key West, *W. H. H. (v. v.)*

Fronde 1—2 inches high, as thick as hog's bristle, repeatedly and pretty regularly dichotomous, occasionally trichotomous, the articulations below the dichotomy similar to the rest (not bifid or two branched). *Branches* spreading to all sides. *Articulations* generally but one between each furcation, cylindrical, those of the lower and middle regions of the frond incrassated at each end, the upper ones not so. *Interstices* or nodes simple, scarcely uncovered. *Conceptacles* numerous on the lower articulations, generally several ranged along one side of the internode.

A much smaller plant than the preceding, with differently shaped articulations. I have not seen any authentic specimen of Kützing's plant, which came from Cuba, but my specimens collected within eighty miles of Havana seem sufficiently to agree with his description.

3. *AMPHIROA cretacea*, Endl.; "dichotomous, diffuse, thick, chalky or ash-coloured; articulations cylindrical, approximate, 1—2 lines long, once and a-half or twice as long as their diameter; branches distant, flexuous and recurved, cylindrical or conical at the apex." *Kütz. Sp. Alg. p. 701. Post. and Rupr. Illustr. p. 20. t, 40, Fig. 104.*

HAB. Unalashka, *Postels and Ruprecht.*

SUB-GENUS 2. *ARTHROCARDIA*. *Articulations* strongly compressed, frequently winged at the sides, cuneate or obcordate. *Conceptacles* conical, scattered.

4. *AMPHIROA (ARTHROCARDIA) Californica*, Dne. (?); subdichotomous or irregularly branched; articulations strongly compressed, with a sub-evident midrib, the lowermost cuneate, the upper broadly obcordate with blunt upper angles; conceptacles two to four on each fertile articulation. *Dne. Corall. p. 112? Kütz. Sp. Alg. 704. A. Hookeri, Harv. in Hook. Herb.*

HAB. Monterey, *Decaisne*. St. Francisco, *Barclay*. (v. s. in Herb. T. C. D.)

The St. Francisco specimens are three or four inches long, twice or thrice irregularly forked, the ultimate divisions dichotomous, the lower ones irregularly pinnated with numerous, lateral, simple branches. All the articulations are strongly compressed, the sides depressed, the central part raised and rib-like; the lower ones of the larger branches as well as of the lower divisions are cuneate, the upper gradually broader and more cordate, with much produced but rounded upper angles; the terminal articulations narrow. *Conceptacles* large, on my specimens generally in pairs on each articulation, but sometimes four or five on the lower ones.

I have not seen any authentic specimen of the plant of *Decaisne*, who describes it thus; "dichotomous; articulations compressed, and frequently cuneate, and generally furnished with four *conceptacles* on each face:" characters which do not strictly apply to my specimens, which nevertheless, I hesitate to describe as new.

5. AMPHIROA (ARTHROCARDIA) *tuberculosa*, Endl.; "dichotomous; dirty white or rosy violet; lowest articulations subterete, once and half as long as broad, upper dilated, more or less deeply obcordate, uppermost sub-approximate, irregularly cuneate-rhombic, sometimes linear, tuberculated at the back and margin; some of the tubercles perforated; branches scattered, subsimple, clavate or emarginate at the apex." *Kütz. Sp. Alg.* p. 704. *Corallina tuberculosa*, *Post. and Rupr. Ill.* p. 20, t. 40, fig. 100.

HAB. Island of Sitcha, *Postels and Ruprecht*.

I have seen no specimen of this or of the preceding species.

MELOBESIA. *Lamour*.

Fronde attached by its lower surface or free; either flattened orbicular, sinuated or irregularly lobed; or cylindrical and branched; never articulated, coated with a calcareous deposit. *Conceptacles* conical, scattered over the surface of the fronds or partly immersed, furnished with an apical pore, and containing in the base of the cavity a tuft of erect, oblong, four-parted spore-threads.

The North American species of this genus have not yet been carefully examined or collected. Probably several occur along the coast, and will be found either encrusting tidal rocks or stones, or lying at the bottom of harbours in from five to

twenty fathom water. Authors enumerate many forms which are probably but variable shapes assumed by the same species at different times. Thus *M. membranacea*, *farinosa*, *verrucata* and *pustulosa* of Lamouroux, appear scarcely to differ from each other except in age and luxuriance. By Dr. Johnston the whole are regarded as abnormal states of *Corallina officinalis*.

ORDER IV. SPHÆROCOCOIDEÆ.

J. Ag. Sp. Gen. and Ord. Floridearum, p. ix. Part of *Delesseriæ* and *Sphærococoidæ*, *J. Ag. Alg. Medit.* p. 116 and 148. and of *Endl. 3d. Suppl. Harv. Man. Ed. 2, &c.*

DIAGNOSIS. Rosy, purplish, or blood-red sea-weeds, with an inarticulate, cartilaginous or membranaceous, leaf-like or filiform frond, composed either of polygonal or of cylindrical cells. *Conceptacles* with or without a terminal pore. *Spores* roundish or elliptical, formed in moniliform filaments rising from the basal placenta, all the cells of the spore-threads gradually changing into spores. *Tetraspores* variously disposed.

NATURAL CHARACTER. *Root* almost always discoid, rarely branching. *Frond* much diversified in habit, structure, and colour. Most of the North American genera are more or less perfectly leaf-like; the leaf, in the least organised, being an expansion of irregular form, cleft either vertically or laterally, without symmetry, and destitute of central rib or of veins. In others the lower part of the frond is thickened in the centre into a broad, sub-defined midrib, which becomes less evident toward the upper portion of the membrane, and gradually disappears where the laciniae become expanded. In others numerous irregular veins, which are confluent toward the base of the frond, spread out one from another like the rays of a fan and traverse a greater or less portion of the membrane, generally becoming obsolete in its upper divisions; sometimes standing apart and sometimes anastomosing. In others—and these are the most completely organized—the leaf-like body is symmetrical, furnished with a percurrent, filiform midrib, which is a continuation of the stipes or root-stem, and which becomes stem as it is gradually divested of the membraneous border. This takes place with age, and thus old fronds of the same species have often a much branched stem bearing numerous leaves; all which fronds originated in a single leaf whose stripped midrib was converted into stem, and then put forth new frondlets, to undergo a similar metamorphosis. The only North American genus with filiform fronds is *Graci-*

laria, and one of its commoner species (*G. multipartita*) exhibits every stage between a nearly cylindrical, much branched, bush-like frond and a flattened, lacinated membrane.

The internal structure of the frond presents as many varieties as the outward form. Most of the membranaceous fronds are composed of polygonal cellules, not longer than their breadth, those of the surface stratum frequently tabulated. Sometimes the interior cellules are of large size compared to the exterior, and gradually diminish as they approach the surface of the frond, the outer stratum being composed of minute dot-like cells: in other cases all are nearly of equal diameter. In several the axial or medullary region is occupied by cylindrical cells joined end to end into filaments, which are either solitary, or more commonly bundled together or closely compacted into an internal midrib. In others almost the whole internal substance of the frond is composed of a plexus of such filaments, but this structure is rare in the Order, and confined to some genera of the southern hemisphere. As a general rule, an opaque, inarticulate frond, composed of polygonal, tabulated or roundish cellules, is characteristic of these Algæ.

The colour is of various tints, mostly brilliant ones. Some of the finest and purest carmine, crimson and blood-red hues seen among marine plants, are found in this Order. Others are purple-lake, of greater or less brilliancy; and a few, chiefly of the filiform kinds, are dull-red, brownish or whitish, tinted with various pale shades of red, or greenish yellow, the latter colours indicating a weak or blanched growth.

The distinctive character of the Order is found in the structure of the sporiferous-nucleus, which consists of a dense tuft of simple or branched, moniliform spore-threads radiating from a cellular placenta fixed in the base of the cavity of an external conceptacle. The conceptacle is of various forms; bottle-shaped with a prominent orifice, conical, hemispherical or spherical, in the latter cases generally destitute of a pore, and emitting the spores only on the bursting of the pericarp. The walls of this conceptacle are membranous, thick or thin, composed of one or of several strata of cellules. The cavity is generally large, rarely quite filled by the nucleus. The placenta sometimes projects into the cavity so as to fill one-half of the space, and sometimes is but slightly developed. It is always cellular, and generally solid; sometimes, however, hollowed out beneath. The whole surface is densely covered with vertical or radiating simple or dichotomous spore-threads, each consisting of numerous ellipsoidal or roundish cellules which are gradually converted into spores, the terminal cell ripening earlier than the others.

The *tetraspores* are either tripartite or rarely zone-parted, and are either dispersed over the whole frond, or more frequently collected into definite groups or sori, which are sometimes borne in proper leaf-like processes of the frond. They are always sunk among the superficial cells; never collected in *nemathecia*, but sometimes lodged in thickened wart-like prominences rising from the membrane.

Many of the genera of this Order are widely dispersed. The *Delesseriæ* and *Nitophylla* are among the most beautiful of leafy sea-weeds, and are found between the parallels of 30° and 60° north and south of the equator, but are more abundant on the European than the American Atlantic coasts. On the North American

Atlantic coast, indeed, *Nitophyllum* is scarcely more than represented. In South America, especially among the indented shores of Terra del Fuego and the islands and channels near Cape Horn both these genera abound, as they also do in New Zealand and Van Dieman's Land. *Nitophyllum venosum* is one of the largest and most splendid of South African Rhodospiræ, its brilliant fronds being sometimes two or three feet in breadth. *Delesseria Leprieurii*, which is found in the Hudson river at Westpoint, sixty miles from the sea, and in the estuaries of several rivers of the Southern States, was first discovered in the Sinnamar river, Cayenne; and has been also found in New Zealand; a singularly sporadic distribution. *Delesseria quercifolia* of the southern hemisphere is scarcely distinguishable from *D. sinuosa* of the northern; the southern *D. crassinervia* chiefly differs from the northern *D. Hypoglossum* by the thickness of its midrib; while *D. ruscifolia* is found in both northern and southern hemispheres. It is curious that *Hymenena* and *Botryoglossum* are found in South Africa and California, the latter genus also at the Falkland Islands. *Grinnellia* is exclusively American, and is one of the most beautiful and characteristic Algæ of the Atlantic coast. *Sphærococcus* is European. Several genera are exclusively from the Southern Ocean, many being Australian. *Gracilaria* is found from the tropics to very high latitudes at either side of the line, and *G. confervoides* and *G. multipartita* are instances of cosmopolitan species.

Of economical species the only ones deserving notice are the *Graciliaria*, many of which are largely used in India and China, both for food and in the preparation of glues and varnishes. *G. lichenoides* or *Ceylon moss* is a common ingredient in soups and other compound dishes in the East, and is even exported to Europe for similar purposes. It may also be made into jellies and blanc-manges, and is said to be better than *Carrigeen* (*Chondrus crispus*) for all the uses to which that plant is applied. All the *Graciliaria* readily boil down into a gelatine, and probably are nearly equally valuable.

SYNOPSIS OF THE NORTH AMERICAN GENERA.

TRIBE I. DELESSERIEÆ. *Fronde* membranaceous, leaf-like; the surface cells tabular, polygonal, of large size. *Spore-threads* radiating in a circle from a depressed, basal placenta. *Tetraspores* contained in definite sori.

* *Fronde* symmetrical, midribbed.

I. GRINNELLIA. *Conceptacles* scattered over the membrane.

II. DELESSERIA. *Conceptacles* formed in the midrib, or in a lateral vein.

** *Fronde* unsymmetrical, ribless or obsoletely ribbed, or traversed by irregular branching veins.

III. BOTRYOGLOSSUM. *Fronde* thickened in the middle, obsoletely midribbed; the rib broad, vanishing towards the end of the lacinia.

IV. HYMENENA. *Fronde* ribless, traversed by numerous, subparallel, anastomosing veins. *Sori* linear, between the veins.

V. NITOPHYLLUM. *Fronde* ribless, either veinless or traversed by obsolete, slender, branching, irregular veins. *Sori* roundish, scattered.

TRIBE 2. SPHÆROCOCCEÆ. *Fronde* flat, compressed, or cylindrical, cartilaginous or coriaceous, the surface cells roundish, very minute. *Placenta* conical, projecting far into the conceptacular cavity. *Tetraspores* mostly dispersed among the surface cells.

* *Tetraspores* oblong, transversely divided (zonate).

VI. CALLIBLEPHARIS. *Fronde* flat, irregularly cleft, fringed with marginal lobes.

** *Tetraspores* cruciate or triangularly divided.

VII. GRACILARIA. *Fronde* terete, compressed or flat.

VIII. CORALLOPSIS. *Fronde* constricted at regular intervals or nodoso-articulate.

I. GRINNELLIA. (*Nov. Gen.*)

Fronde rosy red, leaf-like, delicately membranaceous, areolated, symmetrical, traversed by a slender, percurrent midrib. *Conceptacles* scattered over the surface of the membrane, bottle-shaped, with a prominent orifice: *placenta* basal, somewhat prominent, crowned with a pulvinate tuft of subdichotomous spore-threads, whose terminal cells are earliest ripened. *Spores* elliptic-oblong or roundish. *Tetraspores* tripartite, immersed in scattered, shapeless, cellular warts.

The remarkable plant which I propose as the type of this genus is peculiar to the eastern shores of North America, along which it ranges from Cape Cod to New Jersey. It abounds in Long Island Sound and New York Harbour, where it constitutes one of the most ornamental features of the submarine flora. It was originally described by the elder Agardh as a species of *Delesseria*, a genus which, as then understood, comprehended almost every Alga with a red, membranous, leaf-like frond, and included also within its limits *Plocamium* and *Stenogramme*. From the restricted genus *Delesseria* it is readily known by the position of the conceptacles, which organs in *Delesseria* are invariably placed either on the principal midrib or on one of its lateral branches. To *Nitophyllum* (*Aglaiohyllum*, Mont.)

our plant has also been referred, but, besides the form of the conceptacle, *Grinnellia* differs from *Nitophyllum* in having a perfectly symmetrical frond, furnished with a single percurrent midrib. In some examples this midrib is very slender, but I believe it may always be distinctly traced, at least in the living plant; and when the frond is bifid, as it occasionally is, the midrib regularly bifurcates, one arm pursuing each branch. A further characteristic, showing the difference between this midrib and the irregular veins of *Nitophyllum*, is that in *Grinnellia* the midribs of old fronds become gradually stripped and converted into stems, and are then often prolific; perfectly formed, ribbed leaflets springing from them. The only other genus of which it is necessary to speak is *Hemineura* (Harv. Ner. Austr. t. 45) but the different nervation and ramification, as well as the position of the conceptacles, afford sufficiently obvious distinctions.

The generic name, GRINNELLIA, is bestowed in honour of HENRY GRINNELL, Esq. of New York, whose noble conduct in promoting the search after the missing Arctic Expedition of SIR JOHN FRANKLIN justly entitles him to the respect and gratitude of every man of science. Doubtless there will be other and more worthy memorials; but yet it seems to me that a beautiful *marine* plant may not unfitly preserve, among the Algologists of America and England, a kindly remembrance of an act of disinterested kindness to wanderers at sea, or let me rather say, a *naval* action to which both Nations may look back with undivided feelings.

1. GRINNELLIA *Americana*.—*Delesseria Americana*, *Ag. Sp. Alg.* 1, p. 173. *J. Ag. Sp. Alg.* 2, p. 681. *Aglaiophyllum Americanum*, *Mont. in An. Sc. Nat.* 3d. Ser. vol. xi. p. 63. *Cryptopleura Americana*, *Kütz. Sp. Alg.* p. 872. (Tab. XXI. B.)

HAB. On stones and shells, in four or five fathoms. Abundant in Long Island Sound and New York Harbour. (v. v.)

Root scutate. *Frond* densely tufted, leaf-like, from one to two feet in length, and from one to four inches in width at the widest part, lanceolate, tapering to the base, and usually also to the apex, but sometimes very obtuse and sometimes bifid, delicately membranaceous, wavy and often curled at the margin, traversed by a slender, slightly wavy, central nerve, which runs through the frond from the base to the apex, gradually becoming more slender upwards, being as thick as hog's bristle in the lower part of the leaf and as fine as human hair towards the tip. The frond usually consists of a single leaf, or of three or four leaves springing a short way above the base of a common stem; but when the membrane of the leaf is destroyed by the waves, as often occurs, the old midrib survives and throws out numerous leaflets, and the frond becomes compound. Such secondary leaflets are usually small and densely crowded. *Fructification* of both kinds abundantly produced and scattered thickly over both surfaces of the membrane. *Conceptacles* resembling in form ancient lacrymatories or the wide glass jars in which sulphuric acid is commonly sold, depressed hemispherical, with a more or less prominent orifice, the neck varying in length on the same plant in different conceptacles. The

walls are thin ; the sporiferous nucleus depressed, not filling the cavity ; the *spores* ellipsoidal, the terminal ones ripening much earlier than the rest. *Tetraspores* tripartite, immersed in fleshy, prominent warts, variously lobed and distorted. *Colour* a brilliant lake-red, quickly becoming orange and soon perishing in fresh water. *Substance* very thin. Surface areolated with large hexagonal cells. In drying, it closely adheres to paper.

Plate XXI. B. *Fig. 1.* GRINNELLIA *Americana*, the natural size. *Fig. 2 and 3,* conceptacles of different forms ; *fig. 4,* a conceptacle divided vertically ; *fig. 5,* spore-threads ; *fig. 6,* a wart with tetraspores ; *fig. 7,* the same, divided vertically ; *fig. 8,* a tetraspore ; all more or less *magnified.*

II. DELESSERIA. *Lamour. Grev. ref.*

Fronde rosy-red (very rarely purple), leaf-like, lacinate or branched, delicately membranaceous, areolated, symmetrical, traversed by a percurrent midrib. *Conceptacles* sessile on the midrib or on a lateral nerve, globose, without orifice : *placenta* basal, more or less prominent, crowned with a pulvinate tuft of simple or subdichotomous spore-threads whose terminal cells are earliest ripened : *spores* elliptical or roundish. *Tetraspores* tripartite, grouped in definite spots or sori, occupying portions of the frond or of separate leaflets.

With the exception of *D. sanguinea*, Ag. which has a sporiferous nucleus of a very different structure and now forms the genus *Wormskioldia* of J. Agardh, I retain most of the species included in Dr. Greville's restriction of the genus. By Kützing these are arranged in his genera *Phycodryis* and *Hypoglossum*, groups which I regard as subgenera only. The species are numerous and many of them are widely dispersed. Of the following, *D. tenuifolia* and *D. involvens*, now first described, have been found only on the Florida Keys.

SUB-GENUS 1. PHYCODRYIS, Kütz. *Fronde pinnatifid or sinuated.*

1. DELESSERIA *sinuosa*, Lamour. ; stem (at length) elongated, branched, beset with oblong or obovate, deeply sinuated or pinnatifid, toothed, penni-nerved leaves ; nerves opposite. *Harv. Phyc. Brit. t. 259. J. Ag. Sp. Alg. 2, p. 691. Phycodryis sinuosa, Kütz. Sp. Alg. p. 874. Fucus sinuosus, Turn. Hist. t. 35. E. Bot. t. 822.*

HAB. Arctic Sea Coast, *Mr. Seaman.* Halifax, *W. H. H.* Boston Bay, *Mr. Emerson, Dr. Durkee, &c.* Newport, *Prof. Bailey, Mr. Olney, &c.*

Fronde originating in a single, oblong or obovate, sinuous or deeply pinnatifid leaf, 4—8 inches long and from one to four inches broad, denticulate at the margin, furnished with a strong percurrent midrib, and with opposite, lateral nerves or veins set at an angle with the midrib of about 45°. As the frond grows larger the first formed leaf becomes more deeply lacinated, the laciniae which were at first little more than denticulations lengthening, widening, and becoming again pinnatifid. The membrane of the older parts decays and the denuded midribs are thickened into filiform, imperfectly winged stems and branches, which bear from their sides and apex numerous leaves resembling the original one. Such specimens are often very bushy and dense. The midribs are usually unbranched, but are sometimes forked. The margin of the frond, which in most cases is merely denticulate, is occasionally bordered with slender, simple or fimbriated lacinulæ, or fringed with great numbers of minute, accessory frondlets. *Conceptacles* hemispherical, formed from the substance of the midrib or of one of its lateral nerves. *Tetraspores* in sori generally lodged in minute marginal leaflets, rarely dispersed over the membrane in patches following the courses of the lateral nerves. *Substance* membranaceous. *Colour* a purple lake, turning rather brownish in drying. It does not adhere strongly to paper.

A specimen from Dr. Durkee has dispersed tetraspores, and unites this species with the *D. quercifolia* of the Southern Hemisphere, which Kützing nevertheless places in a different genus.

In deep water the frond often becomes very narrow, with filiform lobes, produced into long tendrils. Some of my Halifax specimens exhibit this character.

2. *DELESSERIA fimbriata*, Delapyl.; "leaves of the ribbed, oppositely veined frond obovate, pinnatifid; laciniae nerveless or having a vanishing nerve, at length separated as proper, linear-oblong, serrated and sinuous leaflets; sori of tetraspores lodged in marginal, acute and acutely toothed fimbriæ, sub-geminate; conceptacles sessile on the parenchyma of the frond." *J. Ag. Sp. Alg.* 2, p. 690.

HAB. Newfoundland, *De la Pylaie*; fide *J. Agardh*.

SUB-GENUS 2. *PTERIDIUM*, Kütz. *Fronde* alternately or dichotomously branched, rose-red.

3. *DELESSERIA denticulata*, Mont.; frond alternately decomposed or irregularly pinnatifid, costate; branches linear, the primary ones alternate, the secondary often opposite, denticulate or fimbriato-ciliate at the margin; the lamina penninerved with opposite, oblique veinlets; sori linear, at each side of the midrib near the ends of the laciniae. *Mont. in An. Sc. Nat. Ser.* 3. xii. p. 223. *D. alata*, var. *denticulata*, *Mont. l. c.* xi. p. 62.

HAB. Shores of Labrador, *M. Lamare Piquot*, in *Herb. Montagne*. Brandy Pot Island, River de Loup, *Mr. Allom*. (v. s. in *Herb. T. C. D.*)

Of this plant I have as yet seen only small specimens, insufficient to enable me to give as full a description as I could wish. The primary frond is four or five inches or more in length, often a quarter to half an inch broad, linear, membranous, traversed by a strong midrib, which gives off at acute angles alternate branches, one running through each primary lobe, and giving off similar branchlets to the succeeding lobes. The lamina throughout is linear, extending at each side of the midrib like a wing, of variable breadth in different specimens, and closely penninerved with microscopic, articulated, obliquely ascending opposite veinlets, each of which runs out into a marginal tooth or lacinula. These marginal denticulations are sometimes minute, sometimes prolonged into linear, acute, ciliaform processes. *Tetraspores* in linear-sori, extending at each side along the midrib, near the apex of the smaller lacinia. *Axils* acute. *Colour* a purple-rose-red. *Substance* delicately membranaceous.

4. *DELESSERIA alata*, Lamour.; frond irregularly dichotomous or alternately decomposed, costate; branches linear, quite entire at the margin; the lamina (sometimes very narrow) penninerved with opposite, oblique veinlets; sori either at the apices of the segments or in proper leaflets. *J. Ag. Sp. Alg.* 2, p. 683. *Harv. Phyc. Brit.* t. 247. *Hypoglossum alatum*, Kütz. *Sp. Alg.* p. 877. *Delesseria angustissima*, Griff.—*Harv. Phyc. Brit.* t. 83. *J. Ag. Sp. Alg.* 2, p. 686. (an extreme form, nearly destitute of membrane.)

HAB. Boston Harbour, *Mrs. Mudge, Dr. Durkee, &c.* (v. v.)

Frond distichous, two to four inches high or more, much branched, linear, from half a line to half an inch broad, alternately decomposed, in a manner between dichotomous and pinnate; branches having a cartilaginous midrib winged at each side with a narrow or broadish membrane, which is occasionally obsolete. My American specimens are not in fruit. *Colour* a bright purple-lake. *Substance* membranaceous. In drying, it does not adhere strongly to paper.

I am not aware of this species being found south of Cape Cod. The specimens from Boston are of small size and very narrow, many of them as narrow as *D. angustissima*, Griff., but in all that I have seen there is an evident wing to the midrib.

5. *DELESSERIA serrata*, Post. and Rupr.; "stipes winged, compressed, much branched; branches winged, alternately pinnatifid and bipinnatifid; segments linear, costate, serrated at the margin and incised or pinnated in the upper part; sori punctiform, aggregated at each side of the rib along the whole length of the segments. *Post. and Rupr. Illust.* p. 15. *J. Ag. Sp. Alg.* 2, p. 696. *Hypoglossum serratum*, Kütz. *Sp. Alg.* p. 876.

HAB. Parasitical on the stipes of *Ptilota asplenioides*, at Unalashka, *Postels and Ruprecht.*

6. *DELESSERIA corymbosa*, J. Ag.; "frond subfiliform, dichotomo-corymbose, the upper segments linear, obtusely acuminate, slightly incurved above the axil, very entire at the margin." *J. Ag. Sp. Alg.* 2, p. 684.

HAB. Greenland, *Vahl*, fide *J. Agardh*.

7. *DELESSERIA rostrata*, J. Ag.; "frond subfiliform, pinnato-dichotomous, the upper segments patent, linear, acuminate, very entire at the margin; conceptacles immersed in the terminal segments, thrice as thick as the excurrent beak-like point of the ramulus and shorter than it; sori of tetraspores elongated below the summit of the segments." *J. Ag. Sp. Alg.* 2, p. 685.

HAB. Greenland, *Fabricius*, *Vahl*., fide *J. Agardh*.

SUB-GENUS 3. *HYPOGLOSSUM*, Kütz. *Frond undivided, oblong or lanceolate, proliferous from the midrib; rose-red.*

8. *DELESSERIA Hypoglossum*, Lamour.; frond linear-lanceolate, tapering at each end, repeatedly proliferous from the opaque, inarticulate midrib with leaflets of similar form; at length much branched. *Harv. Phyc. Brit.* t. 2. *J. Ag. Sp. Alg.* 2, p. 693. *Hypoglossum Woodwardi*, Kütz. *Sp. Alg.* 875. *Var. β. ovalifolium*, J. Ag. leaves oblong, obtuse or subobtuse, not attenuated. *Var. γ. filiforme*, *Menegh.*; leaves exceedingly narrow, much attenuated at both ends.

HAB. Shores of Carolina and Georgia. Charleston Harbour, the three varieties common, *Prof. Gibbes*, *W. H. H.* Anastasia Island, *Dr. Durkee.* (v. v.)

Frond originating in a simple, lanceolate leaf, which, in the American specimens is seldom more than three or four inches long and a quarter inch wide. This leaf is delicately membranaceous, and has a percurrent, slender, inarticulate midrib formed of numerous, closely packed cylindrical cellules. As the plant develops, the midrib throws out at both surfaces numerous similar leaves which in turn bear others; and thus by the repeated production of new series of leaves from the midrib of the older, the plant at length becomes a leafy ball, very dense with crowded foliage. The margin is entire and generally flat. The membrane is composed of polygonal cells of which those next the midrib are nearly equal-sided hexagons, those next them oblong, and those toward the margin gradually smaller and more cylindrical. *Conceptacles* globose, on the midrib. *Tetraspores* in oblong or linear sori, disposed in pairs at opposite sides of the midrib in the smaller leaves. *Colour* a brilliant carmine-lake. *Substance* delicately membranaceous. The plant quickly becomes orange and decomposes in fresh water, and in drying closely adheres to paper.

In var. *γ.* the leaves are frequently much arched, exceedingly narrow, and tapering to a very slender point. This variety remarkably contrasts with var. *β.* whose

leaflets are as blunt as those of *D. ruscifolia*. Both varieties accompany the ordinary form in Charleston Harbour, the most northerly station hitherto ascertained for *D. Hypoglossum* in America.

9. *DELESSERIA tenuifolia*; frond filmy, pale rose-red, broadly linear, obtuse, flat, repeatedly proliferous from the capillary, articulated midrib with leaflets of similar form; at length much branched, fastigate. (TAB. XXII. B.)

HAB. At Key West, Feb. 1850, *W. H. H.* (v. v.)

Frond originating in a linear, obtuse, perfectly flat leaf, one or two inches long and about two lines in breadth, of extreme tenuity, and furnished with a percurrent, articulated midrib composed of a triple row of cells, of which the central cell is cylindrical and more deeply coloured, the border cells half-hexagonal; the three cells taken together forming a hexagonal arcole or articulation of the midrib. This primary leaf emits others from its midrib, and the process is repeated till there results a much branched, fastigate, globose frond, whose lower branches (the denuded midribs of the primary leaves) are thickened to the diameter of a hog's bristle. I have not seen *conceptacles*. *Tetraspores* occur in very small sori placed one at each side of the midrib near the tips of the young leaves. The substance of the membrane is exceedingly thin and semi-transparent. The cellules toward the midrib are large and polygonal, not regularly hexagonal, but nearly so; those toward the margin oblong or cylindrical, disposed in lines at an angle of 45° with the midrib. *Colour* very pale. In drying, it adheres most closely to paper.

Thin and delicate as are the leaves of *D. Hypoglossum*, those of the present species are much more so, and, when dry, appear as a mere glossy film on the surface of the paper. Under the microscope, it is easily known from *D. Hypoglossum* by the structure of the midrib, and the disposition of the cellules of the membrane, while its pale colour and extreme tenuity sufficiently mark it to the naked eye. In the form of the leaf it resembles *D. ruscifolia*, but in other respects abundantly differs from that strong-growing species.

Plate XXII. B. *Fig. 1*, *DELESSERIA tenuifolia*, the *natural* size. *Fig. 2*, some leaves, with sori in their apices; *fig. 3*. apex of a leaf enlarged to show the structure of the membrane; *fig. 4*, a tetraspore;—all *magnified*.

10. *DELESSERIA involvens*; frond filmy, pale rose-red, linear-lanceolate, attenuate, having the apex strongly involute, bordered with oblique bullate undulations repeatedly proliferous from the articulated midrib with leaflets of similar form; at length much branched and fastigate. (TAB. XXII. A.)

HAB. At Key West, Feb. 1850, *W. H. H.*, *Dr. Blodgett*. (v. v.)

The mode of composition of the frond is the same as in the last species; a pri-

mary leaf, by repeated proliferous development, resulting in a much branched, subdichotomously or secundly divided, globose, fastigiata frond, two or three inches in diameter. Each individual leaf is from half an inch to an inch long and about half a line broad, narrow linear-lanceolate, obtuse at the base, much attenuate at the extremity, which is invariably, on very numerous specimens which I have examined, strongly rolled inwards, and cannot be unrolled without difficulty, immediately rolling up again when released. The margin is quite entire; within it is a wide border, occupying more than a third part of the breadth of the leaf, composed of narrow cylindrical cells disposed in obliquely ascending lines at an angle of about 45° with the midrib; and throughout this border the membrane is raised up in oblong undulations having a common direction with the lines of cells, and appearing more strongly coloured than the surrounding parts. The portion of the lamina between the border and midrib is composed of hexagonal cells of which the innermost are largest. The midrib is of the same structure as in *D. tenuifolia*, but formed of larger cellules. In old specimens it becomes, when denuded, thickened into the setaceous stem and branches of the compound frond. *Conceptacles* very convex, more than hemispherical, borne on the midrib. *Tetraspores* in small irregular sori, one at each side of the midrib in the smaller leaves. *Colour* a pale rosy red. *Substance* extremely thin and delicate. In drying, it adheres most closely to paper.

Plate XXII. A. *Fig. 1.* *DELESSERIA involvens*, the natural size. *Fig. 2.* Some leaves, growing proliferously; *fig. 3.* a leaf, highly magnified to show the structure; *fig. 4.* *tetraspores* lying among the surface cells; all more or less highly magnified.

SUB-GENUS 4. CALOGLOSSA, Harv.; *Frond dichotomous, articulato-constricted, rooting at the forks, livid purple.*

11. *DELESSERIA Leprieurii*, Mont.; frond livid-purple, linear, dichotomous, either rooting or proliferous at the forks; the space between each furcation linear-lanceolate; the ultimate divisions attenuate, bifid at the apex; midrib articulated, three-tubed; conceptacles nearly spherical, on the midrib; tetraspores in lines obliquely drawn from the midrib to the margin near the apices of the branches. *Mont. An. Sc. Nat. 2nd ser. vol. xiii. p. 196, t. 5, fig. 1.* *J. Ag. Sp. Alg. 2, p. 682.* *Hypoglossum Leprieurii, Kütz. Sp. Alg. p. 875.* (TAB. XXII. C.)

HAB. In tidal rivers, growing on stones, woodwork, or on phænogamous water plants, &c. Discovered in North America by *Prof. Bailey* in the Hudson at West Point, and found more recently in the Ashley and Cooper Rivers, S. Carolina, and in several rivers of Georgia and Florida. *Apalachicola, Capt. Pike. (106).* (v. v.)

Frond one to two inches high, from half a line to a line in diameter, many times regularly dichotomous, constricted at the forks, and traversed by a slender midrib. At the point where the midrib bifurcates, there is generally formed a small rootlet or process by which the plant attaches itself when young. Afterwards, when the

divisions are more erect, these expand into frondlets of similar shape to the original, being at first simple, then forked, and at length repeatedly dichotomous. The midrib is formed of a triple row of cylindrical cells of equal length; the membrane, of hexagonal cells set in lines extending obliquely from the midrib to the margin, and gradually of smaller size as they recede from the midrib. The *conceptacles* are very rare, and are formed at the expense of the rootlike process at the furcations. They contain within a thin wall strings of conoidal spores borne on a large cellular, basal placenta. *Tetraspores* are more frequently found, and occupy the summits of the leaves, where they are set in obliquely ascending lines. *Colour* a livid purple, fading to green. *Substance* membranous, not very closely adhering to paper in drying.

A very distinct and curious little species of a colour most unusual in this genus, recalling forcibly the colour of the *Bostrychiæ*, plants found in similar situations. I have only seen conceptacles in one or two specimens from Cooper River, but tetraspores are common in Westpoint individuals. These latter are more slender and much more attenuate at the apices than those from Charleston; a circumstance to be anticipated not merely from the difference of climate, but chiefly from the large admixture of fresh water in the stream of the Hudson at sixty miles above its mouth.

Plate XXII. C. *Fig. 1.* *DELESSERIA Leprieurii*, the *natural* size. *Fig. 2,* a branch to show ramifications and rootlets; *fig. 3,* apex of a branchlet, to show the structure; *fig. 4,* portion with a *conceptacle* formed; *fig. 5,* vertical section of a conceptacle; *fig. 6,* spores; all more or less highly *magnified*.

BOTRYOGLOSSUM. *Kütz.*

Fronde purplish red, with an opaque, cartilaginous stem expanding upwards into an irregularly cleft, coriaceous-membranaceous, areolated lamina, traversed in the lower part by an obsolete, vanishing midrib. *Conceptacles* scattered, sub-hemispherical, with a prominent orifice; placenta basal, crowned with a pulvinate tuft of moniliform spore-threads, whose terminal cells are earliest ripened. *Tetraspores* tri-partite, grouped in definite spots or sori, occupying portions of the frond or lodged in accessory leaflets.

Under this genus I include *Neuroglossum*, *Kütz.* which merely differs from *Botryoglossum* of the same author in having its tetraspores lodged in intra-marginal sori instead of in foliaceous marginal processes, a character which I consider of such minor importance that I am not sure that it is even of specific value, much less generic. In *Delesseria sinuosa*, *Nitophyllum laceratum*, and even in our *Botryoglossum*

platycarpum both positions of tetraspores occur. Indeed I am by no means convinced that Kützing's *Neuroglossum Binderianum* is specifically distinct from *B. platycarpum*.*

Kützing has, as I think unadvisedly, referred *Jeannerettia lobata*, Hook. and Harv. (Ner. Austr. t. 4.) to this place, overlooking the nature of its stichidia, which, in my opinion, clearly indicate an affinity with *Rhodomelaceæ*. However, as the conceptacular fruit is as yet unknown, it may be premature to regard the question decided.

1. BOTRYOGLOSSUM *platycarpum*, Kütz. ; sori of tetraspores (generally) lodged in small leafy processes, which either fringe the margin or are dispersed over the surface. *Kütz. Sp. Alg.* p. 881. *J. Ag. Sp. Alg.* 2, p. 676. *Fucus platycarpus*, *Turn. Hist.* t. 144. *Delesseria platycarpa*, *Ag. Syst.* p. 252. (TAB. XXI. A.)

HAB. Monterey, California, *Mr. Douglas ! Dr. Coulter ! Dr. Sinclair ! Capt. Wilkes !* (v. v.)

Root a large conical disc, throwing out lateral branches. *Fronde* twelve inches long or more, irregularly di-trichotomous or palmate-parted, divided nearly to the base into numerous linear-cuneate laciniaë, which are either simple, or again similarly divided. The lower part of the frond and of its divisions is furnished with a very broad, flat midrib, which spreads over the greater part of the disc. This midrib is cartilaginous and very thick below, but becomes thinner and less defined above, and at length disappears in the upper and wider portions of the cuneate laciniaë. In young fronds the margins of the laciniaë are either deeply crenate or obtusely pinnatifid, the lobes being sometimes deep, sometimes shallow, always very obtuse with bluntish or rounded interspaces. In some specimens the lacinia is merely repand. In old plants the margin is frequently worn away and much jagged, the membrane being reduced to a narrow wing-like border to the broad midrib. In fertile specimens the eroded margin produces a multitude of minute, leaf-like, roundish or lobed processes half a line to a line in breadth, sometimes scattered, but more frequently densely crowded and forming a thick fringe to the segment. In these processes are sometimes found tetraspores immersed in thickened central discs ; and sometimes conceptacles. The tetrasporic fruit is most common. A thin slice of the frond shows several rows of muriform cells, of which the central row is of larger size. The outer row alone contains coloured matter. When the membrane is viewed vertically, the surface appears areolated with hexagonal cells, among which may be traced faint indications of internal, branching veins. *Colour* a dark purplish red, becoming browner in drying. *Substance* cartilaginous and thick. It scarcely adheres to paper in drying.

The tetraspores are by no means confined to the marginal leaflets. In some of

* Since this was prepared for the press, I observe that Professor J. Agardh unhesitatingly unites these plants. *Sp. Alg.* 2, p. 676.

Douglas' and Coulter's specimens, where the margin is uninjured, they are congregated in large, dense, linear intra-marginal sori, extending along the sides of the lacinia. Toward the apices the sori are linear, branching and anastomosing, as in *Hymenena*; and all three characters of sorus, the simply intermarginal, the branching and anastomosing, and that placed in the extramarginal leaflet, may sometimes be found on the same root! The existence of such specimens considerably weakens the claims of *B. Binderianum* to specific distinction.

Plate XXI. A. *Fig. 1.* BOTRYOGLOSSUM *platycarpum*, the *natural* size. *Fig. 2,* marginal leaflet, with sorus; *fig. 3,* a tetraspore; *fig. 4,* portion of the areolated surface; *fig. 5,* section through the frond; the latter figures *magnified.*

IV. HYMENENA. *Grev.*

Frond rosy red, expanded, irregularly laciniated, unsymmetrical, membranaceous, areolated, without midrib, but everywhere traversed with numerous prominent, anastomosing, subparallel nerves. *Conceptacles* sessile on the nerves, depressed in the centre (umbilicate), with an orifice; walls very thick; *placenta* basal, slightly prominent, crowned with a depressed tuft of dichotomous spore-threads whose terminal cells are earliest ripened. *Tetraspores* tripartite, in long linear sori lodged in the spaces between the nerves, or in marginal leaflets.

This genus, which is perhaps too closely related to the preceding, chiefly differs in the absence of midrib, and in the numerous anastomosing nerves which supply its place. It is distinguished from *Nitophyllum* by the form of the conceptacle and the thickened substance. The linear disposition of tetraspores occurs in the three genera.

1. HYMENENA *fissa*, Grev.; frond palmate, the lacinia linear-cuneate, undulate, obtuse, erect, very entire at the margin. *Harv. Ner. Austr. p. 118, t. 44. Kütz. Sp. Alg. p. 873. J. Ag. Sp. Alg. 2, p. 674. Fucus venosus, Turn. Hist. t. 138.*

HAB. Monterey, California, *Capt. Beechey*; *Capt. Wilkes.* (v. v.)

Root branching. *Fronde* six to twelve inches high, palmate, or irregularly dichotomous, broadly cuneate in outline. *Lacinia* linear-oblong, simple or lobed, undulate, with an entire margin. Every part of the frond is traversed by closely placed, longitudinal, anastomosing prominent nerves, on which the *conceptacles* are formed, and between which the *tetraspores* are scattered in long lax sori. The

colour when recent is a brilliant purplish lake, reflecting prismatic hues, especially when viewed through water. The *substance* is rather rigid, containing much saline matter and mannite. In drying, it does not adhere to paper.

I do not possess American specimens of this plant, and transfer this description from *Ner. Austr.* p. 118. An outline drawing of Capt. Wilkes's plant sent to me by Prof. Bailey seems to accord well with my Cape of Good Hope specimens, and I formerly examined one of Capt. Beechey's which appeared also similar.

2. *HYMENENA fimbriata*, Post. and Rupr.; frond palmate or multifid, the segments cuneate, deeply lobed, round-topped, traversed by numerous dichotomous nerves which coalesce into a broad compound nerve or imperfect midrib toward the base; the margin of fertile specimens fimbriate with small, roundish leaflets. *Post. and Rupr. Illustr.* p. 15, t. 38. *Kütz. Sp. Alg.* p. 873. *J. Ag. Sp. Alg.* 2, p. 674. *Hymenena fissa*, β . *marginata*, Harv. in *Bot. Beech. Voy.* p. 407.

HAB. St. Francisco, *Dr. Sinclair*. Golden Gate, *Capt. Pike* (21). Norfolk Bay, *Postells and Ruprecht*. (v. s. in Herb. T. C. D.)

Frond 12—14 inches long, with a linear-cuneate stipe three to four inches long, nearly filled in its lower part with a broad cartilaginous midrib. As the frond gradually widens upwards, the midrib branches into numerous strongly elevated nerves which divide more and more, distributing themselves among the laciniae of the palmate or multifid membrane. Each segment is broadly linear, half an inch to an inch wide, cuneate, rounded at the top, two thirds or more of its surface occupied by the dichotomously branched, longitudinal nerves, which in some specimens are very strongly elevated, with deep furrows between them, in others less evident and even somewhat obliterated. The margin in young specimens is flat and smooth, in older ones fimbriate with minute roundish processes, which bear the fructification. *Tetraspores* in the thickened marginal lobes, precisely as in *Botryoglossum*. *Structure*, of several rows of quadrate, muriform cells. *Colour* a dark purple-lake. *Substance* rigid. It does not adhere to paper.

This plant has so much in common with *Botryoglossum platycarpum*, that it is hardly natural to place them in different genera.

V. NITOPHYLLUM. *Grev.*

Frond rosy-red or purplish, expanded, irregularly laciniated, unsymmetrical, delicately membranaceous, areolated, without midrib, either altogether destitute of nerves or having towards the base a few irregular, branching, vanishing nerves. *Conceptacles* sessile, scattered, globose, without orifice; *placenta* basal, crowned with

a pulvinate tuft of simple or dichotomous spore-threads whose terminal cells are earliest ripened : spores elliptical or roundish. *Tetraspores* tripartite, grouped in definite spots or sori, variously dispersed over the frond.

This genus is nearly related to *Delesseria*, from which it is only to be distinguished by its unsymmetrical frond destitute of a single percurrent midrib. This character will generally be found sufficient readily to distinguish these groups, but some species of the southern hemisphere exhibit intermediate stages ; as *Delesseria dichotoma* and *Nitophyllum multinerve* which sometimes approach each other *inconveniently* near.

A considerable number of species have been described, which Kützing divides into three genera, *Aglaiophyllum*, *Schizoglossum*, and *Cryptopleura*, distinguished by some differences in the structure of the frond. *Aglaiophyllum* is limited to those species which are altogether nerveless, and have a membrane composed of a single stratum of large cellules: *Cryptopleura* to those in which nerves are more or less obvious, with a similarly constructed membrane: and *Schizoglossum* to such nerveless species as have a membrane composed of more than one stratum of cellules. I do not adopt these genera, because I find the characters untenable. The more or less nervated frond varies even in the same species ; *Schizoglossum Gmelini*, Kütz. for instance, which ought, by generic character, to be nerveless, is frequently abundantly supplied with nerves, much more abundantly than *Cryptopleura Bonnemaisoni* and *C. Crozieri*. The character founded on compound structure is equally nugatory, for *Cryptopleura lacerata*, which is, moreover, the *type* of the genus so called, has a frond constructed of more than one row of cellules, contrary to the generic character. There is, indeed, a most close affinity in structure between *S. Gmelini* and *C. lacerata*, and they cannot be separated generically without violence.

With respect to nomenclature, I prefer retaining the name *Nitophyllum*, under which this genus was first defined, although it may not be constructed on classical principles, to adopting the modern, more classical, but less euphonious, and as I think unnecessary *Aglaiophyllum* of my friend Dr. Montagne. The change of long established names, except in cases of clear necessity, is very objectionable ; and if all names in natural history were to be rejected that are not founded according to strictly classical rules, a large number of new synonyms would soon be added to the copious list already a burden to the science.

One of the more distinctive features of the marine flora of the Atlantic coast of America as compared with that of Europe is, as has been already noticed in our introduction (Part i, p. 24), then early total absence of species of *Nitophyllum*, a genus which abounds on the European coasts, where many kinds are dispersed from the shores of Scotland to those of Spain, and in some places in such profusion that they give the chief character to the vegetation, at certain depths. In contrast to this I can only as yet claim, for the North American seaboard, a few scraps, almost too imperfect for determination. Very different is the case on the shores of South America, beyond the tropic, where the genus flourishes in many fine species, as also

on the South African continent, and along the southern shores of Australia and New Zealand.

1. *NITOPHYLLUM punctatum*. Var. *ocellatum*, Grev. ; frond linear, many times dichotomous, fastigiate, the axils rounded and apices blunt ; sori scattered over the lower segments of the frond. *Harv. Phyc. Brit. t. 203, fig. 1. J. Ag. Sp. Alg. 2, p. 659. Nitophyllum ocellatum, Grev. Alg. Brit.—Grev. Scot. Crypt. t. 347. Aglaio-phyllum ocellatum, Mont.—Kütz. Sp. Alg. p. 867.*

HAB. At Key West, *W. H. H. (39)*. Smithville, N. Carolina (?), *Mr. C. Congdon. (v. v.)*

The Key West specimens are about two inches high, exceedingly thin and filmy, divided nearly to the base into repeatedly dichotomous laciniaë, which are about a quarter inch wide. The margin is flat or slightly undulated. The sori are of large size, nearly orbicular, irregularly scattered on the laciniaë. *Colour* a delicate rosy red. *Substance* very soft and flaccid. It adheres most closely to paper in drying.

The specimens examined are very similar to a specimen from Catania, Sicily, preserved in Herb. T.C.D. They are smaller and more delicate in substance than the ordinary British form of this variety ; but in so variable a species no importance attaches to such minor differences.

Mr. Congdon's specimens from the mouth of the Wilmington river are very imperfect and destitute of fructification, but, so far as I can judge, belong to the ordinary form of *N. punctatum*. It is to be hoped that some southern collector may ascertain the fact.

2. *Nitophyllum laceratum*, Grev. ; frond sessile or shortly stipitate, dichotomous, traversed by numerous slender, branching, and anastomosing nerves ; segments linear, variously cleft and lobed, waved at the margin, obtuse ; spots of tetraspores oblong, either intra-marginal or borne on distinct leafy processes of the margin. *Harv. Phyc. Brit. t. 267. J. Ag. Sp. Alg. 2, p. 657. Cryptopleura lacerata, Kütz. Sp. Alg. p. 870. Fucus laceratus, Turn. Hist. t. 68. E. Bot. t. 1067.*

HAB. Newfoundland, *De la Pylaie, fide J. Agardh.* Golden Gate, California, *Capt. Pike (47). (v. v.)*

Frond (in the Californian specimens examined) six to eight inches long, cleft nearly to the base into numerous linear segments half an inch wide below, branched alternately or subpalmatifid above, each ultimate lacinia a quarter inch wide, linear oblong, obtuse, erect, the axils rounded. The whole substance of these specimens is traversed with slender, branching, immersed veins, very visible when the frond is examined with a pocket lens. *Tetraspores* either in linear, intra-marginal, longitudinal sori, or in little, roundish marginal leaflets. *Colour* a livid

purple-red. *Substance* rigidly membranaceous. In drying, it imperfectly adheres to paper.

The specimen examined accords very well with some of those from the west coast of Ireland where this species abounds, and where it exhibits many variations in breadth and ramification. It is easily recognised from all its congeners except *N. Gmelini* by the position of the sori. We have not perhaps sufficient data yet to determine whether *Hymenena fimbriata* be anything more than an extravagant variety of this plant, as I have sometimes supposed.

VI. CALLIBLEPHARIS. *Kütz.*

Fronde flat, cartilagineo-membranaceous, dichotomo-pinnate, often margined with wing-like segments or ciliate, formed of two strata of cells; the medullary cells roundish-angular, longitudinal, of large size, in several rows; the cortical minute, coloured, in one or two rows. *Conceptacles* sessile on the marginal processes, with a thick pericarp, containing on an elevated basal placenta a dense tuft of fastigate, moniliform spore-threads forming ellipsoid spores from their upper articulations. *Tetraspores* oblong, zonate, lodged in the peripheric cells of the frond (dispersed), or of the marginal processes.

Separated by Kützing from *Rhodymenia*, on account of the very dissimilar structure of the conceptacular nucleus, and the zonate division of the tetraspores. This last character distinguishes it from *Gracilaria*, from which also it differs by a peculiar habit. The species are of a very deep and brilliant red while growing, but become darker, sometimes almost black, in drying. Their substance is thicker than that of most of the membranous plants of the Order. They are natives of the Northern and Southern Oceans.

1. *CALLIBLEPHARIS ciliata*, Kütz.; root branching; frond shortly stipitate, thick, subcartilaginous, dull-purplish red, lanceolate or forked, irregularly pinnated with lanceolate or bifid segments, which are attenuated at the base; the margin, and often the disc, more or less furnished with subulate processes in which the conceptacles are lodged; tetraspores collected in cloud-like patches, dispersed over the lamina. *Kütz. Sp. Alg. p. 755. J. Ag. Sp. Alg. 2, p. 619. Rhodymenia ciliata, Grev. Harv. Phyc. Brit. t. 127. Fucus ciliatus, Turn. Hist. t. 70, fig. a—e. E. Bot. t. 1069. Var. β. cirrhata*; frond very narrow, dichotomous, the apices cirrhiform, repeatedly forked.

HAB. Boston Bay, *W. H. H.* Var. β. dredged in Halifax Harbour, *W. H. H.* (v. v.)

My American specimens of this plant are neither numerous nor quite satisfactory. One from Boston Bay is not unlike some of the smaller forms of the species as known in Europe. It is about four inches long, partly dichotomous, partly pinnated with lateral, simple laciniae, the margin closely fringed with slender, sub-filiform, simple or slightly branched processes from a quarter to half an inch in length. The colour is dark red, inclining to purple; and though it has perhaps more the technical characters of *C. jubata*, its aspect and substance are those of *C. ciliata*.

The Halifax specimens were dredged in deep water, to which circumstance I attribute their peculiarities. They are but two or three inches in height; one of them is half an inch wide at the widest part, but the usual breadth is from one to two lines or less. The frond is cuneate at base, twice or thrice forked, the apices of the last divisions drawn out into filiform points which are repeatedly forked toward the summit. The margin is fringed with slender lobes, from one to two lines to upwards of an inch in length, in the latter case often dichotomous. Can these be *Rhodophyllis veprecula*, J. Ag.?

VII. GRACILARIA. Grev. J. Ag. ref.

Frond either filiform, compressed, or flat, narrow, carnosocartilaginous, dichotomous or irregularly decomposed, composed of two strata of cells; the inner stratum of large, roundish-angular longitudinal cells, more or less filled with granular matter; the outer of minute, coloured cellules in vertical lines. *Conceptacles* sessile on the branches, hemispherical or conical, with a thick pericarp at length opening by a terminal pore, containing, on an elevated basal placenta, densely tufted, dichotomous, fastigiate, moniliform spore-threads radiating to every side; *spores* evolved in the upper articulations. *Tetraspores* oblong, cruciate, dispersed among the surface cellules of the branches and ramuli.

This genus, originally proposed by Dr. Greville in his *Algæ Britannicæ*, has been amended by Prof. J. Agardh by the rejection of such species as do not accord with the above characters. It is the same as the *Plocaria* of Endlicher, and, to a great extent, as the first section of Kützing's genus *Sphærococcus*. The name *Plocaria candida* was given by Nees von Esenbeck to the Ceylon moss of commerce (*Gracilaria lichenoides?*), and has been extended to the Grevillio-Agardhian genus by Endlicher on the plea that it had the priority in order of publication. But I agree with Professor Agardh in regarding the mutation of an established generic name as being in this instance uncalled for, inasmuch as the name *Plocaria* (which has very little the priority over *Gracilaria*) was given in ignorance of the natural affinities of the plant so-called, Nees believing it to be a lichen; nor is it very

certain whether the author intended to include in his description one or many species.

The type of this genus is the *Fucus confervoides*, Lin.; a widely dispersed plant, found from the tropics to a high latitude in both hemispheres. *G. multipartita* has also very considerable geographic range. Many of the species, perhaps all, may be reduced by boiling to a tasteless gelatine, which when properly seasoned is palatable and considered wholesome. Some of the tropical species, particularly *G. lichenoides*, yield a very tenacious jelly.

1. *GRACILARIA cervicornis*, J. Ag.; membranaceo-cartilaginous, flattish, pinnately decomposed; pinnæ linear, dentate, the ultimate ones often filiform, teeth very acute; conceptacles hemispherical, apiculate, on the disc of the upper lacinia near the margin. *J. Ag. Sp. Alg.* 2, p. 604. *Sphærococcus cervicornis*, Kütz. *Sp. Alg.* p. 775. *Rhodymenia cervicornis*, Montagne. *Voy. Bonite*, p. 108. *Fucus cervicornis*, Turn. *Hist. t.* 121.

HAB. Gulf of Mexico, *J. Agardh.* (v. s. in Herb. T. C. D.)

Frond six or eight inches long, pinnately much branched, the upper branches more or less dichotomous. Main rachides flat, one or two lines broad, linear; branches not half that breadth, the upper ones very narrow and subterete. Marginal teeth very acute. Colour in the dry state dull brownish, with a purple tinge. Substance rigid.

Of this plant I possess only South American specimens.

2. *GRACILARIA multipartita*, J. Ag.; frond compressed or flat, dull purplish-red, deeply cleft vertically in an irregularly dichotomous or palmate manner; lacinia linear-wedge-shaped, acute; conceptacles conical, very prominent, numerous, scattered. *J. Ag. Sp. Alg.* 2, p. 600. *Harv. Phyc. Brit. t.* 15. *Sphærococcus polycarpus*, *Grev. Crypt. Scot. t.* 352. *Fucus granateus*, Turn. *Hist. t.* 215. Var. β . *angustissima*; frond exceedingly narrow, almost filiform below, compressed, irregularly dichotomous, the apices frequently palmatifid.

HAB. Pacific Coast, California, *Douglas ! Capt. Pike !* Massachusetts Bay, *Capt. Pike !* Long Island Sound and New York Harbour, *Prof. Bailey ! Mr. Hooper ! W. H. H., &c.* Charleston Harbour, *Prof. Gibbes ! W. H. H., &c.* β . at Providence, Rhode Island, *Prof. Bailey ! Mr. S. T. Olney !* Longbranch, New Jersey, *Miss Morris.* Charleston, *W. H. H.* (v. v.)

Frond six to twelve inches long, extremely variable in breadth and in its ramification. Stem short, at first sub-filiform, compressed, soon expanding into the cuneate base of a flat, multifid frond, somewhat flabelliform in outline, and more or less deeply cleft vertically into numerous lacinia, varying in breadth from quar-

ter to half an inch or more. These laciniaë are sometimes strap-shaped and nearly simple, or having at one side a few lateral lobes; sometimes they are secundly or alternately multifid; sometimes nearly regularly dichotomous, sometimes palmatifid; and frequently the summits of long, nearly simple lobes are shortly palmate. *Apices* acute, somewhat attenuate, often jagged or irregularly cleft. *Axils* rounded but not very wide. The colour is a dark brownish purple, changing to greenish on exposure. The substance is thickish, cartilaginous, and rather brittle. *Conceptacles* prominent, and generally very abundant on the branches of fertile specimens. In drying, it adheres to paper.

Var. β . which Prof. Bailey finds growing in vast quantities on a sandy bottom, is for the most part so exceedingly slender that it may readily be taken for a distinct species, or even confounded with *G. confervoides*. I have however distinctly traced the connection between the narrowest form and the ordinary one, and this through an extensive series of specimens collected from various localities. Even among Prof. Bailey's specimens from Providence there is considerable variation in breadth and flatness.

3. *GRACILARIA compressa*, Grev.; frond succulent, brittle, somewhat compressed, alternately or subdichotomously branched; branches long and mostly simple, tapering to a fine point; conceptacles ovate or subglobose, sessile, prominent, numerous, scattered. *J. Ag. Sp. Alg.* 2, p. 593. *Harv. Phyc. Brit.* t. 205. *Sphærococcus lichenoides*, Grev. *Crypt. Scot.* t. 341.

HAB. Gulf of Mexico, at Vera Cruz, *Kützing, Sp. Alg.* p. 774. (v. s. in Herb. T.C.D.)

I have not seen any American specimen of this plant. British ones are 6—12 inches long, the branches 1—2 lines in diameter, succulent and brittle, of a beautiful transparent lake-red. Some varieties of *Solieria chordalis* have externally a considerable resemblance to this, but the fructification and the internal structure of the frond are widely different.

4. *GRACILARIA confervoides*, Grev.; frond cartilaginous, cylindrical, filiform, irregularly (often very slightly) branched; branches long, subsimple, erect, attenuate; ramuli few, tapering at each end; conceptacles sessile, scattered, roundish or conical. *J. Ag. Sp. Alg.* 2, p. 587. *Harv. Phyc. Brit.* t. 65. *Fucus confervoides*, L. *Turn. Hist.* t. 84. *E. Bot.* t. 1668. Var. β . *longissimus*, frond very long, nearly simple, naked or with a few filiform lateral branches.

HAB. Key West, *Mr. Binney, Dr. Blodgett* (46). Apalachicola, *Capt. Pike* (36). Var. β . dredged in Charleston Harbour, *W. H. H.* (v. v.)

The ordinary specimens of this variable species are six or eight inches long, as

thick as sparrow's quill, gradually attenuate upwards, more or less branching, sometimes very much branched, irregularly decomposed, the branches alternately cleft or subdichotomous. The lesser divisions are mostly distichous, either alternate or secund, and are commonly virgate with a few short lateral ramuli, always attenuate to the acute apex. Axils rounded. *Conceptacles* scattered over all the branches, prominent, as large as rape-seed. *Colour* when growing in deep water a dark, dull purple or brownish, much paler in shallow places, and fading on exposure to a waxy white. *Substance* rigid, cartilaginous.

Var. β . is often six feet long and quite simple, or with a few short lateral ramuli. Its peculiarities appear to result from its place of growth, and intermediate forms connect it with the ordinary much branched varieties.

5. *GRACILARIA armata*, J. Ag.; frond robust, cartilaginous, subcompressed, divaricately much branched, distichous; larger branches forked, their divisions multifid; lesser branches and the subulate, curved ramuli generally secund; axils very obtuse; conceptacles ellipsoidal, depressed, scattered on the larger branches. *J. Ag. Sp. Alg.* 2, p. 591. *Sphærococcus armatus*, Kütz. *Sp. Alg.* p. 774.

HAB. Key West, *Dr. Wurdeman*, *W. H. H.* (49), *Dr. Blodgett* (58 and 68), *Prof. Tuomey* (15). (v. v.)

Fronde densely tufted, six to eight inches long, as thick as crow's quill below, attenuated upwards, excessively, but very irregularly branched. All parts of the ramification are much divaricated. The main branches either arise several together, from nearly the same point of a short, erect stem, or they divide in an irregularly dichotomous manner, one arm of the fork being frequently suppressed. In this way the branch becomes zig-zag flexuous with secund divisions. The tendency to secund ramification is greater in the minor divisions, almost all the smaller upper branches being secund and set with several linear-subulate, secund, incurved or arching ramuli, the lowermost of which are an inch long, the rest gradually shorter. *Colour* varying from a dark-brownish purple to dirty white. *Substance* cartilaginous, but softer than in *G. confervoides*. *Conceptacles* scattered over the branches, not very prominent, longer than their breadth, obtusely conical, with thick walls. In drying, the frond shrinks much, and imperfectly adheres to paper.

6. *GRACILARIA divaricata*; frond cartilagineo-membranaceous, succulent, subterete, collapsing and plano-compressed when dry, divaricately much branched, sub-distichous; branches irregularly dichotomous, zig-zag or secund, very patent, attenuated to a fine point, copiously furnished with lateral, horizontal, simple or forked ramuli, apices all very acute; fr—?

Key West, *Prof. Tuomey*. (No. 13.) (v. s. in Herb. T.C.D.)

A single specimen only seen by me. *Fronde* about four inches long, a line or rather more in diameter at the base, much attenuated upwards, very much branched in a very irregular manner, between dichotomous and secundate, the main divisions frequently secund, and then dichotomously multifid. Principal branches and their divisions distichous. *Ramuli* irregularly inserted, nearly at right angles with the branches, two or three lines long, simple or forked, very acute, the bifid ends divaricating. *Colour* a purplish red, fading to white. *Substance* much more tender than in *G. confervoides*. Fruit unknown.

7. *GRACILARIA Poitei*, Lam. ; frond terete, very thick and robust, cartilagineo-corneous, dichotomously decompound, fastigiate, densely branched ; branches erecto-patent, with rounded angles, dichotomo-multifid or furnished with lateral short ramuli, the apices very obtuse, rounded or truncate or sometimes incrassated and distorted ; conceptacles obtusely conical, depressed, scattered on the larger branches. *J. Ag. Sp. Alg.* 2, p. 596. *Fucus Poitei*, Lam. *diss.* p. 63, t. XXXI. fig. 2, 3.

Key West, rare, *W. H. H.* (48). (v. v.)

*Fronde*s (in my specimens) about three or four inches high, varying in diameter from the thickness of a pigeon's quill to that of a goose quill, shrinking very much in drying, somewhat flabelliform in outline, rising at first with an undivided, erect stipe, then forking and afterwards repeatedly irregularly divided ; the branches opposite, alternate or secund, fastigiate or nearly so, dichotomo-multifid, of nearly equal diameter throughout. *Axils* rounded. Lateral ramuli few, chiefly near the ends of the branches. *Apices* very obtuse, rounded or truncate, sometimes much thickened, and occasionally hollowed out into cups twice or thrice as wide as the branch. *Conceptacles* plentiful, obtusely conical, with a wide mouth opening by a largish pore. *Colour* a livid purple, fading to greenish white. *Substance* carnosocartilaginous when recent, rather horny when dry. It does not adhere to paper in drying.

My specimens are more robust than those described by Agardh, but as some are of much greater diameter than others, I do not attribute much importance to this character ; and in most other respects our specimens seem to agree pretty well. One of mine is well supplied with conceptacles.

8. *GRACILARIA damæcornis*, J. Ag. ; "frond terete, very thick, carnosocorneous, decompound-dichotomous, subfastigiate ; branches sub-erect, often incurved, below subsecundly, above subdivaricately ramulose ; ramuli very patent, acuminate from a broader base." *J. Ag. Sp. Alg.* 2, p. 598.

HAB. On the Atlantic coast of North America, *J. Agardh*.

Unknown to me.

9. *GRACILARIA caudata*, J. Ag. ; "frond terete, thick, carnosio-corneous, elongated and laterally ramulose ; branches below dichotomo-ramulose, above prolonged, nearly naked, segments acuminate ; conceptacles hemispherical, scattered over the whole frond." *J. Ag. Sp. Alg.* 2, p. 598.

HAB. Gulf of Mexico, *J. Agardh*.

Unknown to me.

10. *GRACILARIA?* *Blodgettii* ; frond cartilagineo-membranous, irregularly dichotomous or alternately decomposed, filiform, the axils rounded ; branches and ramuli very much attenuated at the base, acute ; fructification unknown.

HAB. Key West, *Dr. Blodgett*. (v. s. in Herb. T.C.D.)

Frond five or six inches long, as thick as sparrow's quill, cylindrical or subcompressed, not much attenuated upwards, irregularly much branched, the branches and their divisions either alternate or secund, here and there forked, but not regularly dichotomous. All the branches and their minor divisions and the ramuli, which are few and scattered, taper very much to the base and are attenuated to an acute point ; the lesser ramuli are spindle-shaped. No fruit has been detected. A cross section shows a lax medullary stratum, formed of a few very large, distended, thin-walled, irregularly polygonal cells, with some smaller but similar external cells ; and a periphery of very minute, vertically subseriate, coloured cellules. *Substance* rather rigid when dry. *Colour* faded in all the specimens yet seen.

A curious plant of doubtful affinity. The ramuli taper to the base fully as much as in a *Chondria*, but there is no articulated polysiphonous axis. The structure is not very different from that of other *Gracilariæ*, and the habit is sufficiently like. I have seen no specimens but those received from Dr. Blodgett, to whom this species is inscribed.

VIII. CORALLOPSIS. *Grev.*

Frond subterete, succulent, articulato-constricted ; branches proliferous from the constriction, composed of two strata of cells ; the inner of very large, oblong cells, smaller toward the circumference ; the outer of minute, coloured cellules in a subsimple row. *Conceptacles* on the primary branches, hemispherical, inflated with a thick pericarp at length opening by a pore, containing on an elevated basal placenta densely tufted, fastigate spore-threads radiating to all sides ; spores obovate, formed in the upper articulations. *Tetraspores* unknown.

Nearly related to *Gracilaria*, from which it chiefly differs in the constricted coral or cactus-like frond.

1. CORALLOPSIS *Salicornia*, Grev. ; frond from the base articulo-constricted, di-trichotomous, articulations swollen upwards, club-shaped, three or four branches springing from the summit of each. *J. Ag. Sp. Alg.* 2, p. 582. *Sphærococcus Salicornia*, *Ag. Ic. Ined.* t. 8.

HAB. Unalaschka, *Chamisso*.

Frond 5—6 inches long, articulate throughout ; the articulations an inch long, very slender at the base, gradually swollen upwards, truncate and slightly hollowed at the apex. From the summit of each joint spring three or four similar articulations, and thus the frond lengthens proliferously. *Substance* when moistened fleshy, when dry cartilaginous.

This curious plant I only know through the figure and descriptions above quoted.

ORDER V. GELIDIACEÆ.

Hypneaceæ, Gelidieæ and Solierieæ, J. Ag. Sp. Gen. and Ord. Algarum, pp. viii. ix. xi. Part of Cryptonemeæ and Sphærococcoideæ, J. Ag. Alg. Medit. Endl. 3d. Suppl. Harv. Man. Ed. 2. &c.

DIAGNOSIS. Purplish or blood-red sea-weeds, with an inarticulate, cartilaginous or horny, filiform or flattened frond ; the axis (at least) composed of longitudinal confervoid filaments ; the superficial cellules minute. *Conceptacles* half immersed, prominent towards one or both surfaces. *Spores* attached either to a net-work of slender filaments filling the cavity of the conceptacle, or to a fibro-cellular placenta which either adheres to one wall of the cavity, or runs through its centre, dividing it into two loculi.

NATURAL CHARACTER. *Root* either discoid or branching. *Fronds* almost always tufted, often very densely so, and sometimes forming inextricable matted or pulvinate masses, mostly filiform, either cylindrical or compressed, rarely flattened and somewhat leaf-like, generally much branched. The ramification is commonly pinnate, the frond often many times compounded ; sometimes it is irregularly alternate or secund, rarely and very imperfectly somewhat dichotomous ; sometimes the

sub-simple branches are densely clothed with irregularly inserted ramuli. In *Suhria* and *Ptilophora* the branches are flattened, traversed by a distinct midrib; in the other genera, they are either cylindrical or compressed; in the latter case thickened in the middle, but without a perfect midrib. The structure of the frond varies considerably in minor points, chiefly in the greater or less development of cylindrical, axial cells. In the typical genus *Gelidium* the whole structure is very dense; the axis composed of a bundle of very slender cylindrical cells, associated in filamentous series, and very strongly soldered together; the periphery, of minute roundish cells formed into vertical filaments; and the intermediate stratum, of seriated cellules having a direction partly longitudinal, but curving outwards towards the periphery. The whole frond, therefore, is constructed of confervoid filaments strongly glued together. In *Eucheuma* the axial and peripheric strata, both well developed, have an arrangement not dissimilar to that of the same regions in *Gelidium*, but the intermediate layer is composed of polygonal cellules forming a honey-combed substance. In *Solieria* the axial stratum is very lax, in the young frond made up of a few distantly set anastomosing and interlaced filaments, but gradually with age it becomes dense; still it never attains to the closely interwoven and firm axis of *Eucheuma*; the peripheric layer is very thin, and the intermediate stratum of honey-combed cells forms the larger portion of the frond. At length in *Hypnea* we find an axis reduced to a few slender filaments or even to a single filament; a periphery of one or two rows of minute cellules, and a frond almost entirely constituted of the honey-combed cells belonging to the intermediate stratum. All these varieties of structure appear to constitute a regular series of successive degradations; and though in comparing together *Gelidium* with *Hypnea* the difference is very great, yet when these genera are looked upon as the extreme types of a natural group in one of which the axial, and in the other the intermediate stratum is in excess, I think it will be seen that they are brought together through *Eucheuma* and *Solieria*, which exhibit axial and intermediate strata in various proportions. In external habit, too, and in substance, there is considerable resemblance between the *Gelidia* and the *Hypneæ*.

If, in like manner, we compare the structure of the pericarp and its contents in these genera, I think we shall find a greater similarity than is apparent on a cursory view; taking, as before, *Gelidium* to express the most developed, and *Hypnea* the least developed type of the Order. In all the genera the spore-threads have few articulations, but one or at most two or three spores ripening on each thread. The spores are sometimes pyriform, sometimes roundish, slightly drawn out at one end, but there is no very marked dissimilarity. The tendency is towards the production of pyriform spores, and is more strongly evidenced in some than in others. The great differences are found in the placentation, and these are so marked as to have led Professor Agardh to place in three Orders the genera which I propose to unite under one. To assimilate the placentation we must bear in mind that the placenta originate in this group not at the apex of the mass of axial cellules, or of a lateral branch from the axis, as is the case in the *Sphærococcoideæ*, *Laurenciaceæ*, and *Rhodomelaceæ*, but from the sides of the axial filaments themselves, which are continued through the cavity of the conceptacle from its base to its apex. In most

genera of the Order this is obviously the case, the conceptacle arising from a swelling in the middle of a branchlet which is continued beyond the swollen part. In such a case the portion of the substance which constituted the axis of the frond below and above the conceptacle becomes the placenta while passing through the cavity. In *Eucheuma*, where the whole branchlet is encysted, this structure is less apparent, but the filaments which connect the suspended placenta of that genus with the walls of the conceptacle show that the axis does not terminate at the placenta, these filaments being continuations of it. In *Pterocladia* an anomalous structure arises from a different cause, namely from the conceptacular cavity being formed not at both sides of the axis as in *Gelidium*, but at one side only. The result is, that the portion of the axis that bears spore-threads, instead of passing through the centre of the cavity, occupies its inner face as a parietal placenta.

Taking this view of the placentation, the connection between the conceptacles of *Gelidium* and of *Hypnea* may be easily understood. In *Gelidium*, as has been already said, the axis is in excess, while in *Hypnea* it is deficient; and the placentæ being a development of the axis, we should expect a corresponding relation in the placentation of these genera. And such is the case. In *Gelidium* a dense, fibrocellular placenta, corresponding with the dense axis, divides the conceptacle through the middle of which it runs into two loculi, and bears spore-threads on both surfaces. In *Hypnea* the spore-threads spring from slender, cobweb-like filaments running through the cavity. The structure of *Solieria* is intermediate, there being in the conceptacle of that genus a fibrocellular placenta suspended in the cavity by filaments connected with the surrounding walls, and bearing spore-threads over the whole outward surface. This genus and *Eucheuma*, which has an analogous structure, appear to me to connect *Hypnea* so far with *Gelidium* as to render it advisable to place them in the same group. And possibly *Chaetangium* also, when carefully compared with *Pterocladia*, may be found, notwithstanding its remarkable characters, to have a close relationship.

The Gelidiaceæ, as here defined, are remarkable for their beauty, the sportive forms which many species assume, and the wide geographical range of some. *Gelidium cartilagineum* has been noticed for the brilliant variety of the colours which it puts on under the bleaching action of the sun and air, before it fades altogether; but *Hypnea musciformis*, *Eucheuma isiforme*, and several others are equally brilliant under similar circumstances. *Gelidium corneum*, a most variable plant, is found throughout most parts of the Atlantic and Pacific Oceans, if we except high northern and southern latitudes. It is however both rare and of small size on the eastern coast of North America, though on the Pacific coast it is apparently common and attains large dimensions. *Solieria chordalis*, so abundant on the American shore, is of rare occurrence and rather local in Europe. *Hypnea musciformis* abounds in all tropical and subtropical seas. *Suhria* and *Ptilophora* are only known at the Cape of Good Hope, and *Pterocladia* is one of the most abundant and characteristic of New Zealand Algæ. *Caulacanthus*, associated with *Hypnea* by Professor Agardh, is of doubtful affinity, its conceptacles being unknown; and I rather incline, with Kützinger, to place it near *Endocladia*.

SYNOPSIS OF THE NORTH AMERICAN GENERA.

SUBORDER 1. GELIDIEÆ. *Conceptacles* divided into two cells by a longitudinal axial placenta which bears *spores* on both surfaces.

I. GELIDIUM. *Fronde* compressed, rigid, decompose-pinnate.

SUBORDER 2. SOLIERIEÆ. *Conceptacles* having a central, fibro-cellular placenta connected with the walls by slender filaments, and bearing *spores* on all sides.

II. EUCHEUMA. *Fronde* terete, cartilaginous, horny when dry, shrub-like. *Conceptacles* ovate, external, sessile on the ramuli.

III. SOLIERIA. *Fronde* terete, succulent, flaccid. *Conceptacles* half immersed in the substance of the filiform branches.

SUBORDER 3. HYPNEACEÆ. *Conceptacles* traversed by arachnoid filaments, to which clusters of *spores* are attached.

IV. HYPNEA. *Fronde* filiform, much branched; branches virgate, clothed with subulate ramuli, their apices often hooked.

1. GELIDIUM. *Lamour. J. Ag. ref.*

Fronde firmly cartilaginous, linear, compressed, decompose-pinnate. *Substance* very compact, composed of three strata; the *axis* of densely interwoven, longitudinal, tenacious filaments, formed of very long, cylindrical cellules; the *intermediate* stratum of small polygonal cellules set in diverging lines, the *periphery* of minute cellules arranged in moniliform filaments at right angles with the axis. *Conceptacles* immersed in the ramuli, prominent on both surfaces, two-celled; the dissepiment longitudinal, connected with the walls of the cavity by slender filaments. *Spores* pear-shaped, on slender funiculi, attached to both surfaces of the medial dissepiment. *Tetraspores* cruciate, immersed among the surface cellules, in subdefined sori near the ends of the ramuli.

The frond is distichous, almost always pinnate, rarely subdichotomous with pinnated lesser branches. It is very narrow, compressed or two edged, rarely quite

cylindrical, of a firm, tenacious substance and densely compacted structure, and when dry is very rigid, almost horny. When growing, the colour is a purplish red of greater or less intensity. On exposure to the air or immersion in fresh water and subsequent drying, this purple changes through various brilliant tints of red, orange and yellow to a waxy or glassy white, retaining a polished surface even when completely bleached. Both kinds of fructification are lodged in the smaller ramuli or pinnules, at some distance below their extremity. The *tetraspores* form little sori, or cloudy patches, and generally occur in slightly expanded, obtuse ramuli, sometimes in the ordinary pinnules and sometimes in minute accessory or special processes of the rachis. The conceptacles whose remarkable structure was first, I believe, correctly described by Prof. J. Agardh (*Advers. p. 42*) are very curious and beautiful microscopic objects. They are formed in the substance of the fertile ramulus, rising towards each of its flat surfaces like little hollow blisters, opposite each other, leaving as a dissepiment between them the flattened axial stratum of the branchlet; so that it would be more correct to describe them as binate, opposite conceptacles, than as a two-celled conceptacle, which is the apparent structure.

1. *GELIDIUM corneum*, Lamour.; frond two edged, flat or sub-terete, purplish red, two to four times pinnated; pinnulæ narrowed at base, linear, entire, obtuse, rarely subacute, those containing the tetraspores club-shaped or obovate, very obtuse; conceptacles below the apex of the ramulus. *Harv. Phyc. Brit. t. 53. J. Ag. Sp. Alg. 2, p. 469. Kütz. Sp. Alg. p. 764. Fucus corneus, Huds.—Turn. Hist. t. 257. E. Bot. t. 1970.*

HAB. Pacific and Atlantic Coasts. Russian America, *Postells and Ruprecht. California, Dr. Coulter, Capt. Pike. Portland, Maine, Capt. Pike (54). Red Hook, New York Bay, Mr. Hooper, Mr. Walters, &c. Sullivan's Island, Charleston, Prof. Gibbes, W. H. H. (v. v.)*

A most variable plant. Dr. Coulter's Californian specimens are three or four inches high, broadly ovate in outline, the lower branches being long, the upper gradually shorter, very densely set and about three times pinnated; the pinnæ and pinnules patent, tapering to the base, very blunt at the apices, either rounded or subtruncate. The colour is a dark brownish purple. The specimens from New York and Maine are very much smaller, rarely more than an inch and half high, scarcely thicker than hog's bristle, less strongly compressed and more flabelliform in outline, the frond and its principal branches being naked below, and pinnated only above the middle. The Charleston specimens are very similar, but less decompound and the ramuli are not so blunt. These latter are in conceptacular fruit, the conceptacle lodged about the middle of the pinnules, or occasionally even in one of the pinnæ toward the base.

2. *GELIDIUM serrulatum*, J. Ag. ; "caulescent, stem two-edged, naked below ; frond three to four times pinnate ; pinnules dilated from a narrower base, cuneate-linear, the younger serrulate at the margin, the fertile subsimple, obovate, serrated, curled and twisted, containing numerous tetraspores." *J. Ag. Sp. Alg.* 2, p. 472.

HAB. Gulf of Mexico. At Guayra, Venezuela, *Liebman*.

This is said to resemble a robust state of *G. corneum*, from which it is readily known by the serrulated pinnules.

3. *GELIDIUM cartilagineum*, Grev. ; root much branched ; frond elongate (12—18 inches) two edged, purple or changeable, decompose-pinnate ; pinnæ patent, with rounded axils, linear, very entire, somewhat flexuous, twice or thrice compound ; pinnules mostly opposite ; tetraspores in the incrassated tips of the ultimate pinnules. *Harv. Phyc. Brit. t.* 337. *J. Ag. Sp. Alg.* 2, p. 473. *Kütz. Sp. Alg.* 763. *Fucus cartilagineus*, *Turn. Hist. t.* 124. *E. Bot. t.* 1477.

HAB. California, *D. Douglas* ; *Dr. Coulter* ; *Lieut. Wood.* (v. v.)

Root a mass of much branched, rigid fibres. *Fronde*s in our Californian specimens about twelve inches long, a line in diameter, compressed, two-edged, becoming flatter upwards, three or four times pinnate. *Stems* naked in the lower half, pinnated above the middle ; primary pinnæ elongate, patent, alternate or sub-opposite, naked below, pinnate or bi-tri-pinnulate above. All the lesser pinnules issue at very obtuse angles, with a distinctly rounded axil ; they are either alternate or opposite, sometimes quite simple, sometimes decompose. Specimens with *tetraspores* have generally more sub-divided pinnules, the tetraspores being lodged in the thickened, gland-like apices. *Substance* cartilaginous, horny when dry. When growing the colour is very dark brownish purple-red, but on exposure to the air it changes through various brilliant tints of red, orange, yellow, and greenish to a horny white. It does not adhere to paper in drying.

4. *GELIDIUM Coulteri* ; frond very narrow, plano-compressed, sub-naked below, decompose-pinnate above ; pinnæ close together, distichous, once or twice compounded, pinnules tapering to the base, acute, the fertile ones spindle-shaped, acute and often aculeate.

HAB. California, *Dr. Coulter.* (v. s. in Herb. T.C.D.)

Densely tufted, three or four inches high, less than half a line in breadth, compressed or two-edged, bare of branches below, closely pinnate above the middle ; the pinnæ one or two lines apart, of various lengths, the lowest longest and most compound, once or twice pinnulated. *Pinnulæ* closely set, distichous, the lower

ones short, subulate, acute, simple, the upper longer and once or twice compounded with similar pinnules. All the pinnules are acute, more or less constricted at their insertion, and many of them denticulate at the margin or set with distichous, tooth-like ramuli, which probably afterwards lengthen into pinnules. The fertile pinnules (containing *tetraspores*) are incrassated in the middle, spindle-shaped, and very generally furnished with marginal spine-like processes. *Colour* a very dark, blackish purple. *Substance* rigid, horny when dry. It does not adhere to paper.

In aspect this plant is most like *G. spinulosum*, J. Ag., but the fertile ramuli are very different.

II. EUCHEUMA. J. Ag.

Fronde terete or plano-compressed, carnosu-cartilaginous, horny when dry, decomposed, usually spiny or tuberculated, solid, composed of three strata; the *medullary* stratum, of densely interwoven, elongated, anastomosing longitudinal filaments; the *intermediate*, of several layers of roundish-angular cells, gradually smaller outwards; the *cortical*, of minute, coloured cellules set in radiating filaments, at right angles to the axis. *Conceptacles* ovate, sessile on the ramuli, furnished with a terminal pore, containing within a very thick pericarp a central, fleshy *placenta* suspended within the cavity, and attached by numerous confervoid filaments to the walls; *spore-threads* simple or branched, issuing from all sides of the placenta, moniliform, three or four roundish, oblong, or sub-pyriform *spores* formed in each thread. *Placenta* often hollow. *Tetraspores* immersed in the cortical stratum, scattered, zonate.

This genus is formed, by Prof. J. Agardh, for several tropical or sub-tropical Algæ with shrub-like, robust, cartilagineo-corneous, mostly spinous, tuberculated fronds. They were formerly placed either in *Sphærococcus*, *Gracilaria*, *Hypnea* or *Gigartina*, from all which genera, as now understood, they differ in structure and fructification. The conceptacles, however, are only known with certainty in our American species, and have a structure in some respects connecting the *Sphærococcoideæ* (among which Prof. Agardh now arranges this genus) and the *Gelidiaceæ*, as here defined. To me the placentation appears so similar to that of *Solieria* that I am unwilling to separate these genera widely; while I admit that the moniliform spore-threads show an affinity with *Gracilaria*.

1. *EUCHEUMA isiforme*, J. Ag.; frond fruticose, very robust, decomposed, much branched; branches spreading to all sides, the lesser branches often opposite or

whorled, simple, whorled at short intervals with broadly subulate, acute or obtuse, spine-like ramuli. *J. Ag. Sp. Alg.* 2, p. 627? *Sphærococcus isiformis*, *Ag. Sp. Alg.* 1, p. 271? *Kütz. Sp.* p. 777. *Hypnea Wurdemanni*, *Harv. MSS.* (TAB. XXIV.)

HAB. Abundant at Key West, *Dr. Wurdeman*, *Dr. Blodgett*, *W. H. H.* Bahia Honda, *Prof. Tuomey.* (v. v.)

Tufts a foot or more in diameter, globose, composed of many stems branching in all directions from a central point. *Stems* of the larger specimens nearly half an inch in diameter at base, soon dividing into several simple branches six or eight inches long, as thick as swan's quills at the base, tapering gradually to the diameter of a crow's quill at the summit, furnished throughout, at distances of two or three lines, with lateral, opposite, whorled, or scattered secondary branches which spread to all sides. These branches are from four to six inches long and in large specimens bear another series of similar branches. They, as well as the main stem, are nodose or swollen at short intervals, the nodes armed with three or four or more verticillate, spreading spines. *Spines* one to three lines long, from a broadly conical base tapering to an acute point; in old specimens and toward the base of the larger branches obtuse, mamillæform or sub-obliterated. The ends of the branches are sometimes incrassated into a subglobose head, which is either simple or lobed and plaited like the inflorescence of *Celosia cristata*. In fertile specimens the whorled spine-like ramuli are much less regularly disposed. *Conceptacles* borne on the ramuli, one, two or more on each ramulus, variously placed, often terminal, ovate, with a minute pore; walls very thick, composed of two strata, the inner of many rows of polygonal cells, the outer of radiating moniliform filaments: *placenta* central, suspended in the cavity by numerous, confervoid filaments connecting it on all sides with the walls of the conceptacle, cellular, often hollow within, bearing moniliform, densely crowded, simple or branched *spore-threads* on every side. *Spores* roundish oblong, the terminal one sub-pyriform. I have not seen *tetraspores*. *Colour* when recent a dark full red, becoming scarlet, orange and yellow, and at length semitransparent and horn-like on exposure. *Substance* firmly cartilaginous. In drying, the frond shrinks very much, and if strongly pressed will adhere, though imperfectly, to paper.

The first specimens of this truly noble plant which I received were collected by the late Dr. Wurdeman, and, believing them to belong to an undescribed species, I wished to bestow his name upon it. Afterwards, on carefully reading the character given by the elder Agardh of his *Sphærococcus isiformis*, described from West Indian specimens, it appeared to me that it had many points in common with Dr. Wurdeman's plant, and I therefore communicated by post a small branch of the latter to Professor J. Agardh, requesting him to compare it with that described by his father, and to give me his opinion as to their identity. In reply he informs me that our Key West plant "looks like a different, though nearly related species; the *S. isiformis* Ag. being a far more gelatino-cartilaginous and coarser plant, with a somewhat different and transparent tint of red, and all the spines obtuse, even the young ones." This opinion was formed on a small branch such as could be sent in

a half ounce letter, but I fear the differences indicated do not amount to specific characters; for I find, among some hundred specimens which have passed through my hands, great diversity in diameter and in the comparative obtuseness of the spines; and the colour depends very much on the longer or shorter exposure to alternate sunlight and rain. Should, however, future observations show that I have confounded two species, the present will, I hope, bear the name of Dr. Wurde-
man, its estimable discoverer at Key West.

Plate XXIV. *Fig. 1.* EUCHEUMA *isiforme*, the *natural* size. *Fig. 2,* part of a branch with conceptacles; *fig. 3,* section of a conceptacle; *fig. 4,* spore-threads; *fig. 5,* semi-section transversely of a branch; *fig. 6,* a longitudinal section through the same; more or less *magnified*.

III. SOLIERIA. *J. Ag.*

Fronde cylindrical, subcartilaginous, succulent, fruticose, composed of three strata; the *axis* (or *medullary* stratum) consisting of longitudinal, anastomosing filaments; at first few, afterwards densely interwoven; the *intermediate* stratum of several rows of roundish cells, of which the inner are large, the outer successively smaller and more angular; the *cortical* of two or three rows of minute, coloured cellules. *Conceptacles* immersed in the axial region of the branch, but prominent to one side, the walls formed of a dense plexus of filaments derived from the axis; *placenta* fibrocellular, central, suspended in the cavity by slender filaments connected with the walls: *spores* pedicellate, pear-shaped, covering the whole surface of the placenta. *Tetraspores* transversely parted, (*zonate*) dispersed among the peripheric cellules of the branches and ramuli.

The *frond* is cylindrical, irregularly branched, of a somewhat tender substance, crisp when quite recent, but soon becoming flaccid. When young the axis is exceedingly lax, and the branches are almost hollow, the axial region being occupied by a watery gelatine, through which a few distant, longitudinal, anastomosing filaments are dispersed. Toward the base of the frond and in older specimens the axis is much more dense, and finally, when the growth is fully matured, it becomes a compact plexus filling up the vacant space, and solidifying the branch. The *intermediate* stratum, or the region between the axis and coloured periphery, in like manner, becomes more compound with age, the addition of new cells being made on the outside; and the cells of the innermost row are always of much greater diameter than those of the exterior rows. The *periphery* does not undergo much change. The *conceptacles* appear externally like obtusely conical tubercles with a dark coloured core, scattered profusely over the branches of fertile specimens. A

cross section through one of them shows that they are deeply sunk in the substance of the branch, being wholly formed out of a portion of the axial filaments. The walls are constructed of filaments, derived from the axis, and very densely interwoven together, and invest the sporiferous nucleus on all sides, enclosing it as within a sac. Numerous slender filaments proceed from the inner face of the walls to a central placenta, formed likewise of a dense plexus of filaments. The whole exterior surface of the placenta is densely clothed with pedicellate, oblong or pear-shaped spores, which are either simple, or (perhaps with age) divided transversely into two or more, chained sporules. The tetraspores are of small size, and scattered without order through the surface cells of the branches and ramuli.

In external habit and even in the internal structure of the frond there is a very close similarity between the species of this genus and of *Rhabdonia*, so much so, indeed, that it is impossible to tell, without examining the conceptacular fruit, to which of these genera any individual specimen may belong. The sporiferous nucleus is however very different, but I know of no other characters by which to distinguish *Rhabdonia*; and before I became aware that the American specimens now to be described were identical with the European *Solieria chordalis*, I had referred them without hesitation to *Rhabdonia*. The genus *Solieria* was founded by Prof. J. Agardh on an Alga first found at Cadiz, and which had been referred by the elder Agardh originally to *Sphaerococcus*; then to *Delesseria*; and which was afterwards associated with *Gracilaria* by Dr. Greville, and with *Gigartina* by Dr. Montagne, from all which genera, as now reformed, it is needless to say that it is abundantly different. In external habit it most resembles *Gracilaria (Plocaria)*, and may even be confounded with *G. compressa*; and before structure of frond and of nucleus were minutely examined it might very well have found a place in the group so called. Though originally observed in Europe, it seems to be much more abundant along the American shore, where its range extends from Long Island to Florida.

1. *SOLIERIA chordalis*, J. Ag.; frond alternately decomposed; lateral branches long, virgate, tapering to the base and apex, and furnished with more or less copious linear-fusiform, acuminate ramuli; conceptacles copious, half immersed in the branches. *J. Ag. Alg. Medit.* p. 157. *J. Ag. Sp. Alg.* 2, p. 723. *Kütz. Sp. Alg.* p. 748. *Delesseria chordalis*, *Ag. Sp. Alg.* 1, p. 189. *Gigartina Gaditana*, *Mont. in Webb. Ot. Hisp. t.* 7. (TAB. XXIII. A.)

HAB. Abundant in Long Island Sound, from Cape Cod to New York, *Prof. Bailey, &c.* Longbranch, New Jersey, *Miss Morris*. Charleston Harbour, *H. W. Ravenel, Esq. and W. H. H.* Apalachicola, *T. Drummond, Dr. Chapman*. Key West, *W. H. H.* (v. v.)

Frond from six to twelve or fourteen inches long, from half a line to nearly two lines in diameter, much branched but very variable in the ramification. Commonly a subsimple stem is set throughout at short distances with many lateral branches, of which the lowest are longest, the rest successively shorter upwards. These branches

are six or eight inches long, undivided, but furnished with copious lateral secondary branches, which are either similarly decomposed once or twice or are furnished with a few scattered, short, erect or spreading ramuli. Sometimes the division is carried on to many sets of alternate branches and ramuli, and then the fronds are exceedingly bushy; sometimes the frond divides near the base into many virgate branches having a second series of naked secondaries, two to four inches long. All the lesser branches and ramuli are linear-fusiform, tapering to a much contracted base and attenuate to a fine point. *Conceptacles* obtusely conical, half sunk in the branches and ramuli, through which, in fertile specimens, they are plentifully scattered. *Tetraspores* dispersed. *Colour* a dark red, becoming blood red on exposure. *Substance* somewhat cartilaginous, but tender, decomposing in fresh water. In drying, it shrinks much and closely adheres to paper.

I have many varieties of this sportive plant from the American shores. At Fort Hamilton, New York, Mr. Hooper pointed out to me a squarrose form of a very dark colour, more slender than usual, the branches distorted and very irregular and the ramuli either patent or recurved: and Capt. Pike and Mr. Calverley have since communicated many similar specimens from Red Hook. At first sight this form looks very distinct from the deep-water varieties, but the microscopic structure is the same, and I hesitate to separate it specifically. The Apalachicola specimens also have a slightly different aspect from the common form.

Before I had seen the fructification of this species I believed it to be a *Rhabdonia* and had distributed it among my friends as *R. Baileyi*, named in compliment to Prof. Bailey, from whom I received the earliest specimens. It so perfectly resembles in ramification the West Indian *R. tenera*, J. Ag. that except by the structure of the sporiferous nucleus, which Prof. Agardh has examined in the latter, I do not see how they are to be distinguished.

Plate XXIII. A. *Fig. 1.* SOLIERIA *chordalis*, the natural size. *Fig. 2,* longitudinal section of a branch, with tetraspores in situ; *fig. 3,* tetraspores; *fig. 4,* transverse section through a branch and conceptacle; *fig. 5,* small portion of the same, to show structure more plainly; *fig. 6,* spores; the latter figures more or less highly magnified.

IV. HYPNEA. Lamour.

Frond cylindrical, cartilaginous, irregularly much branched and set with awl-shaped ramuli. *Axis* consisting of a few slender, longitudinal filaments or filiform cellules, (sometimes wanting); *intermediate* stratum of several rows of oblong, polygonal cells, void of endochrome; *periphery* of one or two rows of minute, coloured cellules. *Conceptacles* hemispherical, without orifice, formed on the ramuli, and containing numerous roundish clusters of pedicellate spores attached to slender, partially anastomosing filaments which traverse the cavity. *Tetraspores* transversely parted (*zoned*), clustered together in swollen ramuli.

The fronds in all the species are much branched, and generally densely tufted, sometimes formed into cushion-like or mossy mats, whence the generic name, derived from *Hypnum*, a well known genus of mosses. The branches are frequently virgate, clothed throughout with awl-shaped, spreading or divaricated ramuli; but there is much difference in ramification between the sterile and fertile fronds of the same species, which makes the determination of these plants often a matter of no small difficulty.

In arranging the American species, I gladly adopt the views of Prof. J. Agardh, who in his recent admirable work (*Sp. Gen. et Ord. Algarum, vol. 2, p. 438-455*) has revised the genus, casting out Algæ which had been erroneously placed in it, and establishing the true congeners on a more certain basis. And I may take this opportunity of confessing that I have myself been guilty in this matter, having formerly associated with *Hypnea*, *Cystoclonium purpurascens*, a plant of very opposite affinities.

SECTION I. VIRGATÆ. *Sterile* fronds tufted, with virgate branches clothed with subulate ramuli, the older ramuli constricted at the base; *tetrasporiferous* fronds similar, having tetraspores immersed in pod-shaped ramuli; *conceptaculiferous* fronds divaricately much branched.

1. *HYPNEA musciformis*, Lamour.; fronds tufted, virgately branched; branches filiform, in the lower part clothed on all sides with subulate ramuli, incrassated and somewhat naked below the apex, which is often strongly hooked inwards; mature ramuli tapering to both ends; those bearing tetraspores incrassated and pod-like in the middle; those with conceptacles spinescent, divaricately branched. *J. Ag. Sp. Alg. 2, p. 442.* *Kütz. Sp. Alg. p. 758.* *Hypnophycus musciformis, Kütz. Phyc. t. 60, fig. 4.* *Fucus musciformis, Wulf.—Turn. Hist. t. 127. Esper, t. 93.*

HAB. New Bedford, Massachusetts, *Dr. M. B. Roche.* Sullivan's Island, South Carolina, *Prof. Gibbs, W. H. H.* Anastasia Island, *Dr. Durkee.* Key West, *Mr. Binney, W. H. H., Dr. Blodgett (17), Prof. Tuomey (19).* Pine Islands and Key Biscayne, *Prof. Tuomey (8, 11, 32).* Pacific Coast, at Nootka Sound, *Mr. Menzies, 1787. (v. v.)*

Fronds densely tufted, four to eight inches long, as thick as sparrow's quill below, attenuated upwards, irregularly decompound, generally with an evident stem set with copious, lateral, virgate branches, the lowest of which are the longest, and most of them, as well as many of the secondary branches, incrassated toward the apex and strongly hooked or revolute, sometimes circinate. *Branches* once or twice compound, for three-fourths of their length furnished on all sides with very slender subulate ramuli, one to three lines long, as thick as hog's bristle, acute, at length constricted at the base, patent, densely or laxly set, gradually fewer toward the ends of the branches, where, especially in the incrassated and hooked extremities, they are secund along the outer side of the branch. In some specimens these

ramuli are very densely crowded, so that the branches are completely echinate with them, in others they are few and far between. *Tetraspores* zoned, lodged in pod-like swellings in the middle of fertile ramuli. The *capsuliferous* plant (of which I have not seen American specimens) has the branches everywhere clothed with divaricately branched, spinous ramuli, on which the conceptacles are formed. *Colour* a dark purple, changing to green, or occasionally into a coral red. *Substance* cartilaginous and brittle when recent. In drying, it shrinks and adheres imperfectly to paper.

2. *HYPNEA* (?) *crinalis*; stem elongated, subsimple; branches lateral, closely set, virgate, very long, filiform, setaceous, attenuated, straight, having a few scattered, subulate, erect ramuli; fructification unknown. *Harv. MS. in Herb. T. C. D.*

HAB. California, *Dr. Coulter.* (v. s. in *Herb. T. C. D.*)

Stems ten to twelve inches long or probably more, as thick as hog's bristle or somewhat thicker, undivided, filiform, furnished throughout at intervals of two or three lines with long, simple, similar branches, 6—8 inches long, about the thickness of horsehair, attenuated, naked or having a few, minute, subulate, erect ramuli scattered along them. *Ramuli* generally two or three lines apart, about a line long, erect or erecto-patent, sometimes copious, sometimes nearly wanting. *Colour* a dark brownish purple. *Substance* cartilaginous. *Fruit* unknown. *Structure* rather different from that of the genus, the peripheric stratum being developed into moniliform strings of cellulose.

This has the external habit of *Hypnea*, but till its fructification shall be discovered must remain among the doubtful species, as its structure is somewhat different from the typical. Its cells do not readily expand in water, and muriatic acid dissolves the membranes rapidly, so that I have not been able to obtain as clear a view of the internal cells as I could wish.

SECTION 2. SPINULIGERÆ. *Sterile* fronds intricately tufted, branches patent, alternately decompound, and beset with thorn-like ramuli acuminate from a broad, conical base; *tetrasporiferous* fronds similar, having tetraspores immersed in the base or swollen middle of the ramuli.

3. *HYPNEA divaricata*, Grev.; intricately tufted, alternately branched; branches not projecting far beyond the tuft, spinulose throughout, less beset toward the straight apices; spines spreading on all sides, the upper ones sub-secund, patent, simple or compound, acuminate from a broad base; tetraspores lodged in the tumid bases of the ramuli; conceptacles three or four together on divaricate, branching ramuli." *J. Ag. Sp. Alg.* 2, p. 448. *Kütz. Sp. Alg.* p. 759. (Excl. Syn. Turn.)

HAB. On the shores of the Gulf of Mexico, *Liebman, fide J. Ag.*

I have not seen any American specimens of this plant, which I know only from Australian and Mauritian examples.

4. *HYPNEA cornuta*, J. Ag. ? frond decomposed, irregularly much branched ; branches widely spreading, both larger and smaller laxly set with scattered, spirally inserted, divaricating, broadly subulate, acute ramuli, which are either simple or forked, and occasionally fasciculate ; ends of the branches sometimes naked, straight." *J. Ag. Sp. Alg. vol. 2, p. 449.*

HAB. Key West, *Prof. Tuomey*, (7 and 33^a), St. Croix, *Miss Dix*.

Frond (in my specimens) three to four inches long, as thick as sparrow's quill, attenuated upwards, very much branched ; the branches alternate or secund, one or two lines asunder, short and long irregularly mingled together, widely spreading with obtuse axils, decomposed three or four times ; their apices produced and somewhat bare of ramuli, straight, simple or dichotomous. *Ramuli* more or less copious, scattered along the larger and smaller branches, very patent or divaricate, half a line to a line long, subulate, rising from a broad base, very acute, simple or forked, sometimes two or three from the same point. *Colour* a full dark red. *Substance* cartilaginous.

I have not seen any authentic specimen of Agardh's plant to which I refer the specimens described. His specific character is as follows :—" *H. cornuta* ; cæspitosa alterne ramosa, ramis extra cæspitem parum porrectis, per totam longitudinem laxè spinulosis apice subdenudato-rectiusculis, spinulis quoquoversum egredientibus patentibus, aliis simplicibus a basi latiore acuminatis rigidis, aliis stellulæformibus vivide rubris, capsuligeris rectis spinulis simplicibus obsitis."

5. *HYPNEA cervicornis*, J. Ag. ; "intricately tufted, sub-decumbent, divaricately much branched and beset with similarly divaricately branched ramuli ; fertile branches projecting beyond the tuft, more densely ramulose, ramuli spreading on all sides, very patent, mostly ramulose ; those bearing tetraspores tumid above the base, ending in a simple or branching point ; those with conceptacles similar." *J. Ag. Sp. Alg. vol. 2, p. 451.*

HAB. Gulf of Mexico, on the Mexican coast, *Liebman, fide J. Agardh.*

SECTION 3. PULVINATÆ. *Sterile* fronds densely pulvinate, intricately much branched, the branches concrete, cohering ; *fertile* emerging beyond the matted tuft, not entangled together.

6. *HYPNEA pannosa*, J. Ag. ; sterile fronds pulvinate, intricately much branched, branches concrete, the exterior ones conical, acuminate ; fertile ones emerging

beyond the tuft, naked at the base, pyramidally branched beyond the middle; branches thick, rather obtuse, those bearing tetraspores sub-unilaterally warted at the base and pod-like below the apex, containing one or more sori. *J. Ag. Sp. Alg. vol. 2, p. 453.*

HAB. On the Pacific coast of the Mexican Republic, *Liebman.*

ORDER VI. SPONGIOCARPEÆ.

Spongiocarpeæ, *Grev. Alg. Brit. p. 69. Part of Cryptonemiæ, J. Ag. Alg. Medit. p. 81. Endl. 3d Suppl. p. 36. Harv. Man. Ed. 2, p. 131. Part of Gigartineæ, Kütz. Sp. Alg. p. 724. Part of Chondrieæ, J. Ag. Sp. Gen. and Ord. Alg. vol. 2, p. x.*

DIAGNOSIS. Brown-red, cartilaginous, fruticose (cylindrical and branching) seaweeds, almost wholly composed of confervoid, interlaced filaments closely set in firm gelatine. *Sporiferous nucleoli* numerous, globose, many associated together in external, wart-like, amorphous excrescences, formed of vertical, confervoid, filaments. *Spores* large, obconical, radiating from a central point of each nucleolus.

NATURAL CHARACTER. *Root* an expanded fleshy disc. *Fronde* cylindrical, firmly cartilaginous, shrub-like, dichotomously branched, composed of three sub-distinct strata of cells, all disposed in filamentous series. The *medullary* layer, occupying more than half the diameter of the frond, is composed of densely packed, longitudinal, elongated, cylindrical, branched and anastomosing filaments, from which are given off towards all sides the filaments of the *intermediate* layer. These are composed of large, elliptical, ovate, or oblong, coloured cells, set in dichotomous filaments which curve outwards, gradually passing from an erecto-patent to a horizontal position. From the ends of these filaments spring those of the *cortical* layer, which are perfectly horizontal, (that is, vertical to the surface of the erect branches), very slender, composed of minute oblong cells formed into dichotomous, fastigiate series. The ends of these filaments, more deeply coloured, constitute the periphery.

In specimens about to produce *spores*, the cortical layer grows out in places into oblong, irregularly shaped *warts* which extend along the branches, sometimes for the space of half an inch. These warts are of a pale, flesh-colour, and wholly

composed of slender, dichotomous filaments, exactly like those of the cortical layer from which they spring. Among these filaments, within the wart, are formed innumerable globose *nuclei* or *spore-clusters*, attached to the filaments; each surrounded by a broad pellucid limbus and consisting of many obconical spores radiating from a minute central placenta. Each *spore* is enclosed in a gelatinous *perispore*; and the pellucid limbus which surrounds the nucleus seems to be formed by the contact of the numerous gelatinous perispores. It is therefore to be regarded as spurious.

Tetraspores are formed in the upper, slightly swollen branches. They are deeply sunk among the peripheric filaments, oblong, and at length cruciately parted.

This Order is founded on a single genus composed of a solitary species, so remarkably distinguished by its fructification from all other known genera of Algæ that it can scarcely be referred without violence to any established group. In external habit of the frond, as well as in internal structure, there is a very close resemblance between *Polyides* and *Furcellaria* (a genus of *Cryptonemiaceæ*), so close indeed that these two genera have frequently been united, and even in the last work of Professor Kützing, an author not remarkable for avoiding generic analysis, *Polyides rotundus* is described as a species of *Furcellaria*. In the fructification of these genera, however, there is so wide a difference that if we are to regard structure of the sporiferous nucleus as a surer guide to natural affinities than structure of frond, we must place them at nearly opposite ends of the systematic arrangement. Another and very opposite affinity for *Polyides* has recently been indicated by Professor J. Agardh, who, in his tabular distribution of the Floridæ, places it among his *Chondriæ*, the proper type of which group is *Laurencia*. This relationship is no doubt inferred from the size and form of the spores, which may be compared with those of *Lomentaria* rather than with those of any other of the *Chondriæ*; but in the absence of any indication of nearer affinity between these genera, the mere form of the spores will hardly be thought sufficient. The appearance and structure of the fronds are very dissimilar, and the details of the fructification abundantly unlike. In the *Chondriæ* (our *Laurenciaceæ*) a single sporiferous nucleus is enclosed in a hollow conceptacle, formed out of the end of a truncated branch, and of the most perfect *type* which the conceptacle attains among the Rhodospematous Algæ. The contained nucleus is attached to a basal placenta, and therefore terminates the axis of growth. Such a structure is extremely different from what we have above described in *Polyides*, and though very unwilling to multiply Orders, I cannot consent to the ordinal association of genera differing so widely in fructification. In my opinion *Polyides* is more nearly related either to the *Gelidiaceæ* or *Helminthocladiceæ*, though scarcely to be placed among either. In the external aspect of the fruit there is much resemblance to *Peyssonnelia*, but much dissimilarity in the nature of the nucleus. So long ago as 1830 Dr. Greville proposed *Polyides* as the type of a separate Order, and I now revert to his views.

I. POLYIDES. *Ag.*

This being the only genus, the character is the same as that of the Order.

1. *Polyides rotundus*, Grev. *Alg. Brit.* p. 70, t. 11. *Harv. Phyc. Brit.* t. 95. *Polyides lumbricalis*, *Ag. Sp. Alg.* 2, p. 392. *Spongiocarpus rotundus*, Grev. *Fl. Edin.* *Furcellaria lumbricalis*, Kütz. *Sp. Alg.* p. 748. *Phyc. Gen.* t. 72. *Fucus rotundus*, Turn. *Hist.* t. 5. *E. Bot.* t. 1738.

HAB. Boston Bay, Mr. G. B. Emerson, Capt. Pike. Newport, Rhode Island, Prof. J. W. Bailey. (v. v.)

Root a spreading disk. *Fronde*s several from the same base, two or more inches high, as thick as crow-quill, rising with an undivided stipe to a third or a fourth of the height, then forking, and afterwards repeatedly dichotomous. The axils are rounded, the apices somewhat attenuated and sub-acute, of equal length, giving the frond a fan-shaped outline when spread on paper. *Colour* a very dark red brown. *Substance* cartilaginous. It does not adhere to paper in drying.

Our American specimens are of small size, about two inches high, and are not in fruit. In all characters of structure, &c. they are the same as the European.

ORDER VII. SQUAMARIÆ.

Squamariæ, J. Ag. *Sp. Gen. and Ord. Alg.* 2, p. 485. Part of *Spongiocarpeæ*, J. Ag. *Alg. Medit.* *Harv. Man. &c.* Part of *Chætophoreæ* and *Porphyreæ*, Kütz.

DIAGNOSIS. Lichenoid, encrusting or horizontally expanded red-brown seaweeds, rooting by the under surface, composed of vertical filaments closely set in firm gelatine. *Spores* in moniliform strings lodged in external wart-like excrescences formed of vertical, confervoid filaments.

NATURAL CHARACTER. This Order is designed to include several anomalous Algæ which agree in a common habit, so far as the frond is concerned, but whose

fructification is yet too imperfectly known to enable us to declare whether the connection be one of analogy or of affinity. Of the eight genera placed here by Prof. J. Agardh, the sporiferous nucleus is known only in one. It is therefore premature to say much of the *natural character* of the Order.

The plants here associated are either gelatinous, cartilaginous, coriaceous or membranaceous expansions, more or less completely attached by their under surfaces to the substances on which they grow. Some few are parasitic on other Algæ, but the greater number adhere to rocks and stones either in the sea or in fresh water streams or rivers. The crust is irregularly orbicular, enlarging by successive additions to its margin, and in the membranous genera is sometimes furnished with concentric lines of growth. In the least developed genus (*Actinococcus*) the whole frond, scarcely more than a line in diameter, is globose, composed of moniliform filaments set in transparent gelatine, and radiating from a common base. Of this type two species, parasitic respectively on *Chondrus crispus* and *Phyllophora Brodiaei*, and which may therefore be expected to occur on the North American coast, have been described. *Petrocelis* and *Cruoria* form widely expanded, skin-like patches of a firmly cartilaginous substance, and dull purple brown or occasionally olive green colour, on the surface of rocks and stones between tide marks in Northern Europe. Like *Actinococcus* they consist of beautifully beaded strings of cells set in gelatine. *Hildenbrandtia* forms thinner and more decidedly membranous, red, or brown-red skins, sometimes merely films, on stones and pebbles, and differs from the preceding as well by the much denser structure of the frond as by having *tetraspores* lodged in minute cavities indicated by dotlike pores scattered over the surface of the crust. In its structure and in this fructification there is some affinity with *Melobesia*, but it wants the deposit of carbonate of lime which distinguishes that genus.

Some or all of the genera just named are probably represented on the North American coast, but in the absence of positive evidence of the fact I can do no more than request the attention of collectors to them. They are all obscure looking, unattractive plants, which may easily escape detection.

I. PEYSSONNELIA. *Dne.*

Frond membranaceous or coriaceous, horizontally expanded and rooting by fibrils emitted from the lower surface, composed of two strata of cellules; the lower stratum of horizontally elongated, cylindrical cellules disposed in radiating filaments cohering laterally into a membrane; the upper of vertically elongated cellules, also arranged in concrete filaments at right angles with those of the lower stratum. Fruit of both kinds lodged in superficial warts composed of vertical confervoid filaments. *Spores* roundish, in moniliform strings. *Tetraspores* oblong, cruciate.

The frond expands horizontally, and is either closely adnate to the substances on which it lies and to which it is attached by means of minute, root-like processes, forming a thin downiness on the lower surface, or it is attached by its lower half only and free at the extremities. It is either orbicular or variously lobed at the margin, the lobes fastigate, circumscribed by a curved line and more or less fan-shaped, often lying on one another in an imbricate manner, and marked on the upper surface by faint concentric lines of growth. The substance in the smaller species is delicately membranaceous, in the larger, thicker and more leathery. The structure is entirely composed of cylindrical cellules twice or thrice as long as their diameter and firmly set in filaments which closely cohere together and form the membranous or coriaceous substance. These filaments are disposed in two strata. The lowest are horizontal, radiating from a central point in the orbicular fronds, and from the base of the fan-shaped ones; they form the substratum or basis of the membrane, and by their development determine its limits. From the upper surface of the membrane so formed spring the obliquely vertical filaments of the upper stratum which are closely combined into a crust of greater or less thickness, their length determining the thickness: and as they arise from the radiating filaments of the lower membrane, their terminal cells also form radiating lines on the upper surface.

The fructification is lodged in shapeless, depressed warts irregularly scattered over the upper surface, and formed of vertical confervoid filaments resembling those of the upper stratum but less closely concrete. These warts sometimes contain *spores*, and sometimes *tetraspores*, on separate plants. The *spores* are formed consecutively, one in each cell of the vertical filaments, and are therefore set in moniliform strings, simple or branched according to the nature of the filaments composing the wart. A portion of the wart is thus converted into a sporiferous nucleus, the remainder consisting of barren paranemata which serve the purposes of a conceptacle. The *tetraspores*, in the warts which produce them, are lodged among the bases of the paranemata, several in the same wart, but never placed in strings, each tetraspore being formed of an arrested and transmuted filament. They are pedicellate and at maturity divide into four equal parts placed crosswise.

The type of this singular genus is the *Fucus squamarius* of Gmelin (*Turn. Hist. t. 244*) a native of the Mediterranean, long misunderstood by botanists, and placed by the elder Agardh in *Zonaria*, to which its flabelliform fronds suggested a relationship. Its true characters were pointed out nearly about the same time by Decaisne and Zanardini, both of whom proposed it as the type of a new genus distinguished alike by external habit and by the curious tetrasporic fructification. Montagne, more recently, has described the sporiferous nucleus and thus completed the generic character. To this original species several have since been added, of which the two following are claimed for the North American flora.

1. PEYSSONNELIA *Dubyi*, Crouan; frond membranaceous, orbicular or lobed, attached by the whole of its under surface. *Crouan, Ann. Sc. Nat.* 1844, p. 368, t. 11, B. *Harv. Phyc. Brit. t. 71.* *J. Ag. Sp. Alg.* 2, p. 501. *Kütz. Sp. Alg.* p. 691.

HAB. On corals, &c. at Key West, *W. H. H.* (v. v.)

Fronds from half an inch to an inch in diameter, delicately membranaceous, orbicular or reniform, closely applied by the whole inferior surface to the object on which they grow, and to which they are attached by minute rootlets, freely emitted from the membrane. Upper surface finely striate, the striæ radiating from the centre to the circumference, composed of hexagonal, seriated cells. Margin circumscribed, flat. *Colour* toward the centre of the frond dark-red brown, paler and redder toward the margin. I have not seen fruit on the American specimens, which in other respects closely resemble those from the West of Ireland.

2. PEYSSONNELIA *imbricata*, Kütz.; "depressed, adnate, red-black, coriaceous, irregularly sub-orbicular, lobed, imbricated, rugose, the lobes rounded." *Kütz. Sp. Alg. p. 694.*

HAB. Newfoundland, *Lenormand*, fide Kützing.

ORDER VIII. HELMINTHOCLADEÆ.

Helminthocladeæ, *J. Ag. Sp. Gen. and Ord. Alg. 2, p. 410.* *Part of Cryptonemeæ*, *J. Ag. Alg. Medit. p. 81.* *Harv. Man. Ed. 2, p. 131.*

DIAGNOSIS. Gelatinous, or gelatino-membranaceous, rosy or purple (cylindrical) sea-weeds, almost wholly composed of confervoid filaments set in loose gelatine. *Sporiferous-nucleus* immersed in the frond, destitute of pericarp, spherical, formed of branching spore-threads radiating from a central point, and bearing minute, roundish spores.

NATURAL CHARACTER. *Root* discoid, little developed. *Fronds* cylindrical or compressed, rarely somewhat flattened, dichotomous, pinnate, or shrub-like, sometimes very much branched, composed wholly or in great part of slender cylindrical or moniliform filaments variously combined together and lying in a transparent gelatine of greater or less consistence. The *axis* of the frond is in all cases formed of a bundle of longitudinal threads, interlaced together and frequently anastomosing, generally compactly united by a rather tenacious gelatine, and giving off, on the outside of the bundle, numerous horizontal filaments which terminate in those of

the periphery. These latter are generally moniliform, either elongated and free one from another, or abbreviated and combined by firm gelatine into a thin membrane. In the suborder *Liagoreæ* they are invested with a secretion of carbonate of lime.

The *sporiferous nucleus* is not contained within any conceptacle, but freely suspended among the threads of the peripheric stratum, by which it is surrounded and involucreted. It consists of a spherical ball composed of innumerable slender, articulated, branching filaments radiating from a common central point, and bearing small, oval *spores* on the ends of the branches. Such is the structure in the first suborder at least. In *Scinaia*, however, I think I have seen, under a highly magnifying power, a cellular membrane as described by Montagne, but denied by Prof. J. Agardh, investing the ball of spore-threads. *Tetraspores* have only been observed in *Nemalion*, where they are formed in the terminal cellules of the peripheric filaments.

The close mutual relationship of the genera here associated will be generally admitted; with perhaps the exception of *Scinaia*, should the fact of its possessing an external membrane to the nucleus be established. However this may be, the *internal* structure of its nucleus bears a near resemblance to that of the typical genera. The fructification of the *Liagoreæ* is not yet fully known, but the habit and nature of the frond are so similar to those of the *Gloiocladeæ* that there is nothing to invalidate the juxtaposition, at least, of these Algæ. *Dudresnaia*, *Crouania*, and *Gloiosiphonia*, which were formerly arranged among *Gloiocladeæ*, differ essentially in the structure of the sporiferous nucleus, and are now properly placed by Prof. Agardh, the two former in *Ceramiceæ*, the latter in *Cryptonemiaceæ*. In those Orders they represent, by analogy, the present group.

The geographical distribution of these plants is extensive. Of the five genera yet known four are North American; two of these, *Helminthora* and *Nemalion*, being also European; *Liagora* common to all tropical and sub-tropical regions; and *Scinaia* dispersed north and south of the equator through the Atlantic and Pacific basins. *Helminthocladia* has, as yet, only been found in Europe. None are applied in the arts.

SYNOPSIS OF THE NORTH AMERICAN GENERA.

SUB-ORDER I. GLOIOCLADEÆ. *Periphery* formed of moniliform filaments lying in rather loose, transparent gelatine.

- I. HELMINTHORA. *Axis* laxly cellular within (the interior filaments much distended). *Frond* decomponently much-branched.
- II. NEMALION. *Axis* cord-like, composed of closely interlaced, very slender filaments. *Frond* sparingly dichotomous.

SUB-ORDER 2. SCINAIEÆ. *Periphery* membranous, very thin, composed of angular cellules.

III. SCINAIA.

SUB-ORDER 3. LIAGOREÆ. *Periphery* formed of moniliform filaments, lying in gelatine and more or less invested with a deposit of carbonate of lime.

IV. LIAGORA.

I. HELMINTHORA. *J. Ag.*

Fronde cylindrical, gelatinous, elastic, much branched, with a filamentous *axis* clothed with a continuous *periphery* of filaments, invested with a loose jelly; *axis* composed of concrete, parallel, longitudinal, articulated filaments of which the interior are of large diameter compared with the exterior; *periphery* of dichotomous moniliform, fastigiate, horizontal filaments emitted laterally by those of the axis. *Sporiferous nuclei* immersed among the filaments of the periphery, spherical, composed of numerous clavate spore-threads, radiating from a central point. *Tetra-spores* unknown.

This genus is proposed by Prof. Agardh for the *Dudresnaia divaricata* of authors whose want of accordance with *Dudresnaia* and affinity with *Nemalion* I had already indicated in the Phycologia Britannica. From *Nemalion* it differs in external habit, but chiefly by the structure of the axis, which is here composed of parallel filaments, concrete together, but not intertwined, and of different diameters, the inner ones being distended, and void of endochrome; the outer, from which those of the periphery are derived, of much greater tenuity and furnished with colouring matter.

1. HELMINTHORA *divaricata*, J. Ag.; frond filiform, pale red, very much branched, branches opposite or alternate, horizontal, decompound; ramuli numerous, divaricate, scattered, obtuse. *J. Ag. Sp. Alg. vol. 2, p. 416.* *Dudresnaia divaricata*, *J. Ag. Alg. Medit. p. 85.* *Harv. Phyc. Brit. t. 110.* *Nemalion divaricatum*, *Kütz. Sp. Alg. p. 713.*

HAB. Key West, *Dr. Blodgett* (No. 60). (v. v.)

Of this plant I have seen but a single American specimen, collected by Dr. Blodgett. It is about three inches long, rather thicker (in the dry state) than hog's bristle, with an undivided stem furnished with several lateral, horizontal branches

which are three or four times compounded, the divisions irregularly alternate, and spreading at right angles. The ramuli scattered, cylindrical and obtuse. *Peripheric* filaments irregularly branched, moniliform. *Nuclei* abundant.

Possibly this may be distinct from the European plant. The axial and peripheric filaments are rather more robust than in British specimens with which I have compared Dr. Blodgett's, but in other respects, internal and external, the two plants nearly coincide. The structure of the nuclei offers nothing peculiar.

1. NEMALION. *Duby.*

Fronde cylindrical, gelatinous, elastic, dichotomous, with a cord-like axis clothed with a continuous periphery of filaments invested in gelatine; the *axis* composed of elongate, simple, longitudinal, interlaced filaments forming a medullary column, and surrounded by anastomosing threads from which issue the horizontal, dichotomous, fastigate, moniliform filaments of the *periphery*. *Sporiferous-nuclei* immersed among the filaments of the periphery, spherical, composed of numerous clavate spore-threads radiating from a central point. *Tetraspores* "formed in the terminal cells of the peripheric filaments, triangularly divided, with prominent sporules." (*J. Ag.*)

The fronds are worm-like, either nearly simple or dichotomously branched, of a dull purple colour, and a highly elastic, gelatino-cartilaginous substance, shrinking very much in drying. A cross-section shows a very densely compacted medullary cord or axis composed of interwoven, twisted, slender, longitudinal filaments, giving off obliquely to all sides horizontal, dichotomously-divided branches which form the periphery. The evolution of the frond is thus described by Prof. J. Agardh:—"The different strata of the frond seem to me to be formed in an opposite direction. First, unless I am deceived, the peripheric stratum begins to be developed, from the base upward, by progressive evolution; some of the branches emitted by the peripheric filaments constitute the peripheric stratum, but others are erected, with a direction more vertical, giving off on their outer side new peripheric filaments, and on their inward side longitudinal filaments. These latter, at first, by an oblique course are directed towards the centre of the axis; then they take a downward direction, by a longitudinal course. In some respects, therefore, the mode of growth of the Endogenous stem is imitated. The filaments proceeding downwards are inarticulate and cylindrical; those growing upwards are articulated, and more or less contracted at the dissepiments. So that one may describe the stratification as threefold; a medullary stratum formed of longitudinal, simple filaments, an intermediate of obliquely horizontal, anastomosing filaments and a peripheric of horizontal, dichotomous, fastigate filaments."

1. *NEMALION multifidum*, J. Ag. ; frond dichotomous, with rounded axils. *J. Ag. Sp. Alg. vol. 2, p. 419. Harv. Phyc. Brit. t. 36. Kütz. Sp. Alg. p. 712. (Tab. XXIX. C.)*

HAB. Bangor, Maine, *Mr. Hooper*. Newport, *Prof. Bailey*. Narragansett Pier, *Mr. Olney*. Providence, *Mr. Girard*, *Mr. Thurber*. Portland, *Capt. Pike*. Little Compton, *Mr. Geo. Hunt*. (v. v.)

Fronde six to ten inches long, as thick as crow's quills or thicker, worm-like, distantly forked, either regularly dichotomous or sub-palmate, the lesser branches frequently terminating in four or five finger-like lobes. *Axils* rounded. *Apices* very obtuse. *Substance* very elastic, firm. In drying, it shrinks very much, and closely adheres to paper. It is of a dull brownish purple colour.

Plate XXIX. C. *Fig. 1.* *NEMALION multifidum*, the *natural* size. *Fig. 2,* cross section of the frond ; *fig. 3,* peripheric filaments ; *fig. 4,* nucleus separated ; the latter figures *magnified*.

2. *NEMALION virens*, J. Ag. ; "frond compressed, gelatinous, horny when dry, short, repeatedly forked, by degrees attenuated." *J. Ag. Sp. Alg. vol. 2, p. 420.*

HAB. Pacific coasts of the Mexican Republic, *Liebman*.

"*Frond* as thick as a pigeon's quill, three inches long, below whitish with a yellowish tinge, green above ; when dry cartilaginous."

III. SCINAIA. *Bivona*.

(*Ginannia*, Montagne.)

Frond terete or compressed, dichotomous, gelatinoso-membranaceous, filled with fluid gelatine, traversed by a fibrous axis from which slender, dichotomous, horizontal filaments radiate towards the membranous periphery which is formed of a thin layer of roundish-angular cells. *Sporiferous nuclei* suspended within the membranous walls of the frond, spherical, (invested with a very thin membranous pericarp ?) composed of innumerable, branching, fastigate, articulated spore-threads radiating from a central point, and bearing pyriform spores. *Tetraspores* unknown.

The frond in the typical species is rosy red, dichotomously branched and fasti-

giate, always regular in its ramification, but very variable in size and in substance. The widest specimens are always the most delicately membranaceous and gelatinous, the narrower ones being much firmer and of darker colour. The branches are bag-like, and filled with a half slimy, half watery gelatine, which may be squeezed from them, and which, being exuded in drying, causes the filmy remains of the plant to adhere very strongly to paper. The *axis* is composed of a densely interwoven rope-like bundle of very slender, longitudinal filaments, and is much more strongly developed in some specimens than in others; sometimes being reduced to a few threads, sometimes of considerable diameter, appearing in the dried plant like a strong midrib. A considerable space, filled with gelatine, intervenes between this axis and the membranous periphery, which is, however, organically connected with the axis throughout by innumerable obliquely-horizontal dichotomous filaments, or branches issuing from the axial threads, and terminating in the periphery. These constitute the *intermediate* stratum of the frond. The periphery is composed of one or two rows of roundish, coloured cellules, as it were the apices of the excurrent filaments of the axis, united together into a membrane.

The *sporiferous nuclei*, which are almost always to be found, are abundantly produced in all parts of the frond. They are suspended immediately within the membranous walls, or among the upper dichotomies of the excurrent, horizontal filaments. Professor Agardh describes them as naked, and as such I formerly figured them in *Phycologia Britannica*; but a recent examination, carefully made with a high magnifying power, favours the existence of a thin, membranous pericarp, composed of hexagonal cells, as described by Dr. Montagne. On removing some nuclei and pressing them gently between two pieces of glass, I repeatedly have seen a thin torn membrane among the dispersed sporethreads, and which most probably invested the ball. I have not, however, been able, by any other means, to obtain a view of it.

I follow Professor Agardh in adopting the name *Scinaia*, proposed, it would appear, so long ago as 1822, though overlooked until recently. I regret being obliged to lay aside that of *Ginannia*, under which the genus has been generally adopted, but the stringent laws of priority allow me no choice.

1. *SCINAIA furcellata*, Bivona; frond cylindrical, tender, uniformly dichotomous, fastigiate, equal or here and there constricted; apices obtuse. *J. Ag. Sp. Alg. vol. 2, p. 422.* *Ginannia furcellata*, Mont.—*Harv. Phyc. Brit. t. 69.* *Kütz. Sp. Alg. p. 715.* *Myelomium furcellatum*, *Kütz. Phyc. Gen. t. 73, f. 1.* *Ulva furcellata*, *E. Bot. t. 1881.*

HAB. Newport, Rhode Island, *Prof. Bailey.* Key West, *W. H. H.* (v. v.)

Frond two to four inches long or more, cylindrical, varying much in diameter, sometimes as thick as a swan's quill and sometimes not thicker than a sparrow's quill, many times forked, regularly dichotomous, level-topped, the branches when displayed having a definite, semicircular outline. Lower dichotomies sub-distant, upper successively closer together. *Axils* and *apices* blunt. *Substance* more or less

gelatinous. *Fructification* generally present. *Colour* a fine rosy or lake-red, becoming darker and browner in drying.

The largest of my Key West specimens is quarter of an inch in diameter, most of the others scarcely the tenth of an inch.

This species, first noticed on the east coast of England about fifty years ago, has been brought from very distant localities. It is found in Europe from the Baltic Sea to the shores of Spain, and in the Adriatic; in Africa at the Cape of Good Hope; in Tasmania and New Zealand; and on the coasts of Chili and of the Sandwich Islands.

IV. LIAGORA. *Lamour.*

Fronde terete or compressed, dichotomous or pinnate, at length coated with a calcareous deposit, with a filamentous axis and continuous stratum of peripheric filaments; *axis* consisting of elongated, branching, interlaced, longitudinal filaments; *periphery* of horizontal, articulated, moniliform, much branched filaments. *Fructification* imperfectly known.

Under this genus are placed several Algæ of a gelatinous substance, formed of interlacing, longitudinal and horizontal confervoid filaments, and coated at maturity with a crust of carbonate of lime, organically deposited by the cellules of the frond. In consequence of this calcareous coating, Lamouroux placed the genus among the Tubularian Zoophytes; an association which could only be made on the most cursory observation of dried specimens. The elder Agardh therefore early restored the genus to the Florideous Algæ, to which group their colour indicates an affinity, while the structure of the frond is so very similar to that of *Helminthora* or *Nemalion*, that, even in ignorance of the fructification, we should be disposed to place them near those genera. The only other association which needs to be spoken of is that proposed by Decaisne, who refers *Liagora* to his *Batrachospermeæ*. Against this arrangement the chief obstacle is that the *Batrachospermeæ* are fresh water Algæ and of the Chlorospermatous division, while *Liagoræ* are marine and Rhodospermatous. It is true that some of them turn green in drying, but they also at the same time partially decompose, and we know that almost any red marine Algæ will in decay assume a green tinge. On the other hand *Thorea*, and even some species of *Batrachospermum* itself, become violet when dry. I have not seen fructification, which Prof. J. Agardh describes as "protruding beyond the calcareous crust; and composed of innumerable club-shaped, naked spore-threads radiating from a central point."

All the species are natives of the warmer parts of the sea, particularly of coral

reefs and islands. Of the described species four or five occur in the Mediterranean, and one extends along the Atlantic coast of Europe as far north as Brest, the highest latitude attained by the genus. Probably many remain to be described, but require careful attention in a living state for their correct determination, as all change considerably, and some can scarcely be recognized in a dried state. Several reputed *Galaxauræ* of the section *Microthoe*, perhaps all the species of that section, appear to me to belong to *Liagora*, but I have not had good opportunities of examining them.

* *Fronds covered with a continuous calcareous deposit.*

1. *LIAGORA valida* ; frond robust, repeatedly dichotomous, fastigate, with rounded axils, becoming when dry whitish with red-brown apices, covered with a thin continuous, calcareous deposit ; apices obtuse, not attenuated ; filaments of the periphery repeatedly forked, fastigate, moniliform, their cells elliptical. (TAB. XXXI. A.)

HAB. Sand Key, Florida, *W.H.H.* (v. v.)

Fronds tufted, two to three inches long, half a line in diameter, terete when fresh, becoming compressed in drying, repeatedly and nearly regularly dichotomous from the base, the axils rounded, the apices obtuse and divaricating, not at all attenuate. *Calcareous* coat thin, but uniformly spread, completely coating the peripheric filaments in the lower part of the frond, less dense near the ends of the branches, allowing the tips to project beyond it. When dry, the coated portion of the frond assumes a chalky whiteness. On removing the lime by acid, the peripheric stratum resembles that of *Helminthora*. The peripheric filaments are three or four times divided, the articulations of equal diameter throughout, the lower ones sub-cylindrical, the upper successively more elliptical and contracted at the dissepiments. The colour when recent is a pale pinky red, which is partially retained in the microscopic view of the re-moistened plant.

This may have been previously described as a *Galaxaura* of the section *Microthoe*, but I am not possessed of materials sufficient to decide the point.

Plate XXXI. A. *Fig. 1.* *LIAGORA VALIDA*, the *natural* size. *Fig. 2*, portion of a branch from which the lime has been removed ; *fig. 3*, axial and peripheric filaments ; *fig. 4*, a peripheric filament ; *fig. 5*, apex of the same ; the latter figures more or less *magnified*.

2. *LIAGORA pinnata* ; stem sub-simple, closely set throughout with lateral branches, which spread toward every side ; branches pinnate, or sub-bipinnate, the pinnæ frequently opposite, the pinnules irregularly placed, cylindrical, obtuse, spreading ; calcareous deposit thin, continuous ; apices reddish-brown when dry ; filaments of the periphery not much branched, irregularly dichotomous, fastigate, not beaded, their cells about twice as long as broad, cylindrical. (TAB. XXXI. B.)

HAB. Sand Key, Florida, *W. H. H.* (v. v.)

Fronde about three inches long, about as thick as sparrow's quill, with a leading stem set at short intervals with branches an inch or two in length, spreading to all sides, the lowest short, the middle ones longest, the rest shorter upwards. *Branches* mostly pinnated, sometimes forking or sub-bipinnated, the larger ones occasionally more compound, all the divisions very patent. *Ramuli* opposite or alternate, cylindrical, obtuse. When dry, the frond, as usual, becomes compressed and loses colour; the older and more coated parts turn white, the younger change to a dark reddish brown; under the microscope exactly a "pepper and salt," or mottled with specks of white and brown. The peripheric threads are simpler, less regularly forked, and more cylindrical than in the preceding species, their cells being scarcely constricted at the ends. *Colour* when growing, a pale pinky red. *Substance* cartilagineo-gelatinous. In drying, it closely adheres to paper.

Plate XXXI. B. Fig. 1. *LIAGORA pinnata*; the natural size. Fig. 2, part of a branch; fig. 3, peripheric and axial filaments; fig. 4, a peripheric filament; fig. 5, apex of the same; all more or less magnified.

3. *LIAGORA ceranoides*, Lamour.; "frond compressed, canaliculate at one side from the base to the apex, dichotomously branched, fastigiata, clothed with a continuous crust, apices forked, sub-diverging, the younger ones purplish red." *J. Ag. Sp. Alg.*, vol. 2, p. 426.

HAB. Vera Cruz, *Liebman*.

It must be borne in mind that the above description has been made from dried specimens, and the *compressed, canaliculate frond* may refer only to the dried plant. I am not acquainted with this species, which is said to agree with *L. viscida* in size and ramification.

* * *Fronde* covered with a powdery calcareous deposit.

4. *LIAGORA leprosa*, J. Ag.; frond terete, (compressed when dry) repeatedly dichotomous, fastigiata, with rounded axils, covered with a pulverulent calcareous deposit, whitish when dry, with the ends of the branches greenish; filaments of the periphery flabelliform in outline, excessively di-trichotomous, moniliform, the ultimate cellules very minute. *J. Ag. Sp. Alg.* 2, p. 427. *Kütz. Sp. Alg.*, p. 539. (TAB. XXXI. C.)

HAB. Vera Cruz, *Liebman*. Sand Key, *W. H. H.* (v. v.)

Fronde tufted, one to two inches high, as thick as sparrow's quill, terete when recent, compressed or channelled at one side when dry, repeatedly and very regu-

larly dichotomous from about an inch above the base, without lateral branches; the segments fastigiate, sub-corymbose. *Axils* all very obtuse. *Apices* blunt, rounded or emarginate in the dried specimen. On removing the calcareous matter with muriatic acid, the axis is seen to be composed of many very slender, cobwebby, hyaline, long-jointed, cylindrical filaments, from which issue laterally toward the outside the horizontal peripheric filaments whose apices constitute the continuous surface of the frond. These are pedicellate or unbranched for a third of their length, then forked, and afterwards excessively di-trichotomous, all the branches fastigiate, composed of elliptical or globose cells, strung together like the beads of a necklace; the ultimate cellules exceedingly minute, and appearing dot-like even under a high magnifying power. *Colour* when growing a pale pinky red, soon changing on exposure, and fading altogether during the process of drying. The dried plant is coated with a powdery, calcareous deposit, and white, except the ends of the branches, which become green. The substance is soft, between gelatinous and cartilaginous, and the plant rapidly decomposes. In drying, it adheres closely to paper.

I should not have ventured to refer my specimens as above, had I not received a specimen of Professor Agardh's plant from that author himself, and found it to agree with my Sand Key specimens in every particular. The differences in our descriptions arise from his having seen and examined dried specimens only.

Plate XXXI. C. *Fig. 1*, tuft of *LIAGORA leprosa*, the natural size. *Fig. 2*, portion of a branch; *fig. 3*, axial and peripheric filaments from the same; *fig. 4*, part of one of the lesser branches of a peripheric filament; *fig. 5*, apex of a division of the same; the latter figures more or less highly magnified.

5. *LIAGORA pulverulenta*, Ag.; "frond compressed, sub-canaliculate, terete above, dichotomous, with many lateral proliferous branches, covered with a powdery crust; the apices divaricate, obtuse; the younger ones purpurascens." *J. Ag. Sp. Alg. vol. 2, p. 427. Kütz. Sp. Alg. p. 538.*

HAB. Vera Cruz, *Liebman*.

I am not acquainted with this species.

ORDER IX. WRANGELIACEÆ.

Wrangeliæ, J. Ag. Sp. Gen. Ord. Alg. vol. 2, p. 701. Part of *Ceramiaceæ*, J. Ag. Alg. Medit. p. 69. Endl. 3d. Suppl. p. 34. Harv. Man. Ed. 2, p. 156. Part of *Callithamniæ*, Kütz. Sp. Alg. p. 664.

DIAGNOSIS. Rose-red, filiform, articulate or inarticulate sea-weeds, furnished with a monosiphonous, articulated axis. *Sporiferous-nucleus* naked, formed of branching spore-threads radiating from a fixed point, or whorled round minute lateral ramuli. *Spores* pear-shaped, formed in the terminal cell of the spore-thread.

NATURAL CHARACTER. *Root* a small disc. *Fronds* filiform, much branched, alternately decomposed or decomposed-pinnate, the branches either opposite or alternate, articulate or inarticulate, the inarticulate species traversed by an articulated, monosiphonous axis, round which smaller stratified cellules are gradually deposited. The younger portions of the frond in the typical genus are always confervoid, or composed of a single row of cellules placed end to end in an articulated thread. The cell-walls are thick, pellucid, and of a softish substance, soon decomposing in fresh water. The endochrome, when recent, is generally a brilliant rosy red or purple-lake tint, which is sometimes partially preserved in drying, but frequently it becomes browner in drying, and in several species changes to a dark brown or even black. This a good deal depends on the state of individual specimens, as the shade of colour varies in the same species.

The *sporiferous nucleus* is not enclosed within any conceptacle, nor is it immersed in the frond, but exposed wholly naked, or at most surrounded with involucrel ramuli, which close over it without contact. It consists of many branching spore-threads, either springing in a globose cluster from the end of a shortened branch, or whorled round the middle portion of minute, lateral ramuli. These spore-threads at maturity bear on the branches solitary, pear-shaped spores, formed by a transmutation of the terminal cells. The *tetraspores* are only known in some species of *Wrangelia*. They, also, are naked, scattered along the monosiphonous, confervoid ramuli, each tetraspore being formed of a ramulus shortened to a single cell.

At present this Order consists of two genera, one removed from the *Ceramiaceæ*, the other from the *Gloiocladææ*. In the structure of the frond and in the whole external habit, *Wrangelia* so perfectly resembles a *Ceramiaceous* plant that some of its species have been, at different times, referred either to *Griffithsia* or to *Callithamnion*, and so far as structure may indicate affinity there is a near agreement between *Callithamnion* and *Wrangelia*. But here the relationship ends, for the nature of the

sporiferous nucleus in these genera is widely different. In *Callithamnion* the nucleus is a naked *favella* or encysted cell filled with a mass of disconnected spores originating in the repeated division of the endochrome of the mother cell; in *Wrangelia*, as already described, it is a tuft of spore-threads bearing pear-shaped pedicellated spores. If therefore the structure of the nuclei is to be our guide in arrangement, the resemblance of *Wrangelia* to *Callithamnion* is one of analogy only, these genera representing each other in the series to which they respectively belong.

Naccaria, which is associated with *Wrangelia* by Prof. J. Agardh, appears at first sight to have little affinity with it, differing especially in the wholly inarticulate frond. This character is, however, of minor importance, as is seen in *Ceramiaceæ*, where some genera are inarticulate; or even in *Wrangelia* itself, where the older portions of the stem and branches in several species are opaque. A comparison of the sporiferous threads of *Naccaria* with those of *Wrangelia* will show an agreement in essential structure; and the differences in the nuclei are chiefly in the arrangement of the parts, the spore-threads of *Wrangelia* radiating from the end of a truncated branch, those of *Naccaria* being whorled round the ramuli. I think, therefore, a true relationship between these genera has been established.

WRANGELIA. Ag.

Frond filiform, decompose-pinnate, articulated, one-tubed; the *internodes* naked or coated with minute cellules, the *nodes* clothed with opposite or whorled, byssoïd, articulated ramelli. *Sporiferous-nucleus* terminal, involucreted, the involucre formed of byssoïd ramelli, the nucleus composed of a dense tuft of radiating pyriform spores, formed of the terminal cells of the spore-threads. *Tetraspores* naked, sessile on the sides of the ramuli, spherical, triangularly divided.

In some species the frond is pellucidly articulate throughout, each internode formed of a single, cylindrical, thick-walled cell, filled with a brilliant carmine endochrome, and separated from the internodes above and below it by a hyaline diaphragm. In others the younger parts of the frond alone exhibit this perfectly articulated structure; the older portions being more or less fully coated with a stratum of small cellules; and in some other species the whole of the stem and branches are rendered opaque by these accessory cells, and the articulated structure of their fronds can only be ascertained by a careful dissection. In all the species the ultimate ramelli, which are often of a byssoïd tenuity, are single-tubed and pellucidly articulate, and they generally spring from each node throughout the frond. They are minute, pinnately or dichotomously compounded, mostly whorled, but sometimes distichous, and, in that case opposite each other. It frequently

happens that the ramelli are longer at one side of the stem than at the other, the long and short filaments alternating from node to node.

The *sporiferous-nucleus* generally terminates a short branch. It is destitute of any proper coating or pericarp, but is surrounded and often closely invested by a whorl of byssoid ramelli. It consists of a tuft of spore-threads, radiating from the apex of the branch, and bearing terminal, pear-shaped spores. The *tetraspores* are scattered along the ramelli, of whose metamorphosed branches they are formed; they are spherical or ellipsoidal, sessile, and triangularly divided.

Of this genus, which was originally founded on our *W. penicillata*, several species are now known, dispersed through the Atlantic and Southern Oceans. Some of them have the external habit of *Griffithsia*, others of *Callithamnion*, and others of *Dasya*, genera to which, in their fructification, they have but little affinity. In the nature and position of the tetraspores, indeed, there is a close resemblance between *Wrangelia* and *Callithamnion*; but the structure of the sporiferous-nucleus obliges us to place them widely apart. From *Dasya* the monosiphonous frond affords an easily-seen distinction, independently of fructification.

1. *WRANGELIA penicillata*, Ag.; frond ultra-setaceous, decompose-pinnate, distichous, the stem and larger branches corticate, opaque, the lesser branches articulate; ramelli whorled round the nodes, repeatedly dichotomous, of nearly equal diameter throughout, obtuse, their articulations contracted at the dissepiments, 4—8 times as long as broad. *J. Ag. Sp. Alg.* 2, p. 708. *Kütz. Sp. Alg.* p. 664. (TAB. XXXIV. B.)

HAB. Key West, very abundant. *W. H. H., Dr. Blodgett, Prof. Tuomey, &c.* (v v.)

A most variable plant in aspect, according to the greater or less development of the primary and secondary branches; but when this is borne in mind, easily recognisable under all its forms. The branching is uniformly distichous, and decompose-pinnate. Sometimes it is nearly simply pinnate, with few and distant pinnæ; sometimes a few alternate long branches, or primary pinnæ, are set with minute alternate pinnules 2 or 3 lines long; sometimes the frond is closely and regularly thrice or four times pinnated, each branch having an ovate or lanceolate outline and fern-like aspect; and between these extreme forms there are endless varieties. In all cases the branches are whorled at every node with very soft, repeatedly dichotomous, confervoid filaments, which are very frequently longer at one side of the branch than at the other. The articulations of these ramelli are 4 to 6 or 8 times as long as broad, swollen upwards, the dissepiments much contracted, and the terminal cell obtuse. The stem and larger branches are coated with small cellules, and thus appear opaque and inarticulate; in the smaller branches the cellular coat is less uniformly spread, and the ultimate or youngest branches are pellucidly articulate. The *sporiferous nucleus* is globose, and usually terminates the shorter branches. It is surrounded by an involucre composed of copious

ramelli, which often overtop it, and completely hide it. *Antheridia* frequently occupy the position of tetraspores. They consist of minute spherical tufts of dichotomous, radiating filaments attached to the sides of the ramelli. I have not found *tetraspores* on the American specimens. When quite fresh the frond is of a beautiful rosy red, and sometimes this is partially preserved in drying; but more commonly, especially if the specimen be suffered slightly to decay, it turns dark brown or blackish in the drying process, and stains the paper of the same colour. The *substance* is very flaccid and tender, soon decaying in fresh water.

I was at first disposed to regard our American plant as distinct from the European *W. penicillata*, and had proposed to call it *W. filicina*, but a careful comparison of numerous specimens has shown that the distinctions on which I had relied are insufficient.

Plate XXXIV. B. *Fig. 1 and 2*, different varieties of *WRANGELIA penicillata*, the natural size. *Fig. 3*, one of the smaller branches, with its whorled ramuli; *fig. 4*, a small portion of the stem or of a large branch; *fig. 5*, cross section of the same; *fig. 6*, a fertile branch, with terminal involucre and nucleus; *fig. 7*, nucleus (not quite correctly drawn); *fig. 8*, spores from the same; *fig. 9*, vertical view of a whorl of ramuli, to shew the excentric position of the branch: the latter figures more or less magnified.

2. *WRANGELIA plebeia*, J. Ag.; "fronds corticate, sub-pinnately branched, and verticillately ramellose at the nodes, penicillate at the apex; ramelli repeatedly dichotomous, the terminal cells acute, articulations of the ramelli contracted at the disseiments, 4—5 times as long as broad." *J. Ag. Sp. Alg. vol. 2, p. 708.*

HAB. At Vera Cruz, Mexico, *Liebman.*

Probably, as Professor Agardh suggests, only a variety of the preceding species.

ORDER X. RHODYMENIACEÆ.

Rhodymenia, *J. Ag. Sp. Gen. and Ord. Algarum, p. 373.* Part of *Rhodymeniaceæ*, *Harv. Man. Ed. 2, p. 120.* Part of *Sphærococcoideæ* and *Delesseriaceæ*, *Auct. &c.*

DIAGNOSIS Purplish or blood-red sea-weeds, with an inarticulate, (flat, compressed or filiform) membranaceous frond, composed chiefly of polygonal cells; the surface cells forming a continuous coating. *Nucleus* lodged in an external *conceptacle*, simple or formed of several nucleoli. *Spores* at first associated in moni-

liform, branching strings issuing from a placenta, at length massed together without order.

NATURAL CHARACTER. *Root* mostly a mere disc, sometimes, as in *Plocamium*, branching. *Fron*d membranaceous in substance, very variable in general habit and branching. Most commonly the membrane is flat, narrow, or expanding into broad dichotomously or irregularly cleft expansions, without trace of midrib or veins. In one genus only (*Wormskioldia*) nerved leaves, of definite form and delicately membranous areolated substance, occur. In *Plocamium* the frond is linear, often very narrow, much branched in a pinnate order, flat or compressed, with or without midrib. In *Rhabdonia* it is terete, the exterior strata composed of the ordinary polygonal cells, the axis of closely interwoven cylindrical cells disposed in filaments.

The sporiferous *nuclei* are always lodged in proper conceptacles, external or partly immersed, usually hemispherical and destitute of apical pore, sometimes opening at the apex, or even furnished with a prominent orifice. These conceptacles are either marginal or scattered over the surface, or (rarely) formed in proper leaf-like processes. Within a densely cellular pericarp, a basal or central placenta is often largely developed; from it issue toward all sides dense tufts of branching spore-threads, either united in a single nucleus or divided into several, which are sometimes separated by barren filaments running from the placenta to the pericarp. The sporiferous threads are moniliform, branched, articulated, each articulation containing at an early stage a simple mass of endochrome, but by repeated cell-division the contents of each cell is finally converted into a cluster of *spores*, held together by the dilated cell-wall. The clusters thus originated, being confined within the narrow cavity of the conceptacle, are closely pressed together and at length massed into nuclei or nucleoli without obvious order. The spores, also by reason of pressure, become irregularly angular or wedge-shaped. The *tetra-spores* are roundish or oblong, and variously parted; and are either dispersed among the surface cells, or collected in definite sori, or lodged in proper leaflets.

This order has recently been proposed by Professor J. G. Agardh to include a few genera which, on account of the very different structure of their conceptacular fruit, he has rejected from the *Sphærococcoideæ*; a measure rendered necessary by the new principles of arrangement developed by that author. These plants, however, so closely resemble the genuine *Sphærococcoideæ* in external habit, and even in the internal structure of the stem and leaves, that recourse must sometimes be had to an accurate microscopic analysis of the contents of the conceptacle, before the student can ascertain the proper place in the system of the plant under examination. This is notably the case in the genera *Wormskioldia* (founded on *Delesseria sanguinea*, Ag.) and *Delesseria* (*D. sinuosa*, &c.), two genera with fronds of precisely similar texture and appearance, but with a fructification of a structure so different that we are compelled to place them not only in different Orders, but in different Series. If this seems an unnatural distribution, as it certainly is contrary to long established prejudice, let it be remembered that there are species of *Cactus*, *Stapelia*, and *Euphorbia* equally resembling each other in habit,

but equally differing in fructification; and that in every natural arrangement characters derived from the structure of the fructification are to be preferred to all others.

All the genera of this Order are widely dispersed. *Rhodymenia* has species in the Arctic and Antarctic Oceans, as well as in the temperate and tropical zones. *Euthora* and *Rhodophyllis* characterise high northern and high southern latitudes. One species of *Plocamium* is cosmopolitan, while the rest, fourteen in number, are confined to the southern hemisphere. *Rhabdonia*, the only remaining genus, has tropical and Australian species.

Among the useful plants the most remarkable is *Rhodymenia palmata*, the Dulse or Dillisk of the Irish (*see* INTROD. Part 1, p. 33); and among the most beautiful are *Euthora cristata*, *Wormskioldia sanguinea*, and the various species of *Plocamium*,—all highly prized by collectors of “Ocean flowers.”

SYNOPSIS OF THE NORTH AMERICAN GENERA.

* *Fronde flat, dichotomous or irregularly laciniate or multifid.*

† *Sporiferous nucleus simple, surrounded by a gelatinous integument.*

I. RHODYMENIA. *Fronde stipitate, leaf-like, dichotomous or palmate.*

†† *Sporiferous nucleus compound, formed of several nucleoli more or less confluent.*

II. EUTHORA. *Fronde dichotomo-pinnate or laciniate, often very narrow. Tetraspores cruciate.*

III. RHODOPHYLLIS. *Fronde dichotomous, often fringed with marginal lobes. Tetraspores zonate.*

** *Fronde linear, plano-compressed, pectinato-pinnate, the ramuli alternately secund in threes or fours.*

IV. PLOCAMIUM. *Tetraspores zonate, contained in marginal spore-leaves.*

*** *Fronde terete, alternately decomposed.*

V. RHABDONIA. *Conceptacles half immersed in the branches. Tetraspores zonate, dispersed through the superficial cells.*

VI. CORDYLECLADIA. *Conceptacles* external, sessile. *Tetraspores* cruciate, lodged in proper, pod-like ramuli.

I. RHODYMENIA. *Grev.*

*Fron*d flat, membranaceous, dichotomous or palmate, often proliferous from the margin or disc, composed of two strata of cells; the inner cells oblong, the superficial minute, in few vertical rows. *Conceptacles* scattered over the frond, sessile, hemispherical, with a cellular pericarp at length opening by a terminal pore; *sporiferous filaments* very numerous, emitted from a *basal* placenta, and forming a simple nucleus surrounded by a gelatinous pellicle. *Tetraspores* either collected in cloud-like patches, or dispersed over the frond among the superficial cellules, roundish, cruciate or tripartite.

This genus, as originally constituted, included a large number of plants which had a resemblance in habit to each other, but which a more accurate examination has shown to belong to several widely separated types of structure: hence the genera *Euthora*, *Rhodophyllis*, *Kallymenia*, *Callophyllis*, *Calliblepharis*, *Sarcodia*, &c., have been formed at its expence. The generic character, as here given, is that fixed by Prof. J. G. Agardh. It reduces the species now placed in *Rhodymenia* to about a dozen at the most; and, small as this number is, they naturally divide into two sections or sub-genera, distinguished not less by peculiarities of fructification than by minor external characters. In the first section the tetraspores are scattered through the surface cellules over the whole frond; the fronds are of large size, purplish or dull-red, sub-simple or irregularly palmatifid, and the stem is but little developed. In the second the tetraspores are confined to definite sori, placed immediately below the ends of the lobes; the fronds are dichotomous, of a bright red or rosy, and the stem is always considerable, and sometimes branched. The species of this latter section have a habit very similar to that of *Phyllophora*.

1. *Palmatæ*: tetraspores scattered in cloudy patches over the whole frond.

1. RHODYMENIA *pertusa*, J. Ag.; stipes short, cartilaginous, compressed, expanding into a broadly lanceolate, sub-undivided, membranaceous, blood-red lamina (one to three feet in length) attenuated at the base; conceptacles very numerous, densely scattered over the surface of the frond. *J. Ag. Sp. Alg.* 2, p. 376. *Rhodymenia Wilkesii*, *Bail. and Harv. in Bot. Expl. Ex. cum Icone, ined.* *Porphyra pertusa*, *Post. and Rup. Alg. Ross.* p. 20, t. 36.

HAB. Straits of St. Juan de Fuca, *Capt. Wilkes.* (v. s.) Greenland, *Wormskiold.*

Root scutate. *Fronde*s tufted, rising with a compressed stem, which, at half an inch to an inch from the base becomes flattened, cuneate, and gradually widens, until it passes into the base of a broadly lanceolate lamina, from one to three feet long, and from four to eight or ten inches wide. *Lamina* much attenuated at the base, commonly quite simple, sometimes forked; the newer portions formed, as in *Laminaria*, between the apex of the cartilaginous stem and the base of the expansion. *Colour* pale blood-red, fading into greenish. *Conceptacles* as large as poppy-seed, spherical, extremely numerous, half immersed in the lamina and scattered thickly through three-fourths of it, commencing at the apex and extending toward the base.

This fine species was originally published under the erroneous generic name of *Porphyra*; and as such it escaped the notice of Prof. Bailey and myself when, in examining the Algæ of Wilkes' Exploring Expedition, we proposed to give Capt. Wilkes's name to what we rightly considered a *Rhodymenia*, and believed to be an unpublished species. Meantime, Professor Agardh having received specimens of the so-called *Porphyra pertusa*, and at once perceiving that they were referable to *Rhodymenia*, has sanctioned the specific name *pertusa* in his recently published Species Algarum. I am therefore constrained to adopt this name, in preference to that which my friend Bailey and I had proposed. It is given by its author in allusion to certain roundish holes often to be found in the membranes, but which appear to me to be casualties, such as occur in very many of the membranous Algæ, as in *Ulva latissima*, &c. I have received from Dr. Ruprecht an authentic specimen of his plant, and find it identical in species with the specimens brought home by Wilkes. These latter are, however, of much greater size and in more perfect condition.

2. RHODYMENIA *palmata*, Grev.; frond coriaceous or membranaceous, purple, broadly wedge-shaped, irregularly cleft, palmate or dichotomous, sometimes repeatedly lacinate; the margin flat and even, sometimes winged with leaflets; tetraspores distributed over the whole frond in cloud-like spots. *Harv. Phyc. Brit. t. 217 and 218. J. Ag. Sp. Alg. 2, p. 376. Sphærococcus palmatus, Kütz. Sp. Alg. p. 781. Fucus palmatus. Lin.—Turn. Hist. Fuc. t. 115. E. Bot. t. 1306. Dulse or Dillisk, vulg.*

HAB. Parasitical on littoral *Fuci*, *Laminariæ*, etc. Halifax, *W. H. H.* Boston Bay, *Dr. Asa Gray*, *Mr. G. B. Emerson*, etc. Long Island Sound, *Prof. Bailey*, *Mr. Hooper*, etc. Common. (v. v.)

Frond 6—12 inches long or more, from one to four or six inches broad, cuneate at the base, and generally broadly cuneate in outline, vertically cleft in a sub-palmate manner; sometimes quite simple, sometimes cloven nearly to the base into innumerable slender ribbons. The margin is generally flat, but is often furnished at intervals with simple or forked leaf-like lobes, giving a pinnate character to the frond. *Apices* obtuse. *Axils* generally acute. *Substance* firmly membranous or

leathery, not adhering to paper except after a long maceration in fresh water. *Colour* a deep brownish purple.

In some specimens dredged in Halifax Harbour the frond is very much broader than its length, but little divided, and having the margin very much waved. The substance is thinner than in the common form, which occurs abundantly at Halifax.

3. RHODYMENIA? *interrupta*, Grev. ; frond membranaceous, irregularly divided, sub-dichotomous ; the laciniaë divaricated, linear, constricted at short intervals ; the terminal lobes digitate ; axils and apices rounded. *Grev. in Nov. Act. Nat. Cur.* xiv. p. 423, t. xxvi. fig. 1. *J. Ag. Sp. Alg.* 2, p. 382.

HAB. Arctic Sea, *Lieut. W. N. Griffiths.* (v. s. in Herb. Cl. Dnæ. Griffiths.)

Base unknown. *Frond* (broken) eight or ten inches long, irregularly dichotomous, the terminal lobes digitate or pedate. *Laciniaë* widely spreading or divaricate, about half an inch wide, linear, repeatedly but irregularly constricted at short intervals in a nodose manner ; the margin undulate. *Axils* very obtuse, rounded, from half an inch to an inch wide. *Apices* rounded, somewhat wider than the laciniaë. *Nemathecia* wart-like, small, clustered, growing from the margin or the disc of the lower segments. *Substance* thin. *Colour* a dull red, rather brownish below. It does not adhere to paper.

A thin slice shows two or three rows of large, polygonal, empty medullary cells, with a thin exterior coating of coloured, minute cells, gradually smaller towards the circumference. This structure is different from that of *Phyllophora Brodiaëi*; to an extravagant form of which variable plant this curious species bears some resemblance. I have to express my thanks to Mrs. Griffiths for allowing me to examine the single specimen brought home by her son from the Arctic regions, being that from which Dr. Greville's figure was made, and the only one known to exist at present in any Herbarium.

2. *Palmettaë: tetraspores aggregated in distinct sori below the tips of the laciniaë.*

4. RHODYMENIA *Palmetta*, Grev. ; stipes cylindrical, sub-simple, expanding into a fan-shaped, rose-red frond, more or less deeply cleft dichotomously ; laciniaë linear-wedge-shaped, with broad rounded interstices and a very entire, flat margin ; apices either erose or rounded ; conceptacles marginal or scattered ; tetraspores cruciate, forming deep-red sori in the dilated apices. *Harv. Phyc. Brit.* t. 134. *J. Ag. Sp. Alg.* 2, p. 378. *Sphaerococcus Palmetta*, Kütz. *Sp. Alg.* p. 782. *Fucus Palmetta*, *Esper.* t. 40. *Turn. Hist.* t. 73. *E. Bot.* t. 1120.

HAB. On shells and stones in deep water and on the stems of Laminariaë. Halifax, *W. H. H.* (v. v.)

As yet my only authority for claiming American Citizenship for this plant, is a single fragment picked up at Halifax. It is about an inch and half high, and three-forked at half an inch from the base, the lobes linear, cuneate, dichotomous, spreading; the outline fan-shaped; the ultimate lobes slender. One or two imperfectly developed conceptacles are sessile on the ultimate lacinia, about the middle. It is to be hoped that some more fortunate collector may obtain satisfactory specimens.

II. EUTHORA. *J. Ag.*

Fronde membranaceous, flat, dichotomo-pinnate, composed of two strata of cells; those of the inner stratum, oblong, large; of the outer, coloured, minute, in few rows. *Conceptacles* marginal, sub-spherical, with a closed cellular pericarp (composed of concentric layers of cellules at one point radiating); *sporiferous filaments* very numerous, radiating from a *central* placenta, which is suspended in the cavity of the pericarp by sub-simple filaments; the fertile spore-threads forming roundish masses of *spores* from their upper cells. *Tetraspores* cruciate, lodged in the thickened apices of the frond.

Separated from *Rhodymenia*, where it had been placed by Greville, by Professor Agardh, on account of the different structure of the conceptacles, a character no doubt of grave importance, although difficult to be seen without a careful dissection; and this is difficult to accomplish, owing to the minuteness of the object to be cut through. In *Rhodymenia* the placenta projects from the *base* of the cell, and throws up from its upper surface masses of spore-threads, which finally unite into a single globose nucleus; in *Euthora* the placenta is in the *centre* of the cavity, where it is suspended by cord-like filaments drawn from it to the surrounding walls, and the spore-threads issue from it on every side. This is the essential distinction. Another character is noticed by Prof. Agardh in the structure of the walls of the pericarp, which in *Euthora* are composed of several sub-concentric layers of cells, except at one spot, where the cells are set in lines radiating, like the spokes of a wheel, from the nucleus outwards, and indicating probably, as Prof. Agardh suggests, the point where the wall first gives way to permit the escape of the spores.

1. *EUTHORA cristata*, *J. Ag.*; frond fan-shaped, membranaceous, sub-dichotomous or somewhat pinnately-multifid, the segments dilated upwards and repeatedly subdivided; lesser divisions alternate, linear, laciniate at the ends, and often fimbriate

at the margin; conceptacles spherical, marginal; tetraspores contained in the thickened tips of the laciniae. *J. Ag. Sp. Alg.* 2, p. 385. *Rhodymenia cristata*, Grev.—*Harv. Phyc. Brit. t.* 307. *Callophyllis cristata*, Kütz. *Sp. Alg.* p. 747. *Fucus cristatus*, L.—*Turn. Hist. t.* 23.

HAB. Arctic coast, *Lieut. W. N. Griffiths, R. N.* Abundant from Halifax (*W. H. H.*) to Cape Cod, many varieties, *Mrs. Asa Gray, Mrs. Mudge, Dr. Durkee, &c.* (v. v.)

Fronde one to three inches high, distichous, excessively branched, more or less fastigiate, flabelliform, the expansion of the branches equal to the length of the frond. *Branches* linear, varying in breadth from the diameter of a hog's bristle to one or two lines or more, sub-dichotomously, palmately, or alternately decomposed, the divisions successively narrowed. Sometimes the whole frond is sub-dichotomous and nearly equally narrow; sometimes decomposed-pinnate, and sometimes a few broad, pinnatifid laciniae are bordered by finely-cut ramuli. The frond is not perfectly flat, when narrow, but two edged, slightly convex in the centre. *Conceptacles* abundant, spherical, marginal, as large as poppy seed, dark coloured. *Tetraspores* cruciate, thickly congregated in the thickened and dark coloured tips of the laciniae. *Colour* a beautiful crimson lake, becoming scarlet on steeping in fresh water. *Substance* somewhat cartilaginous. It shrinks in drying, and but imperfectly adheres to paper.

Most of my Halifax specimens are of the narrow varieties, some so narrow and multifid as closely to resemble the smaller and slenderer forms of *Plocamium coccineum*. In Boston Bay, where the plant occurs in great profusion and beauty, broad and narrow varieties are nearly equally common. The geographic range of this species is alluded to in our *Introd. p.* 23.

III. RHODOPHYLLIS. *Kütz.*

Fronde flat, membranaceous, dichotomously cleft, often with marginal lobes, composed of two strata of cells: cells polygonal, those of the medullary stratum larger, longitudinal; of the outer, vertical, in few rows. *Conceptacles* mostly marginal, sub-spherical, with a closed pericarp (composed externally of radiating, internally of concentrically arranged cellules); sporiferous filaments very numerous, radiating from a basal placenta; the fertile ones forming roundish masses of spores from the uppermost cells. *Tetraspores* zonate, immersed in the frond or in its marginal lobes.

A small genus typified by *Rhodymenia bifida*, Grev. (*Fucus bifidus*, Turn.), and

now including four species, three of which are natives of the northern and one of the southern hemisphere. It differs from the restricted genus *Rhodymenia* partly by the structure of the nucleus, and partly by the zonate tetraspores. The generic name here adopted was proposed in 1847 by Kützing, who probably overlooked the name *Wiggia* which I suggested (*Phyc. Brit. t. 32*) some few months earlier. Hoping to find some future opportunity of honouring the memory of Mr. Lilly Wigg, I cheerfully acquiesce in the change.

1. RHODOPHYLLIS *Veprecula*, J. Ag.; "frond dichotomo-decompound, and pinnated at the margin; pinnæ lanceolate or linear, ciliate; cilia subulate, short or the longer ones forked; conceptacles densely clustered at the base of the cilia, often confluent; tetraspores numerous, lodged in the cilia." *J. Ag. Sp. Alg. 2, p. 390.* (*excl. Syn. Beechey.*)

HAB. Greenland, *Agardh.*

"Two to three inches high; the segments sometimes scarcely a line, sometimes three or four lines broad, ciliate, the cilia either very short and subulate, or half an inch long and once or twice forked. *Conceptacles* clustered around the base of the shorter cilia. *Colour* rose-red or brownish. It scarcely adheres to paper."

This plant I have not seen. Prof. J. Agardh seems to doubt whether it may not more properly be referred to *Calliblepharis*. His quotation of "Rhod. ciliata β . microphylla, Bot. Beech. Voy. p. 164," is incorrect.

IV. PLOCAMIUM. *Lamour.* (reform.)

Fronde sub-cartilagineo-membranaceous, linear, plano-compressed, pinnately decompound (the pinnules alternately secund in pairs, or in threes and fours): composed of two strata of cellules; the inner cellules longitudinal, oblong, the outer polygonal, coloured, small. *Conceptacles* sessile or pedicellate, hemispherical, with a cellular pericarp finally opening by a pore; *sporiferous filaments* very numerous, radiating in several tufts (some generally barren) from a basal placenta; the fertile forming masses of spores from their upper cells. *Tetraspores* lodged in proper spore-leaves (*stichidia*), oblong, zonate.

A beautiful genus, readily distinguished by the very peculiar ramification. The frond in all is linear, distichously branched, two-edged or flat, sometimes membranaceous and furnished with a midrib, sometimes thickened and cartilaginous, pin-

nately decompose. The pinnules are of two kinds; the *primary* or lowest in position are generally simple, short, acute, either subulate or cultrate, and are set distichously at alternate sides of the branch; the *secondary* are pinnulate or pectinato-decompose, and spring singly, or two, three, or four consecutively from above the axil of their primary, in the space between its place and that of the next primary at the opposite side of the stem. In this way, the ramuli throughout the frond are alternately geminate, ternate, quaternate, etc. In one section of the genus, peculiar to the southern hemisphere, the ramuli are geminate; that is, each primary subtends but one secondary ramulus; in the other section, to which our *P. coccineum* belongs, two or more secondaries are ranged above each primary. All the species are remarkable for their brilliant colour.

1. *PLOCAMIUM coccineum*, Lyngb.; frond narrow, cartilaginous, plano-compressed, decompose; ramuli alternately ternate or quaternate, the lowest of each series subulate, very entire, the upper pectinate on their upper edges; conceptacles marginal, solitary, sessile; spore-leaves on the inner faces of the pectinate ramuli, divaricately branched. *Harv. Phyc. Brit. t. 44. J. Ag. Sp. Alg. 2, p. 395. Kütz. Sp. Alg. p. 883. Fucus coccineus, Huds. Turn. Hist. t. 59. E. Bot. t. 1242.*

HAB. San Francisco, California, *Dr. Sinclair, Capt. Pike.* Boston Bay, *Miss Hawkshurst.* (v. v.)

Captain Pike's specimen is about four inches high, a line broad, alternately and distantly branched, the stem and branches two-edged, but not much compressed below, flatter above. *Branches* decompose in their upper half. *Ramuli* generally alternately ternate or quaternate, the lowest ramulus subulate, about a line long, the two above it elongate, compound in a similar order. *Stichidia* formed from the ultimate ramuli of the upper divisions of the branches, palmate or dichotomous, the divisions truncate. *Colour* a dark lake-red. *Substance* cartilaginous. It imperfectly adheres to paper.

The rarity of *Plocamium coccineum* on the eastern shores of North America is very remarkable, considering that it is common on the Atlantic shores of Europe, and throughout a very wide extent of the Southern Ocean. The Californian specimen above described is more robust, more cartilaginous, and less compressed than any that I possess from other quarters, but offers no peculiarity of ramification by which it can be distinguished.

V. RHABDONIA. *Harv.*

Frond terete, decompose, somewhat tubular; tube partially filled with longitudinal, branching and anastomosing filaments; the peripheric stratum composed of

polygonal cellules, smaller toward the surface. *Conceptacles* immersed in the branches beneath the periphtric stratum, but prominent to one side, the walls formed of a dense plexus of filaments derived from the axis; *placenta* fibro-cellular, central, suspended in the cavity by slender filaments connected with the walls; *spore-threads* emitted in tufts from all sides of the central placenta, moniliform, forming strings of *spores* in their articulations. *Tetraspores* dispersed through the superficial stratum of the frond, oblong, zonate.

I have already remarked under *Solieria* the very close resemblance, in external habit and in the structure of the frond, between the species of that genus and of the present one. Indeed, except in the development of the spores,—a character, however, which obliges us to refer them to widely distant Orders—the two genera are undistinguishable. *Rhabdonia* was founded on two Australian Algæ, very similar in aspect to the plant now to be described; and Prof. Agardh has added four others, one of which is a native of the West Indies, and may possibly occur at Key West.

1. RHABDONIA *Coulteri*, Harv.; frond filiform, setaceous and bare of branches below, gradually incrassated upwards, pinnate or sub-bi-pinnate above; pinnæ and pinnulæ patent, lineari-fusiform, attenuate at the base, obtuse or sub-acute; conceptacles plentiful, half immersed, hemispherical; tetraspores of large size, dispersed. (TAB. XXIII. B.) *Hypnea Coulteri*, Harv. in *Bot. Expl. Exp. ined.*

HAB. Monterey, California, *Dr. Coulter*. North West Coast, *Capt. Wilkes*. (v. s. in Herb. T.C.D.)

Root a large disc, throwing off creeping fibres. *Fronde*s densely tufted, 6—8 inches high, not thicker than hog's bristle below, gradually thickened upwards to the diameter of a crow's quill. *Stem* once or sometimes twice forked within an inch or two of the base, afterwards simple, naked for half its length, closely pinnate or occasionally bipinnate in its upper half, the pinnæ a line or two apart, very patent, 2—3 inches long, the barren ones as thick as sparrow's quill, the fertile ones twice or thrice that thickness. The pinnules when present are in all respects similar, but are very irregularly placed, often secund. *Conceptacles* large, plentifully lodged in the lesser branches, prominent to one side, as if hemispherical or sub-conical. *Tetraspores* dispersed in the branches. *Colour* a very dark, brownish red. *Substance* cartilaginous. It shrinks and scarcely adheres to paper in drying.

Barren plants are setaceous, irregularly divided, and scarcely dilated upwards.

TAB. XXIII. B. *Fig. 1.* RHABDONIA *Coulteri*; the natural size. *Fig. 2,* longitudinal section of a branch, showing *tetraspores* lodged in the surface cells; *fig. 3,* small portion of the periphery of the same, with two tetraspores; *fig. 4,* transverse section of a branch, cutting horizontally through a conceptacle; *fig. 5,* portion of

the same, showing part of the peripheric stratum, of the fibro-cellular wall and placenta, and of the tufts of spore-threads issuing from the latter; more or less *magnified*.

VI. CORDYLECLADIA. *J. Ag.*

Fronde filiform, irregularly branched, carnosu-cartilaginous, formed of two strata of cells; medullary layer of oblong, longitudinal cells, cortical of roundish, coloured, sub-seriated, vertical minute cellules. *Conceptacles* sessile on the branches, sub-spherical, furnished with a cellular pericarp at length perforate, containing a densely packed globular mass of roundish-angular spores, formed by the evolution of much-branched filaments issuing from a basal placenta. *Tetraspores* immersed in the periphery of pod-like ramuli, oblong, cruciately parted.

The type of this genus is *Gracilaria erecta*, Grev. (*Harv. Phyc. Brit. t. 177.*); a little plant, known only on the shores of the British Islands. In the above quoted figure, which in other respects is characteristic, the tetraspores are incorrectly represented as being *zonate*, instead of *cruciately*, as I find them to be on a renewed examination. The two following species are only doubtfully referred to this genus, their fruit being as yet unknown.

1. CORDYLECLADIA? *Huntii*; fronds densely tufted, springing from a common, expanded, crust-like disc, livid purple, tereti-compressed, once or twice forked or secundly branched; branches subulate, attenuate, acute; fruit . . . ?

HAB. Narragansett Bay, *Mr. Geo. Hunt.* (v. s. in Herb. T.C.D.)

Common crustaceous base, an inch or more in diameter. *Fronde* densely tufted, 2—3 inches high, setaceous below, twice as thick as hog's bristle above, evidently compressed, especially in the upper portion, erect, sub-simple, irregularly divided; sometimes once or twice forked, sometimes with one or two secund lateral branches, sometimes both forked and secundly branched. *Branches* filiform, attenuated, acute. *Fruit* unknown. *Colour* a livid purplish, fading into white. *Substance* cartilaginous, rather soft, adhering to paper in drying. Medullary stratum composed of polygonal cells, filled with granules and smaller towards the margin; cortical of minute, coloured sub-seriated cells.

In the absence of fruit this must remain doubtful. I have as yet seen but a single specimen, which I place in this genus from its strong outward resemblance

to *C. erecta*, from which it differs in being evidently compressed, and in the dull purple colour.

2. *CORDYLECLADIA ? irregularis*; frond filiform, more or less hollow, setaceous, rigid, densely tufted, irregularly branched, somewhat pinnate; branches few, opposite or secund, widely spreading, simple, obtuse.

HAB. Key West, *Prof. Tuomey*, (5) *Dr. Blodgett*, (45) *W. H. H.* (55) (v. v.)

Frond in densely matted tufts, rising from fibres? two to three inches high, as thick as hog's bristle, rigid, mostly hollow in the centre, very irregularly branched. Some specimens are pretty regularly pinnate, or sub-bi-pinnate, the pinnae mostly opposite; others (and these are more common) are set with numerous, lateral, secund branches, which occasionally bear a second series of secund branchlets; and some fronds have both kinds of branching in different parts. All the branches are patent, of unequal lengths. *Colour* a dark reddish brown, turning green in fresh water, or in decay. A cross-section shows a single row of oblong, coloured, peripheric cells, within which are several rows of irregularly polygonal partially coloured cells, gradually of larger size towards the centre of the axis, where there is an irregular cavity (or deficiency of cells) of greater or less diameter. *Substance* rigid. No fructification seen; but some of the tips of the branches are slightly expanded, as if designed to contain tetraspores. In drying it scarcely adheres to paper.

I am very doubtful of the generic relation of this plant, but can think of no more convenient place to put it, the fruit being unknown, than in this genus.

ORDER XI. CRYPTONEMIACEÆ.

Cryptonemecæ and *Gigartineæ*, with part of *Dumontieæ*, *J. Ag. Sp. Gen. and Ord. Algarum*, pp. 165, 229, 346. *Cryptonemecæ* (excl. gen.) *J. Ag. Alg. Medit.* p. 66. *Endl. 3d. Suppl.* p. 36. *Harv. Man. Ed. 2*, p. 131, &c.

DIAGNOSIS. Purplish or rose-red sea-weeds, with an inarticulate (cartilaginous, horny, coriaceous, or gelatinous, rarely membranaceous) frond, composed wholly or in great part of articulated confervoid filaments, compacted together by gelatine; the membranous species sometimes composed of polygonal cells gradually smaller toward the surface. *Nucleus* either sunk in the frond or lodged in an external

conceptacle, simple, or formed of several associated nucleoli. *Spores* congregated without order in the fertile cells or nucleoli.

NATURAL CHARACTER. *Root* seldom more than a mere disc, rarely accompanied by creeping fibres, or forming a prostrate mat from which numerous stems arise. *Fronde* extremely various in size and in outward form, sometimes scarcely an inch in height, sometimes (in the *Iridææ*) two or more feet in length and breadth. Sometimes it is filiform, and then frequently dichotomous, more rarely pinnately parted; sometimes a stipes, soon compressed above the base, gradually widens upwards into an expanded, simple or dichotomous lamina, which is occasionally obsoletely midribbed below. Some laminae are in such cases proliferous, new frondlets springing either from the surface or apices of the old. Sometimes the frond forms a cylindrical, or moniliformly-constricted, undivided or branching tube, the hollow either filled with air or with loose watery gelatine through which a few filaments are dispersed; and sometimes it is completely bag-like, much inflated, ovate or sub-globose.

The *substance* of the frond is as various as the form. It is frequently cartilaginous, gelatino-cartilaginous, or fleshy, sometimes quite gelatinous; rarely coriaceous, and still more rarely membranaceous; in this last case the membrane has much the substance of parchment. It is usually opaque, sometimes semi-transparent, never exhibiting proper articulations to the eye; but when dissected and thin slices are examined under the microscope, the whole substance of a large majority of the plants of this Order, or a greater or less portion of the frond in the remaining species, is seen to be composed of innumerable, slender, confervoid *filaments*, lying in a transparent gelatine, and variously combined together. These filaments are sometimes cylindrical with long articulations, sometimes moniliform, like strings of roundish or oblong beads, and both forms often occur in the same frond. Cylindrical filaments are more commonly found in the middle or medullary portion, and are then always longitudinal in direction, running parallel with the longitudinal axis of the stem or branch. Moniliform filaments are very common in the periphery or external stratum, where they lie at right angles with the longitudinal axis, or vertical to the surface of the frond. Sometimes these radiating peripheric filaments issue directly, as lateral branches, from the longitudinal ones of the axis; sometimes a net-work of anastomosing filaments, or a stratum composed of large, roundish cells, imperfectly ordinated in rows, intervenes: and in a few cases, (as in *Callophyllis*) the medullary region is composed of large, roundish cells, each cell encompassed by a net-work of very delicate filaments. Such genera conduct us to others in which the frond becomes less and less perfectly composed of filaments; roundish and polygonal cells being more and more introduced into its construction. Thus, in the tribe *Tylocarpeæ*, the whole central portion of the frond is made up of polygonal or honey-combed cells, the periphery alone exhibiting a filamentous character, and even this often in a very imperfect

degree. These latter genera lead us at once in structure to the RHODYMENIACEÆ, from which they can be known only by the structure of the nucleus.

The *sporiferous nucleus* is very frequently sunk in the frond, beneath the filaments of the periphery; where it either lies suspended among those of the inner stratum, or it is encompassed by a dense plexus of filaments, forming a sort of immersed conceptacle, not unlike the *cocoon* of a chrysalis. In a few cases (as in *Chrysymenia*, *Chylocladia*, *Gigartina*, etc.) it is lodged in an external globose or hemispherical *conceptacle*, with or without a terminal pore; and in *Stenogramma* many compound nuclei lie within a linear, rib-like conceptacle, running through the middle of the leaf.

The Order naturally divides itself into two sub-orders, distinguished from each other by the greater or less complication of the nucleus. These have been recently elevated by Prof. Agardh into the rank of Orders, but as it appears to me rather unnecessarily; the difference in nucleatic structure being one of degree only, and the plants of both sub-orders having a most intimate relationship in structure and habit. In our first sub-order (GIGARTINEÆ) the *nucleus* originates in *several* congregated, fertile cells, filled at first with dense granular matter or *endochrome*. These, as the fruit matures, enlarge, while the matter contained in each divides into numerous spores; and each original cell is thus converted into a *nucleolus* of spores, retained within the expanded cell-wall; which then forms (till it disappears) a membranous *periderm* to the nucleolus. The whole *nucleus*, or aggregation of these *nucleoli*, appears at first divided by pellucid lines, marking the boundaries of the mother-cells; but all traces of these generally disappear before the spores are emitted, and at this advanced stage it is not always easy to recognise the proper structure. In our second sub-order (CRYPTONEMEÆ) the *nucleus* originates in a *single* cell, which undergoes similar changes to those just described as occurring in the numerous mother-cells of the first sub-order.

The *tetraspores* are either dispersed among the cellules of the periphery, or collected into definite, superficial, or immersed sori; and in a few cases are formed in external wart-like bodies of irregular shape, called *nemathecia*. They are sometimes zonate, but more commonly cruciate.

This is one of the largest Orders of Rhodospirms, and is dispersed through all latitudes from the Arctic regions to the Equator. Thirty-five genera are described by Agardh, twenty-three of which we already claim for the North American Flora; and probably when our coasts have been more fully examined, several others may be added.

Among the useful plants of the Order is *Chondrus crispus* or Carrageen, so well known as an ingredient in blanc-manges and jellies; and many others, particularly of the genera *Iridæa* and *Gigartina*, numerous large species of which are common on the Pacific coasts, have similar properties.

SYNOPSIS OF THE NORTH AMERICAN GENERA.

SUB-ORDER 1. GIGARTINEÆ. *Nucleus* compound ; consisting of several congregated *nucleoli*, or roundish masses of spores.

TRIBE 1. TYLOCARPEÆ : *Fronde* rigid, compact ; its inner stratum composed of roundish, polygonal cells ; its outer of closely packed, vertical, minute filaments. *Tetraspores* contained in external, raised sori or warts.

* *Fronde* leaf-like, flat. *Conceptacles* external.

I. STENOGRAMMA. *Fronde* dichotomous, membranaceous, rose-red. *Conceptacles* linear, rib-like, medial on the lobes of the frond.

II. PHYLLOPHORA. *Fronde* stipitate, flabelliform, cleft. *Conceptacles* roundish, scattered.

** *Fronde* linear, compressed or filiform. *Conceptacles* immersed.

III. GYMNOGONGRUS. *Fronde* sub-terete, compressed or flattish, sub-cartilaginous.

IV. AHNFELTIA. *Fronde* terete, horny.

TRIBE 2. KALLYMENIÆ : *Fronde* membranaceous or coriaceous, its inner stratum composed either of longitudinal filaments, or of polygonal cells surrounded by a net-work of filaments ; its outer stratum of roundish or polygonal cells, smaller towards the circumference, the cortical cellules disposed in minute vertical filaments.

* *Fronde* cylindrical, alternately decomposed.

V. CYSTOCLONIUM.

** *Fronde* flat, its inner stratum composed of large, roundish cells, surrounded by a net-work of anastomosing filaments.

VI. CALLOPHYLLIS. *Fronde* dichotomous, bright red.

*** *Fronde* flat, its inner stratum composed of longitudinal, interlaced filaments.

VII. KALLYMENIA. *Fronde* sub-sessile, expanded, indefinite in form.

VIII. CONSTANTINEA. *Fron*d caulescent, branched ; the branches expanding into carnosu-coriaceous definite laminæ.

TRIBE 3. EU-GIGARTINEÆ : *Fron*d cartilaginous, wholly composed of innumerable, slender, anastomosing, longitudinal and horizontal filaments, set in a firm, pellucid gelatine. *Tetraspores* collected in sori.

* *Nucleus* lodged within a pseudo-pericarp, composed of densely interwoven filaments.

IX. GIGARTINA. *Fron*d terete or flat, mostly branched. *Conceptacles* external, globose.

X. IRIDÆA. *Fron*d flat, simple or vaguely cleft. *Nuclei* immersed in the frond.

** *Nucleus* immersed in the frond, without definite border.

XI. CHONDRUS. *Fron*d dichotomous, flabelliform.

TRIBE 4. ENDOCLADIEÆ : *Fron*d cartilaginous, terete, sub-tubular, formed of a solitary, longitudinal, articulated, axial filament, from which short, horizontal, fastigate filaments issue on all sides, and are united by firm gelatine into a continuous peripheric stratum.

XII. ENDOCLADIA. Peripheric filaments whorled.

XIII. GLOIOPELTIS. Peripheric filaments alternate.

SUB-ORDER 2. CRYPTONEMEÆ. *Nucleus* simple ; consisting of a single roundish mass of spores.

TRIBE 5. GASTROCARPEÆ : *Fron*d membranaceous or sub-gelatinous ; its inner stratum (sometimes obsolete in the tubular fronds) composed of elongated filaments variously anastomosing ; its outer stratum of one or more rows of roundish-polygonal cells, smaller towards the surface, and coalescing into a membranous cortical layer.

* *Fron*d rigidly membranaceous, flat and leaf-like.

XIV. CRYPTONEMIA.

** *Fron*d either filiform or flat, very lax within, or sometimes tubular and inflated.

† *Conceptacles* external with a definite pericarp.

XV. CHYLOCLADIA. *Conceptacles* external, sessile, conico-acuminate, containing a mass of spores surrounded by a gelatinous limbus. *Fron*d tubular, linear.

XVI. CHRYSYMENIA. *Conceptacles* half immersed in the frond, obtuse or acute, containing a very dense, depressed-spherical mass of minute spores attached to a basal placenta. *Fron*d compressed or inflated, hollow or subsolid.

†† *Sporiferous nuclei immersed in the frond.*

XVII. HALYMENIA. *Fron*d flat or compressed, dichotomous or pinnate.

††† *Nuclei unknown (station in the Order doubtful.)*

XVIII. HALOSACCION. *Fron*d membranaceous, tubular or inflated; the walls of the tube composed on the inside of roundish polygonal cells; toward the surface of minute, oblong, vertically seriated cellules.

TRIBE 6. NEMASTOMEÆ: *Fron*d cartilaginous, coriaceous or gelatinous, wholly composed of filaments; the inner stratum longitudinal, interlaced, the outer vertical to the surface and dichotomo-fastigate.

* *Nuclei lodged in terminal, pod-like branches.*

XIX. FURCELLARIA. *Fron*d terete, dichotomous, fastigate.

** *Nuclei lodged in terminal, wart-like excrescences.*

XX. ACROTYLUS. *Fron*d terete, simple or forked, cartilaginous.

*** *Nuclei dispersed through the unaltered frond.*

† *Fron*d compressed or flat, solid, and of very compact substance.

XXI. PRIONITIS. A stratum of roundish cells interposed between the medullary and peripheric strata, which are composed of filaments.

XXII. GRATELOUPIA. Destitute of intermediate stratum; medullary stratum of densely interwoven filaments; periphery of vertical, moniliform, closely packed filaments.

†† *Fron*d tubular, membranous or gelatinous.

XXIII. CATENELLA. *Fron*d membranous, moniliform; constricted at regular intervals as if jointed. *Nuclei* in minute, contracted ramuli.

XXIV. GLOIOSIPHONIA. *Fron*d gelatinous, filiform.

I. STENOGRAMMA. *Harv.*

Frond rose-red, membranaceous, flat, dichotomous and proliferous from the margin, composed of two strata; the inner of several rows of roundish-polygonal empty cells, the outer of minute coloured cellules. *Conceptacles* (resembling a midrib) linear, traversing the medial portion of the fertile lobes; containing, within a thick pericarp composed of radiating cellules, numerous dense clusters of roundish spores, massed together without order; the clusters affixed to all sides of the pericarp. *Nemathecia* superficial, wart-like, scattered, formed of vertical, moniliform filaments, whose articulations are at maturity changed into strings of cruciate tetraspores.

The rare and singular Alga which at present constitutes this very distinct genus was first found at Cadiz in Old Spain by M. Cabrera, and described by the elder Agardh in 1823, under the name *Delesseria interrupta*; the linear conceptacles which are seen on the lobes of fertile specimens having been regarded by the great Swedish Algologist as an interrupted midrib. About ten years subsequently, a solitary specimen, larger and less delicately membranous than the Spanish plant, was brought from California by Capt. Beechey, and described by me in the Botany of Beechey's Voyage as *Stenogramma Californica*. I did not at that time suspect that it had any connexion with the *Del. interrupta* of Agardh, which I only knew by the short description given in the Sp. Alg. vol. 1, p. 179. Some years passed without more being added to the history of this plant. At length, in 1839, Dr. Montagne published a figure in Webb's *Otia Hispanica* of the *Delesseria interrupta*, continuing the Agardhian name. Afterwards, in 1846, the same author found in Bory's Herbarium a specimen, said to have been gathered on the coast of France, agreeing in character with my *S. Californica*; and then for the first time perceived the relationship which the *Del. interrupta*, Ag. bore to it. He accordingly removed the latter plant to the genus *Stenogramma*, calling it *S. interrupta*. Late in the autumn of the same year, 1846,* Dr. John Cocks discovered *S. interrupta* in Plymouth Sound, on the south coast of England, and afterwards dredged it several times in 5—6 fathoms water, the specimens being attached to small stones. All the specimens hitherto seen either produced the linear *conceptacles*, or were barren. The *tetrasporic* fruit was communicated to me in 1848 by Miss Gifford, who discovered it on the Somersetshire coast; but was first described by Dr. Montagne in 1851 (*An. Nat. Hist. ser. 2, vol. 7, p. 481.*) from specimens collected in the Tagus, near Lisbon, by Dr. Welwitsch. In the summer of 1851, I received from New Zealand numerous specimens with both kinds of fruit; and in the autumn had the pleasure to hail it as a native of Ireland, Mr. Isaac Carroll having dredged specimens with conceptacles and tetraspores in Cork Harbour. I have now had the advantage of examining and comparing together specimens from all the above localities, and the result is a conviction that all belong to one species; though the frond is

* Misprinted 1847 in Phyc. Brit. t. 157.

liable to some small variety in substance and ramification. The New Zealand specimens are much the largest that I have seen ; but the lobes in the original Californian fragment being still broader, it is probable that the specimens hereafter to be brought from the latter country will surpass any now in our collections.

1. *STENOGRAMMA interrupta*, Mont. *Harv. Phyc. Brit. t.* 157. *J. Ag. Sp. Alg.* 2, p. 391. *Kütz. Sp. Alg. p.* 873. *Delesseria interrupta*, *Ag. Sp. Alg.* 2, p. 179. *Mont. in Webb. Ot. Hisp. t.* 8. *Stenogramma Californica*, *Harv. in Bot. Beechey, p.* 408. (TAB. XIX. C.)

HAB. San Francisco, California, *Dr. Sinclair*. A fragment picked up at Key West, Florida, *W. H. H.* (41.) (v. v.)

Root discoid. *Fronde* stipitate, the stipes compressed upwards and passing into the cuneate base of a flabelliform, dichotomously cleft lamina, 4—8 or 10 inches in length, and as much in expansion. *Lacinix* linear, obtuse, repeatedly forked ; sometimes irregularly dichotomous, sometimes palmately or alternately cleft, and often furnished at the edges with proliferous, oblong or forked leaflets. Barren fronds, as well as those destined to produce *nemathecia*, are quite nerveless. In fertile or conceptacle-bearing fronds, a slender pseudo-nerve runs through the centre of each fertile lobe, commencing just below one of the furcations, and terminating nearly opposite to a lower fork. In this pseudo-nerve the conceptacle is formed, a less or greater portion becoming thickened, dark coloured, hollow within, and developing from its medullary cells very numerous *nucleoli*, which are densely aggregated together into a linear, sausage-like nucleus. The *tetraspores* are evolved from the radiating filaments of blotch-like, dark red *nemathecia*, scattered irregularly on both surfaces of the frond, and originating in a transformation of the cells of the cortical layer. The substance of the frond is membranaceous, rather rigid below, flaccid, and often delicately thin above. The *colour* is a fine clear pinky red. In drying, it scarcely adheres to paper.

Our figure is taken from the original Californian specimen, now preserved in Sir William J. Hooker's Herbarium, and represents the base of the frond and one of the two principal segments into which it divides. This specimen is more rigid in substance and darker in colour than ordinary European specimens, but an extensive suite from New Zealand connect it with the smallest and most delicate varieties. My specimen from Key West is fragmentary and barren, but very like some of the smaller European grown fronds.

Plate XIX. C. *STENOGRAMMA interrupta* ; the *natural* size. *Fig. 2*, the apex of a fertile lobe ; *3*, section through the same (the *nucleus* not correctly analyzed) ; *fig. 4*, spores ; the latter figures *magnified*.

II. PHYLLOPHORA. *Grev.*

Fronde stipitate ; the stipes expanding upwards into a rigid-membranaceous, flat, simple or cloven lamina, proliferous from the disc or margin, nerveless or faintly nerved at base, formed of two strata of cells ; the medullary portion of oblong, polygonal, empty cells ; the cortical of minute, coloured, vertically seriated cellules. *Conceptacles* sessile or pedicellate, globose or rugged, closed, containing within a thick pericarp, a *nucleus* composed of several coalescing *nucleoli* or masses of minute spores. *Nemathecias* external, wart-like, scattered, formed of vertical, moniliform filaments, whose articulations are at maturity changed into strings of cruciate tetraspores.

The plants of this genus are generally found attached to rocks, near low water mark, or at a greater depth on exposed coasts. Their root is an expanded disc, from which numerous fronds rise in tufts. The young frond commences by pushing up a filiform stipe, which becomes compressed upwards and passes gradually into the cuneate base of a simple, bifid or dichotomous, somewhat flabelliform lamina. From the margin or disc of this primary frond others similar to it in form but with less developed stipites spring proliferously, and thus the plant continues to grow by successive epiphyllous branches. In some species a faint evanescent midrib may be traced from the apex of the stipes into the lower part of the frond. All are of a rigid substance, scarcely at all adhering to paper in drying. Some are of a fine blood-red colour, others livid purplish. The *nemathecias* or warts containing *tetraspores* afford beautiful microscopic objects.

1. PHYLLOPHORA *Brodiaxi*, J. Ag. ; stipe cylindrical at base, compressed upwards, branched, the branches expanding into oblong or wedge-shaped, simple or forked, flat, membranaceous laminae, which are frequently proliferous from the summit ; conceptacles globose, sessile on the laminae ; nemathecias spherical, pedunculate, at the tips of the laminae. *J. Ag. Sp. Alg.* 2, p. 330. *Harv. Phyc. Brit. t. XX.* *Coccotylus Brodiaxi*, Kütz. *Sp. Alg.* p. 791. *Fucus Brodiaxi*, *Turn. Hist. t. 72.* *E. Bot. t. 1966.*

HAB. Dredged in 4—10 fathom water. Halifax, *W. H. H.* Maine, *Mr. Hooper.* Boston Bay, *Mrs. Asa Gray.* (v. v.)

Stem filiform, as thick as sparrow's quill, 3—4 inches long, compressed upwards, irregularly branched, each branch ending in a cuneate, simple or forked, flat lamina, very variable in breadth and in the amount of division, and very generally proliferous either from the margin or the disc. A large suite of specimens now before me exhibit many curious forms ; in some, the laminae are from two to four lines wide, cuneate, obtusely bifid or once or twice forked, with a few apical cuneate

frondlets ; in others, the laminae are repeatedly forked, and these strongly resemble *Rhodymenia Palmetta*. In others, a narrow, cuneate, twice or thrice-forked lamina has its ultimate laciniae suddenly widened into cuneato-reniform lobes from one to two inches wide, and either simple, bifid, trifid, or more commonly truncate and eroded at the summit ; these lobes are so much wider than the laciniae which bear them, that the latter appear like mere stipites in comparison. *Colour* a deep, clear, and full lake red, becoming darker in drying. *Substance* rigid.

I dredged numerous varieties of this plant at Halifax, some of them perfectly resembling the common European form ; others altogether peculiar ; and others approaching so nearly to the Antarctic *Ph. cuneifolia*, Hook. and Harv. (from the Falkland Islands) as to render the specific validity of that plant doubtful.

2. *PHYLLOPHORA membranifolia*, J. Ag. ; stem cylindrical, filiform, branched ; the branches expanding into broadly wedge-shaped, bifid or dichotomous laminae ; conceptacles ovoid, stipitate, rising from the branches or laminae ; nemathecia forming broad, dark-coloured, convex patches in the centre of the laminae. *J. Ag. Sp. Alg.* 2, p. 334. *Harv. Phyc. Brit. t.* 163. *Phyllotylus membranifolius*, Kütz. *Sp. Alg.* p. 790. *Fucus membranifolius*, Turn. *Hist. t.* 74. *E. Bot. t.* 1965.

HAB. Boston Bay (in fruit), *Mrs. Asa Gray, W. H. H.* Newport, Rhode Island, *Prof. Bailey and Mr. S. T. Olney.* New York, *Messrs. Hooper and Calverley.* Long-branch, New Jersey, *Miss Morris.* (v. v.)

Stem filiform, three to four inches long, as thick as sparrow's quill, irregularly divided ; branches ending in fan-shaped, repeatedly forked, flat laminae, one to two inches long. *Laciniae* cuneiform, widely spreading, with very wide, rounded axils, two to four lines broad, obtuse. *Conceptacles* as large as rape-seed, stipitate, scattered on the branches or laminae. *Colour* a dull brownish-purple or livid. *Substance* rigidly membranaceous.

III. GYMNOGONGRUS. *Mart.*

Fronde carnosu-coriaceous, terete, compressed, or flat, linear, dichotomous, composed of two strata of cells ; the medullary stratum of roundish-angular, empty cells ; the cortical of moniliform, vertical, closely packed, short filaments, formed of minute, coloured cellules. *Conceptacular-nucleus* immersed in the frond, more or less prominent, consisting of several associated *nucleoli* or masses of minute spores. *Nemathecia* external, hemispherical, wart-like, formed of radiating, moniliform filaments, whose articulations are at maturity changed into strings of cruciate tetraspores.

Readily distinguished from the last genus by the narrow, generally sub-terete frond, never expanding into membranous leaves, and by the immersed conceptacular fruit. In external habit the *Gymnogongri* much more nearly resemble species of *Chondrus*, in which genus several were formerly included, but they differ from the true *Chondri* essentially in the structure of their medullary stratum. Nearly twenty species are already known, natives of various parts of the world.

1. *GYMNOGONGRUS Torreyi*, J. Ag. ; "frond compressed, flattish, dichotomous, fastigiate ; the segments linear, very narrow ; the axils rounded." *J. Ag. Sp. Alg.* 2, p. 319. *Sphærococcus Torreyi*, *Ag. Sp.* 2, p. 254.

HAB. New York, *Prof. Torrey* in Herb. Agardh.

"*Fronde*s a span long, regularly dichotomous, nearly terete below ; segments linear, very narrow, scarcely a line broad, gradually attenuated toward the obtuse apices. *Axils* rounded ; all the segments ascending and forked at the summit. *Substance* coriaceo-corneous, rigid. *Colour*, in the dry state, brownish." *Ag.*

I have not seen an authentic specimen of this plant, but have received from *Mr. Hooper* a small fragment, which may possibly belong to it. It was found at Fort Hamilton, and is about an inch high, and half a line in diameter, compressed, flabelliform, fastigiate, dichotomous, the segments divaricating, obtuse, or sub-truncate, sometimes emarginate. *Colour* a very dark red-brown. *Substance* cartilagineo-coriaceous. *Structure* as in the genus. This specimen resembles *G. Griffithsia*, but is broader and more compressed, and the medullary cells are rather different. It is well worth the attention of the Brooklyn Algologists to endeavour to clear up the history of this little-known species.

2. *GYMNOGONGRUS tenuis*, J. Ag. ; "fronds tufted, flat, membranaceous, dichotomous, sub-fastigiate ; segments linear, the upper ones narrower ; conceptacles scattered, hemispherically prominent towards one surface of the lamina, flat towards the opposite surface." *J. Ag. Sp. Alg.* 2, p. 319.

HAB. On the shores of the Mexican Republic, *Liebman*, (v. s. in Herb. T. C. D.)

Densely tufted, about an inch and half high, dichotomously-decompound, the upper segments narrow or multifid. *Axils* sub-acute. *Colour* purplish. *Substance* membranaceous, thin.

Nearly related to *G. Norvegicus* but thinner in substance, of a purplish colour, and with more prominent conceptacles. I am indebted to Senator Binder of Hamburg for an authentic specimen.

3. *GYMNOGONGRUS Norvegicus*, J. Ag. ; frond linear, dichotomous, flat, fastigiate ;

the axils patent, rounded ; apices obtuse ; conceptacles imbedded in the upper segments, numerous, slightly prominent toward both surfaces ; nemathecia sessile, hemispherical, densely scattered over both surfaces of the frond. *J. Ag. Sp. Alg.* 2, p. 320. *Chondrus Norvegicus*, Lamour.—*Harv. Phyc. Brit.* t. 187. *Oncotylus Norvegicus*, Kütz. *Sp. Alg.* p. 789. *Fucus Norvegicus*, Turn. *Hist.* t. 41. *E. Bot.* t. 1080. *Chondrus dubius*, Mont. *Fl. Alg.* p. 117.

HAB. Penobscot Bay, Maine, Mr. J. Hooper. (v. v.)

The only American specimen of this species which I have yet seen is two inches long, about a line in diameter, and irregularly dichotomous ; about four or five times forked, the segments linear, divaricating, and the axils remarkably rounded. It bears two or three young nemathecia ; and the cellular structure is exactly as in the European plant. Notwithstanding the northern locality from which it comes, Mr. Hooper's specimen much more nearly resembles the narrow Algerian variety called *Chondrus dubius* by Montagne, than any specimen I possess from the English or Irish coasts.

4. *GYMNOGONGRUS linearis*, J. Ag. ; frond stipitate, slightly channelled or flattish, dichotomous, fastigiate ; segments linear, somewhat thickened at the margin, very entire, the terminal ones obtuse, rounded, and dilated ; nemathecia sub-globose, plentiful on the upper laciniaë, and almost always protruded on the concave surface of the lobe. *J. Ag. Sp. Alg.* 2, p. 325. *Chondrus linearis*, Grev.—Kütz. *Sp. Alg.* p. 738. *Fucus linearis*, Turn. *Hist.* t. 220.

HAB. At Port Trinidad, Pacific Coast, Lat. 41° 12' N., A. Menzies, Esq. (v. s. in Herb. Menzies).

Frond four to six inches high, stipitate. *Stipes* sub-cylindrical, and as thick as a crow's quill at the base, very soon compressed, then flattened, somewhat channelled, one to two lines in diameter, two to three inches long, forked at the summit, after which the flabelliform frond is repeatedly dichotomous. *Laciniaë* linear, slightly channelled, the terminal ones broader and cuneate, very obtuse or subemarginate ; or else bifid, each apex truncate. *Nemathecia* very convex, as large as rapeseed. *Colour* a dark red-brown, more rufous in the tips. *Substance* cartilaginous. It does not adhere to paper in drying.

In aspect this species is not unlike *Chondrus crispus*, but is widely different in structure.

IV. AHN FELTIA. J. Ag.

Frond cartilagineo-corneous, subterete, dichotomous or secundly proliferous, composed of two strata or cells ; the medullary stratum of very slender, densely packed

elongated cells, longest towards the centre, shorter toward the margin ; the cortical of moniliform, vertical, closely packed, short filaments formed of minute coloured cellules. *Conceptacular nucleus* immersed in the frond, sub-prominent, consisting of several associated *nuclei* or masses of minute spores. *Nemathecia* (?) external, surrounding the branches, wart-like, formed of radiating, very densely packed, slender filaments.

Nearly related apparently to the last genus, with which I have formerly felt disposed to unite it. It differs, however, in the much greater density of cellular structure and more rigid substance of the frond. The typical species, *A. plicata*, is widely dispersed, being common on both shores of the Atlantic, in the Pacific Ocean, and extending into high southern latitudes. The other species are local, and comparatively little known.

1. *AHNFELTIA plicata*, Fries ; frond horny, terete, filiform, very irregularly branched, entangled ; branches di-trichotomous, with lateral proliferous often secund ramuli ; axils rounded, apices curving upwards, the terminal shoots elongate. *J. Ag. Sp. Alg.* 2, p. 311. *Gymnogongrus plicatus*, Kütz. *Sp. Alg.* p. 789. *Harv. Phyc. Brit.* t. 288. *Fucus plicatus*, Turn. *Hist.* tab. 180. *E. Bot.* tab. 1089. *β. fastigiata* ; frond more regularly dichotomous, the apices of equal length, *Gymnogongrus fastigiatus* Post. and Rupr. ! *Alg. Russ.* p. 16.

HAB. Boston Bay, Mr. G. B. Emerson, Dr. Asa Gray, &c. Rhode Island, Prof. Bailey. New York, Mr. Calverley. *β.* Unalashka, Wosnessensky ! Halifax, W. H. H. Boston Bay, Mr. Emerson. (v. v.)

Fronde densely tufted, often forming intricate bundles some inches in diameter and 9 or 10 inches long. *Stems* filiform, twice as thick as hog's bristle, very irregularly branched, more or less dichotomous, especially below ; the lesser divisions often lengthened and beset with lateral alternate or secund, erecto-patent branchlets. In var. *β.* the tufts are often perfectly level-topped as if clipped with a shears ; the fronds regularly dichotomous with distant lower forks and approximate upper ones. *Colour* a blackish purple. *Substance* very rigid and wiry. It does not adhere to paper in drying.

I have been favoured by Dr. Ruprecht with an original specimen of his *Gymnogongrus fastigiatus*, but can by no means distinguish it from a fastigiate variety of *A. plicata* which accompanies the ordinary form in Boston and Halifax Harbours.

2. *AHNFELTIA gigartinoides*. *J. Ag.* ; "frond carnosio-corneous, terete, dichotomous and secundly decompound-proliferous ; the proliferous ramuli very patent, obtuse ; the segments erect from the rather acute axils, the terminal ones elongate." *J. Ag. Sp. Alg.* 2, p. 311. *Gymnogongrus gigartinoides*, Kütz. *Sp. Alg.* p. 789.

HAB. On the Pacific Coast of the Mexican Republic, *Liebman* ! (v. s. in Herb. T. C. D.)

Closely related to the preceding species, but more robust (half a line in diameter), and softer when moistened, soon decomposing if kept in fresh water.

3. *AHNFELTIA* ? *pinnulata* ; frond rigid, terete, irregularly branched ; branches few, elongate, subsimple, compressed above, and more or less closely pinnulated with setaceous, short ramuli.

HAB. At Key West, rare, *W. H. H.* (42.) (v. v.)

*Fron*d twice as thick as a hog's bristle, 4—5 inches long, terete below, sub-compressed above, very irregularly branched, and chiefly from the lower part. Branches long, arched or straight, sub-simple, either quite naked or set at distances of a line or two apart with setaceous, horizontally patent ramuli. These are two to four lines long, alternate or opposite, sometimes fasciculate or imperfectly whorled, but mostly distichous, as thick as a hog's bristle, distant or crowded. *Colour* a dull, blackish purple. *Substance* rigid and wiry, as in *A. plicata*. The structure of the medullary stratum is very compact and dense, and nearly as in *A. plicata* ; but the cortical stratum is very narrow, composed of very minute cells, in few rows.

I found but two specimens of this plant at Key West. It seems to me to be a well-marked species, and related to the plants of this genus, if not a genuine congener ; a fact which cannot be ascertained without more complete data.

V. CYSTOCLONIUM. *Kütz.*

*Fron*d carnosomembranaceous, terete, decomposedly branched, composed of three strata of cells ; medullary stratum cord-like, formed of elongated, longitudinal, interwoven confervoid filaments, anastomosing and dichotomous, their branches arching outwards among the large rounded cells of the intermediate stratum ; cells of the cortical stratum small, roundish-angular. *Conceptacles* half immersed in the branches, containing within a thick closed pericarp (formed from the cortical layer) a compound *nucleus*, consisting of several nucleoli or masses of minute spores, separated by sterile filaments. *Tetraspores* dispersed through the cortical layer of the branches, zonate.

This genus, as originally proposed and admirably illustrated by Kützing, in his *Phycologia Generalis* (p. 404, t. 58, fig. I.) is readily distinguished from all neigh-

bouring genera by the structure of the frond detailed above. In external habit the typical species more resembles the *Gracilaria*, among which it was placed by Dr. Greville; or the *Hypnea* (among which, in the *Phycologia Britannica*, I most unnaturally intruded it) than any of the genera with which the structure of its sporiferous nucleus associates it. In the structure of the frond, as well as in habit, there is a near approach also to *Rhabdonia*, and to *Solieria*; from both which genera, as well as from *Gracilaria* and *Hypnea*, the structure of the nucleus widely separates it. This latter character, obviously the first in value as indicating natural affinities, brings it into the present Order. *Cystoclonium purpurascens*, our only species, is common throughout the Northern Atlantic, extending on the European side from the glacial ocean to the southern coasts of France.

1. *CYSTOCLONIUM purpurascens*, Kütz.; frond terete, sub-pinnately decompose, much branched; branches alternate, elongate, set with alternately decompose ramuli which taper to each end; conceptacles lodged in the ramuli, one or more forming nodose swellings in each ramulus. *J. Ag. Sp. Alg.* 2, p. 307. *Kütz. Sp. Alg.* p. 756. *Hypnea purpurascens*, *Harv. Phyc. Brit.* t. 116. *Fucus purpurascens*, *Turn. Hist.* t. 9. *E. Bot.* t. 1243. β . *cirrhusa*; the branches drawn out into long, twisted tendrils.

HAB. On littoral fuci, &c. Common from Halifax to New York Harbour. Squan, New Jersey, *Miss E. Morris*. β . Rye Beach, New Hampshire, *Miss Frothingham*. (v. v.)

Fronde six to twelve inches long or more, as thick as a crow's quill below, attenuated upwards, excessively branched and bushy, alternately decompose; main branches lateral, elongate, spreading, set with two or more series of smaller branches, the last bearing irregularly scattered subulate ramuli: branches and ramuli acute, tapering to the base. *Conceptacles* imbedded in the ramuli, one, two, or more in each, forming a chain of nodes, the conceptacle being much wider than the place where it is lodged. *Colour* a dark brownish purple or brown, sometimes pale. *Substance* between cartilaginous and membranaceous, shrinking in drying. The frond imperfectly adheres to paper.

β . is a singular form in which the ramuli are converted into spirally twisted tendrils, which coil round neighbouring plants.

VI. CALLOPHYLLIS. *Kütz.*

Frond carnosomembranaceous, blood-red or rosy, flat, dichotomous or sub-pinnate, formed of two strata of cells; the medullary stratum of large roundish cells,

smaller toward the surface, each cell surrounded by a net-work of anastomosing cellules; cortical stratum formed of vertical, moniliform filaments. *Conceptacles* immersed in the disc or margin, sub-prominent, roundish, containing within a closed pericarp (formed from the cortical layer) a compound nucleus consisting of several nucleoli or masses of minute spores, separated by a net-work of slender fibres. *Tetraspores* immersed in the frond, scattered, cruciate.

A genus of splendidly-coloured Algæ, chiefly natives of the southern hemisphere. Fronds blood-red, or scarlet-lake, flat, nerveless, dichotomous or somewhat palmate, the laciniae broader upwards, lobed at the extremity, and frequently fimbriate along the margin. The internal structure of the frond is very peculiar. The medullary portion consists of two or more, sometimes of many, rows of large, empty cells separated by narrow interspaces, through which a delicate net-work of cobwebby filaments permeates. The cortical layer is formed of more or less evolved moniliform, vertical, coloured filaments, set in firm transparent gelatine. Formerly these plants were included in *Rhodymenia*, of which genus they have externally the habit, but from which they abundantly differ in the structure of the frond and of the sporiferous-nucleus.

1. *CALLOPHYLLIS laciniata*, Kütz.; frond sub-cartilaginous, bright red, palmate or flabelliform, cleft into numerous, broad, wedge-shaped segments which are again divided dichotomously; apices obtuse; the margin of fertile specimens curled and fringed with minute ciliary processes, in which the conceptacles are lodged. *J. Ag. Sp. Alg.* 2, p. 299. *Kütz. Sp. Alg.* p. 744. *Rhodymenia laciniata*, *Grev.—Harv. Phyc. Brit.* t. 121. *Fucus laciniatus*, *Turn. Hist.* 69. *E. Bot.* t. 1068.

HAB. Pacific coast, *Mr. Menzies* ! 1788. California, *Beechey*. Atlantic coast, at Cape Henlopen, *Miss Morris*. (v. v.)

Apparently very rare on the American coast. I have as yet only seen a solitary, small, but unmistakable specimen from the Atlantic side of the Continent; and it is difficult to conceive that so conspicuous a plant should be overlooked by collectors were it not extremely rare.

VII. KALLYMENIA. *J. Ag.*

Frond carnosomembranaceous, flat, irregularly cleft or divided into indefinitely-circumscribed lobes, composed of three strata of cells; the medullary stratum of densely interwoven, branching and anastomosing articulated filaments; the inter-

mediate of large, roundish-polygonal, seriated cells; the cortical of minute, roundish, vertically seriated cellules. *Conceptacles* immersed in the frond, prominent to both surfaces, roundish, containing within a sub-definite pericarp (formed from the cortical layer) a compound nucleus consisting of several nucleoli or masses of minute spores. *Tetraspores* formed from the superficial cellules, scattered, cruciate.

*Fronde*s intensely and generally brilliantly coloured, blood-red or crimson lake, rarely purplish or brownish, of a thickish, membranous, or somewhat cartilaginous substance, soft to the touch, flat, either quite sessile or somewhat stipitate, irregular in form and in division. In the young state the lamina is generally quite simple, roundish, oblong, obovate or reniform; but in age, either from a natural tendency to split, or from the action of the waves, it becomes much divided; sometimes reduced to narrow ribbons; and sometimes, by new proliferous growths from the injured margin, fringed with small lobes or frondlets. Several species have been described, but owing to the great irregularity of form, they are difficult to characterise, and botanists are not agreed as to their exact limits. I have now to add one to the number, which, though founded on very imperfect specimens, I am unwilling to omit from the present Essay.

1. KALLYMENIA *Pennyi*.

HAB. Dredged on a shingly bottom, in 15—20 fathoms water, in Assistance Bay, Arctic coast, *Dr. Sutherland*, (v. s. in Herb. T. C. D.)

Fragments of leaves three to five inches long, and three to four inches broad, but too much injured to enable me to determine the proper outline, are all that I have yet seen of this supposed new species. They resemble *K. reniformis*; but when thin slices of both are placed together on the table of the microscope, the membrane of *K. Pennyi* is seen to be only half the thickness of that of *K. reniformis*, with the medullary net-work more lax, and the cortical cellules larger. The structure seems essentially the same. The colour of the dried specimens is a dark, full-red, somewhat brownish.

At the request of my friend Prof. Dickie of Belfast, I name this interesting plant in honour of the intrepid commander of the Arctic Searching Expedition, *Capt. Penny*, "by whose energy and determination Dr. Sutherland was enabled to reach the locality where it was found." *Dickie in litt.*

VIII. CONSTANTINEA. *Post. and Rupr.*

Fronde caulescent, branched ; branches sub-terete, expanding into carnosocoriceous, flat, definite laminae, composed of three strata of cells ; the medullary stratum of sparingly anastomosing, interwoven, articulated filaments ; the intermediate of rounded cells ; the cortical of very minute, coloured cellules. *Conceptacular nucleus* immersed in the substance of the leaves, consisting of numerous nucleoli, each surrounded with a gelatinous limbus, and containing a mass of minute spores. *Tetraspores* lodged in external warts (*nemathecias*), oblong, zonate.

Nearly related to the preceding genus in artificial character, but differing in the position of the tetraspores, and very dissimilar in external form. Instead of vaguely shaped, stemless fronds, we have here a regularly branching frond, furnished, from its earliest age, with a distinct stem. At first the stem is simple, bearing at its summit a peltate or reniform lamina : by a renewed growth the stem pushes onward through the base of the first leaf (which thus becomes perfoliate or amplexicaul to the new stem) and forms a new leaf at its summit ; and so the frond lengthens, new leaf-bearing internodes continually rising through the bases of the older leaves. After a while they spring in pairs from each leaf-base, and thus the branching becomes normally dichotomous ; but as one internode of the fork is often abortive, old specimens are frequently irregularly decomposed.

Three species of this curious genus are known ; two of them confined to high latitudes in the Pacific Ocean ; the third to very deep water in the Mediterranean Sea, having been dredged by Prof. Edwd. Forbes in 50 fathoms.

1. *CONSTANTINEA Sitchensis*, Post. and Rupr. ; "stem terete, branched, annulated ; internodes separating the rings four times as long as their diameter ; branches expanded at the summit into an orbicular, peltate, entire lamina." *Post. and Rupr. Illustr. p. 18, t. 40, f. 88. J. Ag. Sp. Alg. 2, p. 295. Neurocaulon Sitchense, Kütz. Sp. Alg. p. 744.*

HAB. Isle of Sitcha, Russian America.

I have seen no specimens of this rare and singular Alga.

IX. GIGARTINA. *Lamour.* (J. Ag. ref.)

Fronde carnososo-cartilaginous, flat or cylindrical, simple or variously branched, composed of two strata of cells; the medullary stratum of cylindrical, articulated filaments, anastomosing into a very lax net-work; the cortical of moniliform, vertical, dichotomous filaments set in firm gelatine. *Conceptacles* external, globose, finally perforate, containing within a saccate *placenta* (?) formed of closely interwoven filaments, a compound *nucleus* consisting of many confluent *nucleoli* or masses of roundish-angular spores. *Tetraspores* collected into dense, sub-prominent sori, lodged beneath the superficial cells, roundish, cruciate.

Fronde very variable in external habit, sometimes filiform, and either pinnated or dichotomously multifid: sometimes compressed or channelled on one side, sometimes completely flat. The flat species are often expanded into broad, leaf-like, simple or proliferously ramose fronds. The substance in all is thick, between fleshy and cartilaginous, elastic and generally tough when recent; firm, crisp, and somewhat horny when dry. The structure in all is very similar, the inner stratum of the frond consisting of a very lax network of filaments traversing a pellucid gelatine; the outer of vertical, dichotomous, moniliform filaments issuing from the outer meshes of the internal network. (See Plate XXVII. C. *fig.* 3.)

This genus, as reconstructed by Prof. J. G. Agardh, is very closely related on the one hand to *Iridæa* and on the other to *Chondrus*. From the former it is only to be known by having its *nuclei* lodged in external conceptacles, instead of being wholly immersed in the frond; from the latter by the same character, and by having the nucleus protected by a closely woven cocoon-like plexus of filaments. Some of the species have the external habit of *Chondrus*, in which genus they were formerly placed, and others as strongly resemble species of *Iridæa*.

SECT. I. EU-GIGARTINA. *Fronde* linear, compressed or subterete, pinnately compound. *Conceptacles* sessile, marginal on the pinnules.

1. GIGARTINA *canaliculata*, Harv.; frond linear, concave on one surface, convex on the other, naked below, forked or irregularly branched beyond the middle; branches distichously pinnate or bi-pinnate; pinnæ patent; pinnules short, spine-like, divaricating; conceptacles formed in abbreviated, spiniferous pinnæ. *Harv. in Beechey Voy.* p. 490. *J. Ag. Sp. Alg.* 2, p. 272. *Chondroclonium canaliculatum*, *Kütz. Sp. Alg.* p. 741. (TAB. XXVII. C.)

HAB. Shores of California, *Douglas, Coulter, Capt. Pike* (26, 30.) (v. s. in Herb. T. C. D.)

Root accompanied by creeping, branched fibres which throw up numerous, erect stems. *Fronde*s densely tufted, two to four inches high, from half a line to a line in breadth, nearly flat, but the margins incurved towards one side, making a channel in the middle of the disc; the *stem* naked for an inch or more above the base, then forked, the segments either simple or again forking, naked below, closely pinnated or bi-pinnate in the upper half. *Pinnæ* distichous, opposite or irregularly placed, from a quarter to half an inch or more long, very patent, simple or set with divaricating, spine-like pinnules. The pinnules in some specimens are mere thorn-like ramuli, but in others are multifid, either irregularly so, or somewhat dichotomous, all the ultimate divisions being remarkably squarrose. *Apices* acute. *Conceptacles* imbedded in the substance of the pinnæ or pinnules, one or more in each, very frequently armed with minute awl-shaped spines, colour very dark blackish purple. *Substance* cartilaginous. It does not adhere to paper in drying unless previously softened by long steeping in fresh water.

A well marked species, probably not uncommon on the Pacific coast.

Plate XXVII. C. *Fig. 1.* GIGARTINA *canaliculata*; the natural size. *Fig. 2,* portion of a frond with conceptacles; somewhat *magnified.* *Fig. 3,* longitudinal slice of a branch, showing the internal structure; highly *magnified.*

2. GIGARTINA *mollis*, Bail. and Harv.; frond cartilaginous, plano-compressed, linear, distichous, pinnately branched; branches alternate or opposite, erect, tapering at the base, naked below, pinnated above; ultimate ramuli narrow, sub-filiform. *B. and H. in Bot. Expl. Exped.*

HAB. Pacific Coast at Puget's Sound, *Capt. Wilkes.* (v. s. in Herb. Expl. Ex.)

Fronde three to four inches high, from one to two lines in breadth, distichously branched, once, twice, or thrice pinnated, the pinnæ (and pinnules) all very erect, naked below, closely set with pinnules above, narrowed to the base and apex, sometimes forked and then each division pinnated. *Colour* purple. *Substance* cartilaginous, soon decomposing if moistened after having once been dried, and then closely adhering to paper in drying.

Of this I have only seen the few specimens collected in Capt. Wilkes' Expedition. So far as these enable me to speak, the species appears different from any previously described.

SECT. 2. MASTOCARPUS, Kütz. *Fronde* thick, dichotomous or sub-pinnate, the segments flat, widening upwards, cuneate or oblong, sometimes very broad. *Conceptacles* formed in papilliform processes issuing from both surfaces of the expanded frond.

3. GIGARTINA *mamillosa*, J. Ag.; frond flattish, channelled, linear, decomposed-dichotomous, fastigiate; upper segments wedge-shaped, bifid; papillæ issuing from the disc and margin, tongue-shaped, each containing a single roundish conceptacle.

J. Ag. Sp. Alg. 2, p. 273. *Harv. Phyc. t.* 199. *Mastocarpus mamillosus*, *Kütz. Sp. Alg.* p. 733.

HAB. Newfoundland, *Agardh*. Penobscot Bay, *Dr. Aaron Young*! Newburyport, Massachusetts, *Capt. Pike*! Unalashka, *Lutke*! California, *Dr. Coulter*! (v. v.)

Fronde three to six inches high, either regularly or very irregularly dichotomous. flattish, channelled on one side, convex on the other, the segments more or less broadly wedge-shaped, simple or forked, the primary ones in the old specimens throwing out, in a proliferous manner from their surface, numerous similar wedge-shaped, channelled simple or forked secondary segments. *Margin* of the frond incurved, either quite entire and simple, or fringed with small lobes. The surface of all the segments, primary and secondary, especially on the concave side, is very frequently densely set with lobules, or filiform or mamilliform processes of various lengths, some mere tubercles, others linear-wedge-shaped frondlets from a quarter to half an inch long. In these the roundish or ovate *conceptacles* are lodged. *Colour* a very dark purple. *Substance* rigid, somewhat horny when dry. It does not adhere to paper.

The specimens from Unalashka are broader and shorter than those from California. I have not seen any from Newfoundland.

4. GIGARTINA *microphylla*, *Harv.*; frond foliaceous, flat, lanceolate, mostly simple (occasionally bifid or trifid), attenuated to the base into a long, slender, linear-cuneate stipe; both surfaces very densely echinate with minute spindle-shaped soriferous papillæ, and the margin fringed with similar processes. *Rhodymenia?* *microphylla*, *Harv. in Beech. Voy.* p. 164. *Mastocarpus Harveyanus*, *Kütz. Sp. Alg.* p. 734. (TAB. XXVIII. A.)

HAB. Monterey, California, *Douglas*! *Coulter*! (v. s. in Herb. T. C. D.)

Root expanded, fleshy, composed of many confluent discs. *Fronde*s tufted; the stipes at first cylindrical, as thick as a sparrow's quill, soon flattened, gradually widening upwards for two or three inches; then either forked or trifid, or simply passing into the base of a linear-lanceolate leaf-like lamina, twelve or fourteen inches long or more, an inch or an inch and half wide, and gradually fining off to an acute point. Both surfaces of the lamina are densely clothed with minute, subulate or spindle-shaped processes; and the margin is also closely fringed with similar ones, which are sometimes lengthened out into marginal lobes from half an inch to an inch in length, and fringed and muricated like the primary leaf. In fertile specimens the papillæ are incrassated. *Sori* one or more in each papilla, immersed, globose, consisting of moniliform strings of cruciate tetraspores. I have not seen conceptacles. *Substance* cartilaginous, thinner than in *G. Radula*. *Colour* a deep, brownish red.

Plate XXVIII. A. *Fig. 1.* GIGARTINA *microphylla*; the natural size. *Fig. 2,* small portion of the lamina, with four fertile, soriferous papillæ; *magnified.* *Fig. 3,* section of a papilla, through a sorus, and 4, a tetraspore; both highly *magnified.*

5. GIGARTINA *spinosa*, Kütz.; frond somewhat channelled below, thick, cuneate at the base, linear-lanceolate, simple or once or twice forked (the segments sometimes sub-pinnate); the margin fringed, and the surface densely muricated with mamilliform or filiform, simple or multifid, acute processes, in which the conceptacles are immersed. *Mastocarpus spinosus*, Kütz. in *Bot. Zeit.* 1847, p. 21. *Iridæa stiriata*, Harv. in *Beech. Voy.* p. 409. (*Excl. Syn.*) *Gigartina ornithorhynchos*, J. Ag. 1849. *Sp. Alg.* 2, p. 274. (TAB. XXVIII. B.)

HAB. California, Douglas; Coulter. (v. s. in Herb. T. C. D.)

Root discoid. *Fronde* densely tufted, six to eight inches long, flat or somewhat channelled below, rising with a short cylindrical stem, as thick as a crow's quill, which soon becomes flattened, and gradually widens into the base of the linear-lanceolate lamina. *Lamina* either simple, tapering to both ends, or more frequently once or twice forked, or irregularly 3—4 cleft vertically, the segments in the dichotomous varieties cuneate, those of the others more lanceolate and longer. In some specimens the margin is pinnated with lanceolate or linear wing-like lobes an inch or more in length. Both surfaces are bristled with spine-like, obtuse or acute, simple or compound papillæ in which the conceptacles are borne. *Conceptacles* as large as rape-seed, globose, immersed in the middle or towards the end of the papillæ, the subulate apex of which often extends beyond the conceptacle like the bill of a bird. *Colour* a dark red brown or dull purple. *Substance* coriaceous-cartilaginous, thick and coarse. In drying it shrinks considerably, and does not adhere to paper.

I formerly confounded this species with *G. stiriata*, to which some of the specimens bear a near resemblance, but our plant is less thick and much less gelatinous, and appears to be sufficiently characterised.

Plate XXVIII. B. *Fig. 1.* GIGARTINA *spinosa*; the natural size. *Fig. 2,* a compound papilla, bearing several conceptacles; *magnified.* *Fig. 3,* segment of a thin section of a conceptacle, shewing a portion of the external wall and of the compound nucleus; *fig. 4,* spores from the same; both highly *magnified.*

6. GIGARTINA *exasperata*, Bail. and Harv.; frond stipitate; stipes expanding into a coriaceous-membranaceous, broadly lanceolate, entire frond, incrassated at the margin, eroso-dentate and with marginal lobules, both surfaces densely muricated with simple or branched spinous processes in which the conceptacles are lodged. *Bail. and Harv. in Bot. Expl. Exped.*

HAB. Fort Nesqually, Puget's Sound, Captain Wilkes. (v. s. in Herb. Expl. Exp.)

Frond two to three feet long, six to ten inches wide, rising with a short stem which soon dilates into a simple, lanceolate lamina, jagged and irregularly dentate at the margin, and rough all over both surfaces, with short simple or forked spines. *Substance* thin, but coriaceous when dry. *Colour* a fine purple. *Conceptacles* formed towards the base of the lamina, in the marginal or discal spines.

Nearly allied to *G. Radula*, but much thinner in substance.

7. GIGARTINA *Radula*, J. Ag. ; frond stipitate ; stipes somewhat channelled, simple or branched ; the branches expanding into thick, fleshy, flat, oblong, ovate, elliptical or obovate entire laminæ, which are either naked or densely muricated with papilliform processes, in which the conceptacles are imbedded. *J. Ag. Sp. Alg.* 2, p. 278. *G. papillata*, Harv. in *Beechey* (not of Ag.) *Mastocarpus corymbiferus*, Kütz. *Sp. Alg.* p. 734. *Fucus bracteatus*, Turn. *Hist. t.* 25.

HAB. North West Coast, *Menzies*. California, *Douglas* ; *Coulter*, *Capt. Pike*, (v. v.)

Fronde (in the Californian specimens) six or twelve inches long or more, three to four inches wide, cuneate or slightly channelled at the base, obovate, obtuse or subacute, sometimes ovato-lanceolate, thick, carnosu-coriaceous, the upper half more or less densely echinate on both surfaces, with mamilliform, acute or obtuse, simple or multifid processes. *Colour* a dark brownish red. A very variable species, common in the Southern hemisphere and on the Pacific coasts. The Californian specimens which I formerly referred to *G. papillata*, Ag. are pretty constantly obovate and quite simple, obtuse, tapering much to the base ; but some are lanceolate, and one is very irregular in shape. At the Cape of Good Hope, where this species is profusely common, many forms occur together ; some having perfectly simple fronds ; others dividing near the base into many segments, or secondary fronds, each of which is stipitate, ovate, obovate or lanceolate. In others each segment is deeply bifid, and in others the frond is somewhat palmate. Specimens bearing tetraspores are quite smooth, destitute of papillæ.

On a careful comparison of the Californian specimens on which Kützing's *Mastocarpus corymbiferus* is founded, with numerous specimens of *G. Radula* collected at the Cape, I do not see how they are to be distinguished : and this opinion is formed from an examination of a much fuller suite of specimens than Kützing, to whom I communicated those which he describes, had before him.

X. IRIDÆA. *Bory*.

Frond gelatinoso-carnose, flat, subsimple, composed of two strata of cells ; the medullary stratum of cylindrical, articulated filaments, anastomosing into a very lax

net-work ; the cortical of moniliform, vertical, dichotomous filaments, set in a firm gelatine. *Sporiferous nucleus* immersed in the substance of the frond, roundish, enclosed in a saccate placenta (?) formed of closely interwoven filaments, consisting of many confluent *nucleoli* or masses of minute spores. *Tetraspores* collected into dense sori lodged beneath the superficial cells, roundish, cruciate.

Technically this genus can only be distinguished from *Gigartina* by having its *nuclei* immersed in the inner substance of the frond, and not contained in external tubercles or conceptacles. The structure of the frond is similar in both genera, but the *Iridææ* have generally simpler, less regularly cleft, and more widely expanded laminae, of a brighter colour and more glossy surface. Their substance is soft, between fleshy and membranous when fresh, somewhat cartilaginous when dry, soon dissolving into gelatine if again moistened after having been once dried. Many species have been described, but I fear often on insufficient data, and I regret that the materials at my command are insufficient to enable me to say, whether all or how many of the following species ought to be retained.

1. *IRIDÆA minor*, J. Ag.; "frond ovate oblong, sub-simple, smooth, abruptly attenuated into an evident, flattish stipes." *J. Ag. Sp. Alg.* 2, p. 252.

HAB. California, *Douglas*.

"Fronds gregarious, 2—3 inches high, an inch broad, rising with an elongated flattish stipes nearly an inch long, then abruptly cuneately expanded into an ovate or oblong, entire lamina, which is either smooth or verrucated with sub-prominent conceptacles ; rounded and very obtuse at the apex. *Colour* livid, brownish. *Substance* gelatinous, cartilaginous when dry." *J. Ag.*

2. *IRIDÆA laminarioides*, Bory ; frond stipitate, linear-obovate or sub-lanceolate, simple or cloven into numerous narrow obovate or lanceolate lacinia; nuclei densely scattered, sub-prominent. *J. Ag. Sp. Alg.* 2, p. 253. *Kütz. Sp. Alg.* p. 726.

HAB. Russian America, *Postels and Ruprecht*. California, *Douglas ! Coulter !* (v. s. in Herb. T. C. D.)

Stipes one to two inches long, cylindrical at the base, soon cuneate and compressed, gradually widening to half an inch, and then suddenly expanding into the base of a narrow, obovate or oblong, linear frond, one to two feet long, obtuse, or more or less acute or acuminate at the apex. Sometimes the frond divides a little above the apex of the stipes into numerous frondlets ; but this chiefly takes place in spe-

cimens which have grown again after having been injured. Barren specimens are perfectly smooth ; nucleiferous ones are densely verrucose with the very abundant, closely set, depressed, hemispheroidal *nuclei*. Specimens containing *tetraspores* are smooth, but closely dotted over the surface with minute, deep coloured sori. *Colour* a dull brown red, sometimes purplish, fading into greenish. *Substance* rather thick, coriaceous, not very glossy.

My specimens from Douglas (can they be Agardh's *J. minor* ?) are smaller than some of those from Dr. Coulter, but appear to be specifically the same.

3. *IRIDÆA cordata*, J. Ag. ; "frond cordate-ovate, sub-acuminate, smooth, abruptly passing into a very short channelled stipes." *J. Ag. Sp. Alg.* 2, p. 254. *Fucus cordatus*, *Turn. Hist. t.* 116.

HAB. Banks Island, on the N. W. Coast, *Menzies*.

Fronde said to be about a foot long and six inches wide, oblong-cordate, sub-acute, flattish or undulate at the margin.

4. *IRIDÆA punicea*, Post. and Rupr. ; "lamina membranaceous, orbicular in outline, fixed by the margin or lower surface, plaited, here and there perforated, entire or eroso-dentate, of a deep crimson-lake colour." *Post. and Rupr. Illustr. p.* 18.

HAB. Isle of Sitcha, *Postels and Ruprecht*.

5. *IRIDÆA pinnata*, *Post. and Rupr.* ; "lamina membranaceous, thickened, linear, regularly bi-tripinnate, purple ; pinnæ and pinnules linear, divaricate, narrowed at the base, very entire or ciliato-pinnate at the margin." *Post. and Rupr. Illustr. p.* 18.

HAB. Norfolk Bay, N. W. Coast, *Postels and Ruprecht*.

Said to resemble *Calliblepharis jubata* in habit, but to have the structure of *Iridæa*. May it not rather be a species of *Gigartina*, possibly our *G. mollis*?

XI. CHONDRUS. *Stack.*

Fronde carnosu-cartilaginous, flat, dichotomous, fastigiata, composed of two strata of cells ; the medullary stratum of cylindrical, articulated filaments anastomosing

into a dense network ; the cortical of moniliform, vertical filaments, set in firm gelatine. *Sporiferous nuclei* immersed in the substance of the frond, somewhat prominent toward one surface, roundish, consisting of many confluent *nucleoli* or masses of minute spores. *Tetraspores* collected into dense sori lodged beneath the superficial cells, roundish, cruciate.

A small genus better distinguished from *Iridæa* by its external habit and firmly cartilaginous substance than by any structural character. Its type in the well-known *Chondrus crispus* or Carrageen (Irish moss), a common littoral plant on both sides of the Atlantic.

1. *CHONDRUS crispus*, Lyngb. ; frond stipitate, flabelliform, dichotomous, fastigiate, flat, the segments linear-cuneate ; nuclei oval, prominent to one surface of the frond, depressed to the other. *J. Ag. Sp. Alg.* 2, p. 246. *Harv. Phyc. Brit. t.* 63. *Kütz. Sp. Alg.* p. 735. *Fucus crispus*, Linn.—*Turn. Hist. t.* 216, 217. *E. Bot. t.* 2285.

HAB. Rocks between tide marks, common on the Atlantic Coast from the shores of British America to those of Long Island. (v. v.)

Frond three to six inches high or more, stipitate, the stipes 1—2 inches long, narrow cuneate, gradually widening to the first fork. *Lamina* flabelliform, fastigiate, many times regularly dichotomous, with patent, rounded axils ; apices either obtuse or acute. In some specimens the width of the laciniaë is only a line or two, and they are nearly of equal breadth throughout ; in others the laciniaë are half an inch to an inch or more in breadth, decidedly wedge-shaped, flat or very much curled. The substance is between horny and cartilaginous, rigid when dry. *Colour* varying from a dull livid purple to greenish and yellowish. Sori of *tetraspores* (like little drops of blood) scattered over the segments.

2. *CHONDRUS affinis*, Harv. ; frond stipitate, flabelliform, dichotomous, slightly concave or channelled on one side, convex on the other ; segments linear-wedge form ; nuclei abundant, scattered through the segments, prominent to both surfaces. *Harv. in Beech. Voy.* p. 408. *J. Ag. Sp. Alg.* 2, p. 247. *Kütz. Sp. Alg.* p. 737.

HAB. California, *Douglas ; Coulter.* (v. s. in Herb. T. C. D.)

Densely tufted, two to four inches high. *Fronde*s rising with a linear, wedge-form stipes, one to two inches long, and somewhat channelled, then forking, and afterwards repeatedly dichotomous, with patent, linear, or wedge-form, slightly chan-

nelled segments and rounded axils; the upper divisions not always regularly dichotomous, but sometimes winged with lateral, secondary segments. Margin of the frond a little thickened and inflexed. *Nuclei* as large as poppy-seed, thickly scattered over the segments, spheroidal, most prominent to the channelled surface of the frond, slightly convex to the convex surface. The plexus of filaments composing the medullary stratum is very lax; the filaments of the cortical layer are minute, moniliform, and densely set. *Colour* a dark, brownish purple. *Substance* cartilaginous. It scarcely adheres to paper.

This plant closely resembles *C. crispus* in external character, but is of a much softer substance and laxer structure, soon decomposing in fresh water.

XII. ENDOCLADIA. *J. Ag.*

Fronde terete, cartilaginous, much branched, muricated with minute spines; the *axis* consisting of a single, articulated, monosiphonous filament, coated with minute cells, from which issue whorls of horizontal, radiating, dichotomous, fastigate, moniliform filaments, whose apices, united by a firm gelatine, form the exterior coat or *periphery* of the frond. *Conceptacles* hemispherical, sessile on the ramuli, containing, within a closed pericarp, numerous laxly aggregated *nucleoli* of angular spores. *Tetraspores* (according to Kützing) exerted, seriated, aggregated in amorphous nemathecium bursting from the tumid upper branches.

A curious and distinct genus, consisting of two species, one of them a native of the Southern Atlantic, the other of the North Pacific Ocean. The frond has externally the habit of a small *Gigartina*, but a cross section of the stem, as shown in our *Plate XXVII. B. fig 4*, shows a very different structure.

1. ENDOCLADIA *muricata*, *J. Ag.*; frond densely tufted, irregularly much branched; branches flexuous, variously divided, set in the upper part with numerous, divaricated, awl-shaped ramuli; the whole frond muricated with very minute, conical or bifid spinules. *J. Ag. Sp. Alg. 2, p. 237.* *Gigartina muricata*, *Harv. in Bot. Beechey, p. 409.* *Post. and Rupr. Illust. p. 16.* *Kütz. Sp. Alg. 2, p. 751.* *Acanthocladia muricata* and *A. hamulosa*, *Rupr. !!* (Tab. XXVII. B.)

HAB. Sitcha, *Dr. Mertens!* California, *Beechey!* *Coulter!* *Wosnessensky!* *Capt. Pike!* (v. s. in Herb. T. C. D.)

Fronde densely tufted, an inch or two in height, as thick or twice as thick as hog's bristle, irregularly branched; stems either sub-simple, or once or twice forked, flexuous, having several arching, simple or sub-simple lateral branches, beset, especially toward the ends, with short, crowded, similar branchlets. Both primary and

secondary branches taper to a fine point, and are muriculated on all sides with very minute, broadly subulate or conical, simple or slightly bifid spines. The frond is formed of a simple, jointed axial filament of large diameter, with internodes containing endochrome and about thrice as long as broad, coated externally by a thin stratum of minute cellules, from which radiate to all sides numerous, dichotomous, moniliform, horizontal filaments, whose apices, strongly soldered together, unite to form the periphery. The *substance* is firmly cartilaginous, rigid when dry. *Colour* a very dark-red brown. *Conceptacles* spherical, sessile on the ramuli.

Dr. Ruprecht's *Acanthocladia hamulosa* is in all respects identical with my *Gigartina muricata*, first described in the Botany of Beechey's Voyage. His *A. muricata* is more slender and less regularly muricated than most of my specimens, but I do not consider it specifically different. I have not seen any specimens of Agardh's *E. vernicata*.

Plate XXVII. B. *Fig. 1.* Tuft of *ENDOCLADIA muricata*, the *natural* size. *Fig. 2,* part of a frond with conceptacles; *fig. 3,* apex of one of the muricated branches; *fig. 4,* transverse section of the stem; *fig. 5,* longitudinal section of the same; *fig. 6,* vertical section of a conceptacle; the latter figures more or less highly *magnified*.

XIII. GLOIOPELTIS. J. Ag.

"*Frond* cylindrical, tubular, lubricous, cartilaginous, dichotomous and branched, composed of two strata; a monosiphonous, articulated, flexuous, axial filament runs through the empty tube, and throws off at alternate sides, di-tri-chotomous, corymboso-fastigiate, moniliform, horizontal filaments, which (united by a loose gelatine), form the peripheric stratum. *Conceptacles* hemispherical, containing within a pericarp finally opening by a pore, numerous laxly aggregated *nucleoli* separated by barren filaments running from an axial placenta to the pericarp. *Tetraspores* oblong, cruciate, scattered among the moniliform, peripheric filaments." J. Ag.

Two species, with neither of which am I acquainted, constitute the present genus; one of them (the *Fucus tenax*, *Turn. Hist. t. 125*) a native of the Chinese seas, and used extensively in the arts of China and Japan; the other a minute plant from the Northern Pacific, which I give below as being probably a native of Russian America.

1. *GLOIOPELTIS furcata*, J. Ag.; "dwarf, tufted; fronds rising from a minute crust, erect, filiform, attenuated at both ends, simple or sparingly forked." J. Ag. *Sp. Alg.* 2, p. 235. *Dumontia furcata*, *Post. and Rupr. Illustr. p. 19.* Kütz. *Sp. Alg.* p. 719.

HAB. In the Northern Pacific, *Mertens*.

“*Crust* minute, tuberculose, adhering to stones. From this crust spring the *fronds*, which are half an inch high, rarely an inch, more or less crowded, terete, attenuate at each end, simple or twice or thrice forked, with patent branches. *Colour* purplish. *Substance* cartilaginous.”

XIV. CRYPTONEMIA. *J. Ag.*

Fronde flat, rigidly membranous, sub-caulescent, proliferous or branched, composed of three strata of cells; the medullary of elongated, branched, densely interwoven filaments; the intermediate of roundish cells, towards the surface passing into the minute cells of the cortical layer. *Nuclei* (favellæ) immersed, prominent to one surface, simple, consisting of numerous roundish spores, contained within a hyaline membrane, at length discharged through a superficial pore. *Tetraspores* collected into roundish, wart-like sori, lodged either in special leaflets or beneath the apices of the leaves, oblong, cruciate.

Plants with the rigid substance and the external habit of *Phyllophora*, from which they are well distinguished both by the different structure of the frond and the simplicity of the nucleus. This latter character, combined with the different disposition of the tetraspores and the rigid substance, distinguishes them from *Kallymenia* to which the internal structure of the frond allies them. Six species are described, four of which are peculiar to the southern shores of Europe, and two to the warmer regions of America. One of these last is described below.

1. CRYPTONEMIA *crenulata*, *J. Ag.*; stipes short, soon expanding into a broadly cuneate, bifid or repeatedly forked frond, eroso-denticulate (or rarely sub-entire) at the margin, and proliferous with similarly forked, broadly proliferous frondlets. *J. Ag. Sp. Alg.* 2, p. 225. *Phyllophora crenulata*, *J. Ag. Kütz. Sp. Alg.* p. 791.

HAB. Common at Key West, Florida, *W. H. H.* (v. v.)

*Fronde*s densely tufted, about six inches long, with a short cylindrical stipes as thick as a crow's quill and half an inch long, which rapidly expands into the cuneate base of a membranous, simple or forked lamina. This lamina is one to two inches wide below the first fork; its segments half an inch wide, linear or wedge-shaped, with acute axils, obtuse or truncate apices, and generally an eroso-denticu-

late and minutely curled margin. Sometimes the margin is quite entire and flat. The primary lamina is frequently proliferous from the summit or disc of its lobes with similar secondary fronds; and these in large specimens bear tertiary ones, the whole resulting in a broadly fan-shaped general outline. *Colour* a clear, deep lake-red, changing to greenish-white in fresh water. *Substance* rigidly membranaceous. It does not adhere to paper. The medullary stratum is formed of densely interwoven filaments; outside which are several rows of coloured, polygonal cells, the innermost being large, the rest successively smaller; the superficial ones very minute.

XV. CHYLOCLADIA. *Grev.—J. Ag. ref.*

Frond terete or sub-compressed, (rarely nodoso-articulate,) alternately or pinnately-decompound, tubular; the tube empty, or traversed by a few slender, longitudinal filaments; the periphery formed of several rows of roundish-angular cells, successively smaller to the surface. *Conceptacles* external, conical or apiculate, at length pierced by a pore, containing a *nucleus* enclosed in a hyaline mucous envelope, surrounded by a net-work of anastomosing filaments; the *spores* "originating in the cells of filaments radiating from a placenta, at length" numerous, massed together. *Tetraspores* triangularly parted, dispersed among the superficial cells of the branches.

I adopt this genus as now, by Prof. J. Agardh, restricted to the *Fucus clavellosus*, Turn. Hist. t. 30, and its allies. Among these latter, however, I place the *F. articulatus*, Lightf. notwithstanding its difference of habit, because, as correctly pointed out by Dr. Greville, (Alg. Brit. p. 114) the structure of its conceptacle, both externally and internally, is similar to that of *F. clavellosus*. I have not verified the mode of development of the spores as given in the generic character on Prof. Agardh's authority; the specimens which I have at hand exhibiting only the nucleus as it eventually becomes, namely, a cluster of disorderly spores contained within a mucous integument, closely resembling a "favella."

1. CHYLOCLADIA *Baileyana*; fronds tubular, cylindrical, densely tufted, short, irregularly much branched; branches (mostly arching) divaricated, secund or scattered, their lesser divisions mostly secund, and furnished with a few secund, spindle-shaped ramuli tapering to the base and apex. *C. divaricata*, Harv. MSS. (not of J. Ag.) (TAB. XX. C. Fig. 1.) β *filiformis*; very slender, elongate, with longer and less arching branches. (TAB. XX. C. Fig. 2) γ .? *valida*; frond robust, firm, sometimes with arching, unilateral ramification; sometimes sub-alternately pinnate.

HAB. Dredged in four or five fathom water. Vars. α and β , Peconic Bay, abundantly, *Prof. Bailey and W. H. H.* Narragansett Pier, *Mr. Olney*. Providence, *Prof. Bailey*. Weymouth Pier, Quincey, Massachusetts, *Dr. Durkee*. γ , abundant in Charleston Harbour, S. Carolina, *Prof. Gibbes and W. H. H.* (v. v.)

Tufts globose, two to three inches in diameter, dense and often intricate, sub-fastigate. *Fronds* in vars. α and β as thick as hog's bristle, branched from the base in a very irregular manner, all the divisions standing at considerable angles and much divaricated. In var. α all the branches are strongly arched back, or revolute, destitute of branchlets on the concave side, and this ramification is repeated several times. In β the tendency to secund ramification is nearly as great as in α , but the branches are straighter and more attenuate. In γ , which may possibly be a different species, the frond is as thick as sparrow's quill, of firmer substance, and the ramification partakes sometimes of the character of α , sometimes of β . *Conceptacles* unknown to me. *Tetraspores* immersed in the smaller ramuli. *Colour* a pinky red, becoming darker and somewhat brownish when dried. In drying, it adheres closely to paper.

I formerly distributed this plant under the MS. name *C. divaricata*, a name which must be laid aside if the *Fucus divaricatus*, R. Br. be correctly referred by Prof. Agardh to this genus. Nor am I certain whether the specific name now imposed be more than provisional, as future observation may show our plant to be identical with the *Ch. uncinata* of the Mediterranean, a point which I have not at present the means of determining satisfactorily.

However this may be, our vars. α and β appear to form a well marked species. Perhaps var. γ should be separated; being much more robust, more readily recovering its form after having been dried, and when pinnulated, not unlike some states of *Ch. clavellosa*.

TAB. XX. C. Fig. 1. CHYLOCLADIA *Baileyana*, var. α ; fig. 2, var. β ; both of the natural size. Fig. 3, part of a branch of var. γ , with ramuli, containing tetraspores; *magnified*. Fig. 4, cross section of a branch of var. γ ; and fig. 5, portion of the same, variously *magnified*.

2. CHYLOCLADIA *rosea*, Harv.; fronds sub-stipitate, distichously-pinnate or bi-pinnate; pinnæ and pinnules elliptic oblong, obtuse or sub-acute, much constricted at the base, compressed, opposite. *Harv. in Phyc. Brit. t. 301 and t. 358 A.*

HAB. On small Algæ in tide-pools, rare. Newport, Rhode Island, *Mr. George Hunt and Mr. S. T. Olney*. β . Portsmouth, New Hampshire, *Dr. Durkee*. (v. s. in Herb. T. C. D.)

Fronds densely tufted, one or two inches high, one to two lines broad, compressed, twice or thrice pinnate; the pinnæ distichous, opposite or rarely alternate, or by suppression unilateral, oblong-linear, much constricted at the base, obtuse, the lowest longest, the rest gradually smaller; pinnules elliptical, very obtuse. *Colour*,

a beautiful rosy red or purplish lake. *Substance* delicately membranaceous. It closely adheres to paper in drying.

Dr. Durkee's specimen, noticed above, is irregularly branched, the primary stems filiform and straggling; the secondary either pinnated or furnished at one side only with pinnules. I have seen British specimens similar to this in ramification.

XVI. CHRYSYMENIA, J. Ag. ref.

Fronde subterete, compressed, or flat, tubular or solid, branched; the tube sometimes nearly empty or with a few percurrent longitudinal filaments, sometimes filled with interlaced filaments; peripheric stratum composed internally of large, roundish-angular, inflated cells, externally of minute, coloured, vertically seriated cellules. *Conceptacles* half immersed in the frond, hemispherical or with a prominent orifice, containing a simple *nucleus* (*favella*) fixed to a basal placenta, surrounded by anastomosing filaments, and consisting of very numerous, densely-packed minute spores enclosed within a membrane. *Tetraspores* cruciate, scattered among the superficial cells of the frond.

This genus, as at present constituted, includes plants of very different habit, and in some respects of different structure. In the genuine species (sections *Halichrysis* and *Chrysymenia*, J. Ag.) the frond is dichotomous or pinnated, evidently tubular, but having the tube sometimes compressed, sometimes inflated, nearly empty, or traversed by a very few slender filaments, which are often obsolete in the full-grown plant. In our section *Cryptarachne*, the frond, which is either flat or cylindrical, is more or less densely filled with anastomosing, branched, often closely interwoven filaments, but the external habit of the species is not very dissimilar to that of the former sections. Finally, in the section *Botryocladia*, J. Ag. a much branched, filiform, solid stem bears inflated ramuli, having the proper structure of the genus. The species of this section depart widely in external habit from the rest; and yet they are perhaps nearer in affinity to the typical species than are those of our section *Cryptarachne*.

SECT. 1. CHRYSYMENIA (*Halichrysis* and *Chrysymenia*, J. Ag.); *frond* compressed or inflated, evidently tubular; the tube empty or nearly so.

1. CHRYSYMENIA *Enteromorpha*; *frond* saccate, fusiform, somewhat compressed, delicately membranaceous, proliferously-decompound; secondary fronds and their

tertiaries strongly constricted at the base, tapering to the apex, springing without order from all sides, and from the apex, of the primary frond.

HAB. Key West, Florida, rare, *W. H. H.* (v. v.)

The full-grown, compound frond is eight or ten inches long or more, and nearly as much in the expansion of the branches. It originates in a simple, saccate, oblong frond, one to two inches long and about half an inch in diameter, rising from a short, cartilaginous stipes, one to two lines long. This primary sac throws out very irregularly, from its sides and apex, numerous secondary sacs of equal breadth, but generally of greater length, three to four inches long, strongly constricted at the base, or rather minutely stipitate, linear-oblong or somewhat obovate and obtuse. These sacs of secondary order, in their turn give off tertiary sacs, which are generally a quarter inch in diameter, more fusiform than the secondary ones, tapering to the apex, and bearing other smaller, more tapering, irregularly set, sac-like ramuli. In large specimens these latter bear others, and thus the frond continues to become compound by successive proliferous repetitions of sac-like branches. *Substance* delicately membranaceous, somewhat gelatinous within. The walls are composed of an inner row of large, empty cells, defended externally by two or three rows of minute, polygonal, coloured cellules. *Tetraspores* abundantly scattered through the cells of the outer coating. *Colour*, a delicate, rosy-red. In drying, it closely adheres to paper.

This plant so much resembles some varieties of *Halymenia ligulata*, that I had at first mistaken it for one of the forms of that sportive species, nor was it till a transverse section assured me that it belonged to a different genus, that I discovered my error. On more closely examining the specimens, an external character is readily found in the ramification; the present species, though it eventually becomes excessively compound, being constituted of numerous series of perfectly *simple* frondlets growing one on the other, and never, that I have seen, *forking*, as do the ramenta of *Hal. ligulata*. Under the microscope, the different structure of the two plants is very obvious.

2. *CHRYSYMENIA halymenioides*; frond compressed, broadly linear, cuneate at the base, dichotomous, fastigiate; the axils rounded, and the laciniaë divaricated, very obtuse; conceptacles hemispherical, prominent, scattered. (TAB. XX. A.)

HAB. Thrown up from deep water. Key West, very rare, *W. H. H.*, *Dr. Blodgett.* (v. v.)

Root scutate. *Fronds* one or more from the same base, three to four inches long, a quarter to half an inch wide in the widest part, rising from a slender, filiform base, rapidly widening upwards to the first fork; thence broadly linear and repeatedly and pretty regularly dichotomous. Sometimes from a wounded part a dense

tuft of dichotomous branches spring, making the habit very bushy. The axils are singularly rounded, the laciniae very widely spreading, and the apices remarkably obtuse. The frond is tubular, but strongly compressed and almost flattened. Its walls are thin; the inner stratum composed of polygonal, inflated, empty cells of large size; the outer of very minute, coloured cellules, set in densely packed, vertical filaments. *Conceptacles* plentifully scattered over all the lower laciniae, between hemispherical and conical, prominent. *Tetraspores* dispersed through the superficial cells of distinct plants. *Colour*, a clear, rosy red, becoming brownish in drying. *Substance* soft and lubricous, full of juice. It adheres closely to paper in drying.

This is nearly related to the Mediterranean *C. dichotoma*, J. Ag.; but appears, judging by the description, to differ in some respects. It has much of the external aspect of some varieties of *Halymenia ligulata*, whence our specific name.

Plate XX. A. *Fig. 1.* CHRYSYMENIA *halymenioides*; the natural size. *Fig. 2,* transverse section of a lacinia, cutting through three *conceptacles*; *fig. 3,* portion of the surface, viewed vertically; *fig. 4,* section of the wall of the frond with immersed tetraspores; *fig. 5,* tetraspores; *fig. 6,* section of a *conceptacle*; *fig. 7,* nucleus from the same; *fig. 8,* spores; the latter figures more or less highly *magnified*.

SECT. 2. CRYPTARACHNE; *frond flat, compressed or cylindrical, sub-solid; the medullary stratum composed of interlaced, anastomosing, branching filaments.*

3. CHRYSYMENIA (CRYPTARACHNE) *Agardhii*; frond gelatino-membranaceous, flat, dichotomously cleft, laciniae cuneate at the base, tapering to the extremity, undulate, unequally eroso-dentate at the margin; the marginal processes sometimes lengthening into linear lobules; conceptacles acuminate, scattered over the laciniae. (Tab. XXX. A.)

HAB. Thrown up from deep water, Key West; rare, W. H. H. (v. v.)

Frond six or eight inches long, as much or more in expansion of the laciniae, having a wide, cuneate base, one to two inches long and an inch and half broad, at once dividing into several laciniae, in a somewhat palmate order. These laciniae are simple or forked, or palmatifid, cuneate at the base, about an inch wide at the widest part, tapering to both ends, undulate, with the margin rarely quite entire, more commonly eroso-denticulate. Marginal teeth horizontally patent, very unequal in size, sometimes mere processes a line or two in length, sometimes half an inch long and a line broad. *Conceptacles* scattered over the laciniae, rather prominent, conical, with the orifice very prominent and slightly oblique. The medullary stratum consists of a dense web of branching and anastomosing filaments; the intermediate of several rows of empty cells, of which the inner are very large, the rest successively smaller; the cortical of very minute, coloured, seriated cells, in two or three vertical rows. *Colour*, a pale rose-red, fading and becoming

brownish in drying. *Substance* very gelatinous. In drying, the frond shrinks and adheres very strongly to paper.

The name is bestowed in honour of my friend Prof. J. G. Agardh, to whose opinion (as expressed in a private letter) I yield in retaining this species and its allies for the present in *Chrysymenia*. They differ, as already stated, from the genuine species in having a far more obvious plexus of filaments occupying the centre of the frond.

Plate XXX. A. CHRYSYMENIA ? *Agardhii* ; the *natural* size. *Fig. 2*, a section of the frond, and *fig. 3*, a small portion of the same ; *fig. 4*, section of a conceptacle ; all highly *magnified*.

4. CHRYSYMENIA (CRYPTARACHNE) *ramosissima* ; frond compressed below, terete above, distichously much branched ; branches patent, with rounded axils, tapering to the base and apex, successively narrower and repeatedly compound, the lesser ones margined with a few spines ; ramuli either filiform, or, when fertile, fusiform, acute and irregularly spinulose ; conceptacles depressed, or sunk in the fusiform ramuli, spheroidal. (Tab. XXX. B.)

HAB. Thrown up from deep water ; rare. Key West, *W. H. H.* (v. v.)

Frond eight to twelve inches long and six to eight inches in the expansion of the branches. Main stem sub-simple, rising from a cartilaginous stipe as thick as a crowquill, soon widening to half an inch in breadth, compressed, tapering gradually to the summit, more or less cylindrical above. This principal stem is furnished throughout, at short distances, with lateral, very patent, distichous branches, issuing at very obtuse angles, tapering to the base and apex like the main stem ; of various lengths, short and long intermixed without order ; the larger ones repeatedly compound in a similar manner. In some specimens the secondary and tertiary branches are very closely set, scarcely more than a line or two apart ; in others they are much more distant. The fertile and barren specimens are also very unlike ; the latter are much more branched, the branches narrower and more finely divided, and the ramuli very slender and abundant ; the former (like that in our figure) have most of the ramuli swollen, broadly fusiform, acute, and sub-dentate. *Conceptacles* lodged in the swollen ramuli, depressed. *Colour*, when growing, a fine, clear rosy red, becoming brownish in drying. *Substance* membranaceous, filled with loose gelatine, which is expelled under pressure, and apt to stain the paper on which the specimen is displayed.

Plate XXX. B. CHRYSYMENIA *ramosissima*, lower part of a fertile specimen ; the *natural* size. *Fig. 2*, a ramulus containing conceptacles ; *fig. 3*, vertical section through a conceptacle ; *fig. 4*, longitudinal section of a branch ; *fig. 5*, filaments of the medullary stratum ; *fig. 6*, transverse section of a branch ; the latter figures variously *magnified*.

5. CHRYSYMENIA ? (CRYPTARACHNE ?) *acanthoclada* ; stem somewhat distended, (laxly cellular with a dense fibro-cellular axis) divaricately much branched, irregularly decomposed ; branches distichous, slender, much attenuated, widely spreading, zig-zag, alternately decomposed, aculeate with short, sub-distichous, spine-like, subulate, acute, divaricated ramuli. (TAB. XXV.)

HAB. Thrown up from deep water. Key West, very rare, *W. H. H.* (v. v.)

Root a spreading disc. *Fronde* solitary (?) rising with a stipes half an inch, then branching, either forked, trifurcate or laterally decomposed, the main branches incrassated, two to three lines in diameter, simple or forked, set with numerous lateral branches, which are much more slender, alternately-decomposed, and very much attenuated at the points, sometimes drawn out almost into setaceous cirrhi. All parts of the frond are distichous and divaricate ; the secondary branches strikingly zig-zag or bent alternately from side to side. *Ramuli* thorn-like, one to two lines long, acute, patent. *Colour*, a deep lake-red when fresh, brownish when dry. *Substance* between cartilaginous and gelatinous. It shrinks much and closely adheres to paper in drying. *Fruit* unknown.

The fruit of this remarkable plant being unknown, its genus is still doubtful, but it seems to me to have many points in common with our *Ch. ramosissima*, and I do not think it placed far from its affinities in the present genus. The perfectly distichous branching and gelatinous substance are worthy of attention in determining its relationship.

Plate XXV. CHRYSYMENIA ? *acanthoclada* ; the *natural* size. Fig. 2, transverse section of a branch ; *magnified*.

SECT. 3. BOTRYOCLADIA, J. Ag. ; *stem filiform, solid, branching, beset with inflated, pear-shaped ramuli.*

6. CHRYSYMENIA *waria*, J. Ag. ; frond cylindrical, solid, dichotomous or irregularly much branched ; branches filiform, beset with scattered or imbricated, inflated, obovate ramuli ; conceptacles depressed, hemispheroidal. *J. Ag. Sp. Alg.* 2, p. 214. *Gastroclonium waria*, *Kütz. Sp. Alg.* p. 865. (TAB. XX. B.)

HAB. Thrown up from deep water. Key West, common, *W. H. H.* (26), (v. v.)

Fronde tufted, six to twelve inches long or more, the larger specimens as thick as crow-quills, the smaller as thick as sparrow-quills, cylindrical, solid, firmly cartilaginous, rigid, irregularly much branched, the lower branches sub-dichotomous. Sometimes the upper branches are bushy with a profusion of rod-like or tendril-like lesser branches. The stems and larger branches of old specimens are generally bare, or furnished with a few imperfectly developed ramuli, but all the younger branches, and the whole frond in young specimens, are thickly covered with quadrifarious, obovate, inflated, glossy ramuli. On these ramuli the depressed *conceptacles*

are borne. The *colour* of the stem and branches is dark red; of the ramuli a brilliant lake. *Substance* of the ramuli succulent and tender.

This very beautiful plant is a native also of the Mediterranean Sea and of the shores of Brazil. It strikingly resembles *Lomentaria ovalis* in ramification, but has a different structure and fructification.

Plate XX. B. Fig. 1. *CHRYSYMENIA uvaria*; the *natural size*. Fig. 2, a ramulus with *conceptacles*; fig. 3, section of a conceptacle; both *magnified*.

XVII. HALYMENIA. Ag.

Fronde cylindrical, compressed or flat, gelatinoso-membranaceous or fleshy, dichotomous or pinnated, consisting of a thin, double membrane, separated by a few internal, laxly set, articulated, branching filaments; membrane composed internally of roundish-angular, empty cells, externally of minute, coloured cellules. *Nuclei* (favellæ) immersed in the frond, suspended beneath the membranous wall, simple, containing numerous minute, densely packed spores, enclosed within a hyaline envelope. *Tetraspores* roundish, cruciate, immersed in the surface cellules, dispersed.

Rose-red Algæ of a very delicate, membranaceo-gelatinous substance, cylindrical or flattened, formed of a membranous coating, enclosing a thin watery gelatine, through which a few articulated, branching and anastomosing filaments are dispersed. The branching is most frequently dichotomous, rarely pinnated; often proliferous, new frondlets springing irregularly from the sides of the old, especially from wounded places. In fertile specimens the *favellæ* are generally equally dispersed in great numbers through every part of the plant. Several species from various parts of the world have been described, of which I can as yet claim but two as North American: viz.

1. *HALYMENIA ligulata*, Ag.; frond gelatinoso-membranaceous, compressed or flattish, linear and dichotomous or cuneately expanded and sub-palmate, often proliferous from the disc and margin. *J. Ag. Sp. Alg.* 2, p. 201. *Harv. Phyc. Brit.* t. 112. *Halarachnion ligulatum*, Kütz. *Sp. Alg.* p. 721. *Ulva ligulata*, *E. Bot.* t. 420. *U. rubra*, *E. Bot.* t. 1627.

HAB. Thrown up from deep water. Key West, a single specimen only. *W. H. H.* (v. v.)

The only American specimen of this variable plant that I have yet seen is four

inches long, about five inches in the spread of the laciniaë, flabelliform, sub-fastigate, repeatedly and pretty regularly dichotomous, the larger divisions a third of an inch wide, the upper gradually narrower, and the ultimate ones a line or less in width; apices acute. *Substance*, membranaceo-gelatinous. *Colour*, a fine, clear, pinky red. It closely adheres to paper in drying.

2. HALYMENIA *Floresia*, Ag. ; frond gelatino-membranaceous, flat, stipitate, elongate, pinnately-decompound; pinnæ and pinnules linear, acuminate, acute, patent, entire or serrato-ciliate. *J. Ag. Sp. Alg.* 2, p. 205. *Kütz. Sp. Alg.* p. 716. *Fucus Floresius*, *Turn. Hist. t.* 256.

HAB. Thrown up from deep water. Key West, rare, *W. H. H.* (66), *Dr. Blodgett.* (v. v.)

Root a small disc. *Fronde* solitary or slightly tufted, six to eight inches long, and as much in the expansion of the laciniaë, somewhat ovate in outline, flat, and very thin, decompound-pinnatifid. Sometimes the main frond (or rachis) is two or three inches wide, with the margin cut into very densely crowded, bi-pinnatifid lobes, half an inch wide and two or three inches long; sometimes the frond is much more deeply laciniated, the rachis and principal laciniaë not more than half an inch wide; the laciniaë once, twice, or thrice compounded; the secondary ones one or two lines wide, and margined with subulate, tooth-like processes. *Axils* rounded; *apices* all acute and attenuated. *Colour*, a beautiful rosy-red. *Substance* delicately gelatino-membranaceous. In drying it adheres most closely to paper.

An extremely handsome plant. The Key West specimens, here described, closely agree with the Mediterranean ones in *Herb. T. C. D.* Some are very broad, others narrow.

XVIII. HALOSACCION. *Kütz.*

Frond cylindrical or obovate, simple or proliferously branched, hollow, the walls formed of two strata of cells; the inner stratum of two or more rows of roundish-angular cells, the outer of oblong, vertically-seriated, coloured cellules. *Conceptacles* (unknown). *Tetraspores* cruciate, dispersed among the cortical cells.

Until the conceptacular fruit of this genus shall be discovered, its proper position must be considered doubtful. It is almost entirely constituted of Algæ from the higher latitudes of the Atlantic and Pacific, and includes two distinct groups, each characterised by differences of outward form, and by habitat. The Pacific species

are all obovate, and unbranched ; the Atlantic cylindrical, proliferously-ramulose. The substance is rather rigid, and the colour purplish or brownish red.

SECT. 1. HALOSACCION ; *frond simple, obovate.*

1. HALOSACCION *Hydrophora*, J. Ag. ; frond rigidly membranaceous, obovate-oval, turgid, attenuate at the base into a short stipes. *J. Ag. Sp. Alg.* 2, p. 358. *Dumontia Hydrophora*, Kütz. *Sp. Alg.* p. 749. *Fucus saccatus*, Turn. *Hist.* t. 241 ?

HAB. Nootka Sound, *Mr. Menzies*. Puget's Sound, *Captain Wilkes*. (v. s.)

*Fronde*s tufted, three inches long or more, three quarters of an inch wide, very obtuse, oblong or sub-obovate, quite simple, contracted rather suddenly at the base into a very short stipes. *Substance* thickish, like that of parchment, rigid. *Colour* a dull livid purple, passing into green. In drying it does not adhere to paper.

2. HALOSACCION *fucicola*, Post. and Rupr. ; frond simple, membranaceous, obovate-oblong, gradually attenuated at the base into a stipes. *J. Ag. Sp. Alg.* 2, p. 358. *Dumontia fucicola*, Post. and Rupr. Kütz. *Sp. Alg.* p. 720.

HAB. On *Fucus vesiculosus* at Sitcha, *Lütke*. On *Laurenciae* at Monterey, *Dr. Coulter*. (v. s. in Herb. T. C. D.)

*Fronde*s resembling the last species, but thinner and softer in texture, and brighter in colour, purple.

SECT. 2. HALOCOELIA, J. Ag. ; *frond cylindrical, elongate, beset with similar proliferous ramuli.*

3. HALOSACCION *ramentaceum*, J. Ag. ; frond cylindrical, much attenuated at the base, simple or irregularly branched, more or less densely beset with lateral, scattered or crowded, simple or forked, tubular ramenta. *J. Ag. Sp. Alg.* 2, p. 358. *Dumontia sobolifera*, Kütz. *Sp. Alg.* p. 749. *Fucus ramentaceus*, Linn.—Turn. *Hist.* t. 149. (TAB. XXIX. A.)

HAB. Greenland, *Agardh*. Newfoundland, *Despreaux*. Arctic Coast, *Seeman*. Halifax, *W. H. H.* Rye Beach, New Hampshire, *Miss Frothingham*. (v. v.)

*Fronde*s very densely tufted, ten to fourteen inches long, cylindrical, one to two lines wide at the widest part, much attenuated to the base, and more or less tapering to the apex, sometimes quite simple, sometimes dividing an inch or two above the base into several long simple branches. The frond is rarely naked, usually it is

beset, in its upper half, with quasi-proliferous ramenta, given off without order and often very densely fascicled, one to two inches long, filiform, simple or slightly ramulose, sometimes forked, and very often twisted or otherwise distorted, all tapering to the base, and in a less degree to the apex. *Colour*, a dark lurid purple, paler in the ramenta. *Substance* rigidly membranaceous or sub-coriaceous. In drying under pressure, it imperfectly adheres to paper.

A most variable plant in the number and disposition of its ramenta, but easily recognised after it has once been seen.

Plate XXIX. A. *Fig. 1*, HALOSACCION *ramentaceum*; the *natural* size. *Fig. 2*, transverse section of the frond; *magnified*. *Fig. 3*, a small part of the same, more highly *magnified*.

XIX. FURCELLARIA. *Lamour.*

Frond terete, dichotomous, fastigiate, solid, composed of three strata of cells; the medullary stratum of densely interwoven, longitudinal, elongate filaments; the intermediate of large, roundish cells; the cortical of small cellules strung together in moniliform, vertical filaments. *Fruit* of both kinds contained in the swollen, pod-like apices of the branches. *Nuclei* (*favellæ*) simple, immersed, formed from some of the cells of the intermediate stratum, numerous in each pod, at length often confluent, each containing many large angular spores in a cluster. *Tetra-spores* immersed within the cortical layer, formed in its filaments, large, pear-shaped, transversely zoned.

Very similar in external aspect, and even in the internal structure of the frond, to *Polyides rotundus*, a plant from which it differs so remarkably in fructification, that in a classification founded on differences of fruit, we are compelled to place these genera at opposite ends of our arrangement. The only known species, described below, is common to a wide extent of the Northern Atlantic Ocean.

1. FURCELLARIA *fastigiata*, *Lyngb.*—*J. Ag. Sp. Alg.* 2, p. 196. *Kütz. Sp. Alg.* p. 749. *Harv. Phyc. Brit.* t. 94 and t. 358. *Fucus lumbricalis*, *Turn. Hist.* t. 6. *E. Bot.* t. 846.

HAB. Newfoundland, *Agardh.* (v. v.)

Root, a mat of creeping fibres. *Fronds* 4—8 inches high, nearly a line in diameter, tufted, cylindrical, repeatedly dichotomous, the branches of equal height, the axils and apices acute. When in fruit, the ends of the branches, for an inch or more,

swell into spindle-shaped, pod-like receptacles, which, when mature, drop off, leaving the branches truncated. In these receptacles either *nuclei* or *tetraspores* are lodged; the former sunk among the cells of the intermediate layer, from some of which they are evolved; the latter lying among those of the outer stratum. *Colour* dark red-brown, blackish when dry. *Substance* fleshy, sub-coriaceous when dry.

XX. ACROTYLUS. J. Ag.

Fronde terete or compressed, cartilaginous, simple or dichotomous, consisting of two strata; the medullary stratum of slender, elongate, branching and anastomosing longitudinal filaments; the cortical narrow, of minute, roundish, densely packed, coloured cellules, vertically seriated. *Favellæ* (known only in one species) formed in wart-like swellings round the apices, many together, containing within a hyaline periderm numerous angular spores. *Tetraspores* (known only in one species) formed in definitely circumscribed spot-like sori (*nemathecia*) situated below the apices of the segments, elongate, surrounded by slender filaments, zonate.

A small genus founded by Prof. J. Agardh on an East Indian and an Australian species, to the former of which the plant now to be described is closely related. *A. prismaticus*, J. Ag. is described as being prismatically three-or-four-angled, a character which it certainly possesses when dry; but I am of opinion that in the recent state it is cylindrical, like our *A. clavatus*, which, if dried without pressure, also collapses in a prismatic-angular manner, and equally refuses to recover its shape on being moistened after having being dried.

1. *ACROTYLUS clavatus*; frond, from a filiform stipe, club-shaped, terete, obtuse, simple or forked (the branches being then club-shaped,) proliferous from the apex.

HAB. Thrown up from deep water, Key West, *W. H. H.* (63). (v. v.)

Root a small disc. *Stipes* a quarter to half an inch high, as thick as hog's bristle, filiform, ending in an incrassated collar. *Fronde* springing from the centre of the collar, about two inches long, club-shaped, tapering to the base, incrassated and obtuse at the apex, terete, prismatically shrinking when dried without pressure, and not recovering its form on re-moistening, simple or forked. *Colour*, a very dark purplish-red. *Substance* firmly cartilaginous. *Structure* very dense. *Fruit* unknown.

Of this curious plant I collected a very few specimens at Key West, in February,

after strong South Westerly gales. They are apparently immature, but unquestionably congenerous with *A. prismaticus*, with which they agree in structure and substance. Possibly mature specimens may be more compound.

XXI. PRIONITIS. *J. Ag.*

Fronde compressed or flat, linear, dichotomous or pinnate, proliferous or glandular on the disc or margin, composed of three strata; the medullary stratum very broad, of densely interwoven, slender filaments; the intermediate of roundish cells, smaller towards the surface; the cortical of minute, coloured, vertically seriated cellules. *Nuclei* (*favellæ*) immersed either in the frond or its marginal processes, simple, containing roundish spores within a gelatinous pellicle, at length discharged through a superficial pore. *Tetraspores* oblong, cruciate, dispersed among the cells of the cortical layer.

Rather coarse Algæ, of a thick, coriaceous or rigid substance and very dense texture, linear, nerveless, pinnate or dichotomous, often much branched, frequently margined with minute glands, which afterwards grow out into lobules. Most turn very dark in drying.

The species here brought together have been formerly arranged with *Sphærococcus*, *Gelidium* or *Grateloupia*; and are nearly related to the latter genus, differing chiefly in the more compound structure of the frond. Eight species are enumerated by Agardh, all natives of the Pacific Ocean, three being found to the north, and five to the south of the equator.

1. *PRIONITIS lanceolata*, Harv.; frond plano-compressed, linear, alternately or irregularly branched; branches ligulate, attenuate at the base and apex, naked or pinnate; pinnæ lanceolate, distichous, mostly opposite; tetraspores cruciate, immersed in the pinnules. *Prionitis ligulata*, *J. Ag. Sp. Alg. vol. 2, p. 189.* *Gelidium lanceolatum*, Harv. in *Bot. Beechey*, p. 164. (Tab. XXVII. A.) β *angusta*; much more slender, forked, with few and nearly naked branches.

HAB. Prince William's Sound and Nootka, *Mr. Menzies*, 1787. California, *Douglas!* *Dr. Coulter!* β St. Francisco, *Capt. Pike.* (v. s. in Herb. T. C. D.)

Root discoid. *Fronde*s tufted, twelve or fourteen inches long, one to two lines wide, much compressed or nearly flat, linear, tapering to the base and apex, alternately branched or pinnate. The primary branches are several inches long, quite simple, and either naked or distichously pinnulate. *Pinnules* about half an inch

XXII. GRATELOUPIA. *Ag.*

Fronde compressed or flat, carnosomembranaceous, dichotomous or more frequently pinnate, consisting of two strata of cells; the medullary of articulated filaments densely interwoven and anastomosing, the cortical of short, moniliform, vertical, closely set filaments. *Nuclei* (*favellæ*) immersed beneath the cortical layer of either

surface, simple, containing, within a gelatinous hyaline pellicle, numerous roundish-angular spores, which are at length discharged through a superficial pore. *Tetra-spores* immersed in the cortical layer, scattered, cruciate.

Fronds dark brownish red or purple, sometimes livid, changing to green in decay, strongly compressed or flat, narrow-linear or rarely cuneato-lanceolate, very generally pinnately decomposed, rarely dichotomous; of a compact structure, and soft, membranaceo-gelatinous or carnosocoriaceous substance, very tough when recent, lubricous, and difficult to detach from the rock on which they grow, membranaceous when dry, shrinking much, and generally closely adhering to paper. The *sporiferous nuclei* are sunk in the frond, but slightly prominent, like little pimples, to either surface, often of small size, and often aggregated in considerable numbers. They communicate with the surface by means of a canal which runs from the nucleus through the cortical layer of the frond, its mouth appearing as a superficial pore. The species are natives of the Tropical Ocean and of the warmer regions of the Temperate zone. One (*G. filicina*) is found as far north as the south of England.

1. GRATELOUPIA *Gibbesii*; frond (one to two feet long) flat, cuneate at the base, polymorphous; lanceolate or wedge-shaped, simple, forked, or alternately multifid; the laciniae very long, lanceolate, acute; margin entire or repand, or fringed with linear lobes which sometimes lengthen into pinnæ; conceptacles immersed in the lamina, minute, scattered. (Tab. XXVI.)

HAB. On the breakwater at Sullivan's Island, Charleston, South Carolina, *Prof. Lewis R. Gibbes* and *W. H. H.*, January, 1850. (v. v.)

Fronds densely tufted, six, twelve, twenty inches in length, the laciniae from half an inch to an inch and half wide at the widest part, tapering very much to the base and apex, flat, coriaceous-membranaceous, and rather thin, with the feel of fine kid leather. The ramification is so different in different specimens, that an adequate conception of the species can hardly be obtained without the comparison of many individuals. In some the frond is quite simple, lanceolate or cuneate, the margin flat, naked, or winged with lanceolate lobes on one or both sides. In others the frond divides at an inch or two above the base into ten or twelve laciniae; each several inches long, tapering greatly to both extremities, either perfectly flat and entire or with the margin undulate and repand, now and then furnished with a few secund pinnæ. Other specimens have the laciniae forked or even palmate near the apex; and in others a primary, linear lamina is pinnated throughout with linear-cuneate, simple or forked lobes. In fact, in the same tuft scarcely two specimens are similarly branched. *Colour*, when growing, a very dark, blackish purple; changing more or less completely to a livid green in drying. *Conceptacles*, which

I have only as yet seen in an immature state, densely scattered through the lobes.

This is the largest and most *fucoïd* plant in Charleston Harbour, and one of the noblest species of the genus. In the belief that it is distinct from the *G. Cutleriæ* of Valparaiso, its nearest relation, I give it the name of my friend Prof. Lewis R. Gibbs, as a memento of a delightful day spent in his company on the shores of Sullivan's Island.

Plate XXVI. *Fig. 1.* GRATELOUPIA *Gibbesii*; the natural size. *Fig. 2,* a section of the frond, *magnified.*

2. GRATELOUPIA *versicolor*, J. Ag. ; "frond (purple, changing to blackish green,) flat, thickish, pinnately decomposed ; pinnæ linear, tapering at both ends, dentato-pectinate at the margin, the young teeth acuminate, at length growing out into horizontal, cuneato-linear pinnules." *J. Ag. Sp. Alg. 2, p. 181.*

HAB. At St. Augustin, Pacific coast of Mexico, *Liebman.*

3. GRATELOUPIA *cuneifolia*, J. Ag. ; "frond (blackish green when dry) flat, cuneate or linear, pinnate, here and there dilated and palmate, the margin and disc beset with lesser ciliary processes, segments linear, elongate, rather obtuse." *J. Ag. Sp. Alg. 2, p. 181. Kütz. Sp. Alg. p. 732.*

HAB. La Guayra, Gulf of Mexico, Herb. *Binder.*

4. GRATELOUPIA *prolongata*, J. Ag. ; "frond (violaceous, turning greenish) compressed, nearly flat, undulated, interruptedly pinnate and proliferous from the disc, the apex lengthened out and naked ; pinnæ linear-subulate from a narrower base, long and short intermixed together." *J. Ag. Sp. Alg. 2, p. 181. Kütz. Sp. Alg. p. 730.*

HAB. Pochetti, Pacific coast of Mexican Republic, *Liebman*, (v. s. Herb. T. C. D.)

5. GRATELOUPIA *filicina*, Ag. ; frond plano-compressed, pinnately decomposed and proliferous from the disc, pinnæ narrowed at base, linear, acuminate, the lowest longest, and often pinnulate, the upper sub-simple ; nuclei numerous, immersed in the disc of the pinnæ. *J. Ag. Sp. Alg. 2, p. 180. Kütz. Sp. Alg. p. 730. Harv. Phyc. Brit. t. 100. Fucus filicinus, Turn. Hist. t. 150.*

HAB. Apalachicola, Florida, *Mr. Lounsbury.* (v. s. in Herb. T. C. D.)

I have seen but a single specimen, which appears identical with some of the Mediterranean forms of this variable plant.

XXIII. CATENELLA. *Grev.*

Fronde sub-tubular, constricted at intervals as if jointed, dull purple, membranous; the axile portion composed of a lax net-work of anastomosing, longitudinal filaments, emitting to the periphery dichotomous, moniliform, horizontal branches, whose apices, strongly cohering together, form the membranous wall of the frond. *Nuclei* contained in the axile net-work of minute, ovate or roundish ramuli. *Tetra-spores* also in small ramuli, lying among the dichotomous peripheric filaments, zonate.

Small, densely tufted, littoral Algæ of a dark purple colour. *Fronde*s rising from matted creeping filaments, half an inch to an inch or two in height, vaguely branched, constricted into spurious joints, the branches resembling those of an *Opuntia* in miniature. The internodes are somewhat tubular, laterally compressed, hollow, except that a very lax net-work of anastomosing longitudinal filaments runs through them. From the exterior meshes of this net issue to all sides horizontal, dichotomous, moniliform filaments, whose apices, strongly glued together by firm gelatine, form the membranous wall of the frond. *Conceptacles* are very rare. *Tetra-spores* are more frequently found.

The genus at present consists of two, or perhaps three species, if the form now to be described be entitled to specific distinction.

1. *CATENELLA pinnata*; densely tufted, rising from creeping filaments; stems erect, once or twice pinnate; branches horizontally patent; internodes oblong, the terminal ones acute, all the ramuli divaricate. (TAB. XXIX. B.)

HAB. On the stems of the mangroves, at high-water mark. Key West, *W. H. H.* (v. v.)

*Fronde*s densely tufted, forming wide patches, rising from prostrate surculi, which are attached to the mangrove trunks by lateral discs. These prostrate surculi throw up numerous erect stems, half an inch to an inch high, divaricately pinnate or bipinnate; the branches horizontally patent, opposite or alternate, either naked or having a few secondary branches which are equally patent, the longer ones bearing a few ramuli. Branches moniliform; the lower internodes sub-cylindrical, the upper compressed, oblong or sub-lanceolate, the ramuli spindle-shaped, acute or sub-acuminate. *Colour* a dark purple. *Substance* membranaceous, rigid. It does not adhere to paper.

Perhaps this is only a variety of *C. Opuntia*; but it is much more regularly pinnated than any form of that species known to me, and the internodes are less frequently obovate.

Plate XXIX. B. *Fig. 1*, *CATENELLA pinnata*; the natural size. *Fig. 2*, part of a frond, *magnified*. *Fig. 3*, transverse section, and *fig. 4*, longitudinal semi-section of an internode; highly *magnified*.

XXIV. GLOIOSIPHONIA. *Carm.*

Frond terete, gelatinous, decomponently much branched; *axis* composed of a column of densely interwoven, longitudinal, articulated filaments, at length hollow and tubular; *periphery* of verticillate, moniliform, dichotomous, fastigate, densely packed filaments, set in gelatine. *Nuclei* (*favellæ*) immersed beneath the peripheric filaments, simple, containing, within a gelatinous envelope, numerous roundish spores. *Tetraspores* unknown.

This genus at present contains but a single species, a native also of the Atlantic Coasts of Europe. It is a brilliant carmine, very much branched, filiform plant, of a very tender gelatinous substance, and wholly composed of articulated, confervoid filaments, invested with transparent gelatine. A cross section of one of the youngest ramuli shows a solitary axial longitudinal filament, from which four verticillate, horizontal, dichotomous, fastigate, moniliform branches issue, whose apices, closely pressed together and united by gelatine, constitute the periphery of the branchlet. An older branchlet, similarly treated, shows a solid columnar axis formed of the union of several filaments, from which spring a proportionably larger number of verticillate peripheric strings of cells. As older branches are successively subjected to the lens, the axis is seen to be more developed, until it results in a vast number of interlaced, anastomosing and branching longitudinal filaments densely packed together. Finally, either from distension, or the perishing of the central cells, the axis becomes hollow in the centre. *Favellæ* are generally very abundantly scattered through the branches. They are wholly immersed, and appear to be attached to the lower branches of the peripheric filaments. *Tetraspores* are unknown.

1. *GLOIOSIPHONIA capillaris*, *Carm.*—*J. Ag. Sp. Alg.* 2, p. 161. *Kütz. Sp. Alg.* p. 714. *Harv. Phyc. Brit. t.* 57. *Fucus capillaris*, *Turn. Hist.* 31. *E. Bot. t.* 2191.

HAB. Nahant, *Mrs. Mudge*. Hampton Beach, *Dr. Durkee*. Chelsea, *Miss E. H. Brewer*. New London, *Miss French*. (v. s. in Herb. T. C. D.)

Frond 4—6 inches long, 1—2 lines in diameter, the older parts hollow and tubular, the younger filled with longitudinal threads, excessively and irregularly branched; the branches spreading towards all sides. Main stem sub-simple, terete,

tapering to the base and apex, naked for an inch or two above the base, afterwards very densely set with lateral branches, which are many times decomposed, with several series of lesser branches and ramuli. *Ramuli* tapering remarkably to the base and apex; the alternate ones very slender, setaceous, attenuated. *Colour* a brilliant carmine. *Substance* elastic, shrinking in drying. It closely adheres to paper.

The American specimens, here described, closely resemble those from Europe.

ORDER XII. SPYRIDACEÆ.

Spyridiæ, *J. Ag. Sp. Gen. and Ord. Algarum*, vol. 2, p. 337. *Part of Ceramiaceæ*, *J. Ag. and Auct. Harv. Man. Ed. 2*, p. 156.

DIAGNOSIS. Rosy or brown-red sea-weeds, with a filiform, articulate, monosiphonous frond, partially or entirely coated with small cellules. *Conceptacles* external, furnished with a closed, cellular pericarp, containing numerous *nucleoli*, formed by the transformation of spore-threads radiating from a placenta: these spore-threads are much branched, articulated, and produce in their upper cells, by repeated divisions of the endochrome, numerous oblong spores, which are at length massed together without order. *Tetraspores* external, on the ramelli.

NATURAL CHARACTER. *Root* an expanded disc. *Fronde* filiform, articulated, the tube coated externally by a stratum of small, polygonal coloured cellules, which at length conceal the articulations, except in the young branches. *Stem* much branched, alternately or pinnately compounded, all the lesser divisions clothed with minute, setaceous ramelli. *Ramelli* simple, pellucidly articulate, or coated at the nodes with small cellules.

Conceptacles external, pedicellate, roundish or lobed, formed by the metamorphosis of one of the smaller branches. *Pericarp* closed, formed of a stratum of polygonal cells. Its contents are thus described by Prof. J. Agardh: "*Placenta* central, continuous from the peduncle, and prolonged to the apex of the cavity, formed of dense, dichotomo-fastigate and anastomosing filaments woven together. From this central column of the conceptacle issue filaments (as it were branches) radiating in all directions, many of them elongated and sterile, some shorter and fertile. The sterile filaments are nearly regularly dichotomous, articulated, passing off at the apices into the pericarpal cells; the fertile form many fascicles, directed to the

different lobes ; the younger filaments paniculately branched, with short oblong articulations, the mature ones constituting an obconic cluster of spores. These spores, which originate in a cell-division of the articulations, are oblong ; at length, by mutual pressure, angular, separated from one another and held together by a firm gelatine." *J. Ag. Sp. Alg.* 2, p. 337.

The *tetraspores* are formed along the sides of the ramelli ; either from the evolution of new cells or of those of the cortical layer. They are triangularly parted, and sessile.

At present this Order consists of a single genus, separated by Prof. Agardh from the *Ceramiceæ*, on account of the very different structure of its conceptacular nucleus, a character by which it is more nearly related to the *Rhodymeniaceæ* than to any other family. The structure of the frond, on the contrary, is identical with that of the former family, so much so, that the species of *Spyridia* were formerly referred to *Ceramium* itself.

Possibly when the conceptacles of *Ballia* are better known, that genus will form a second in this very distinctly characterised though at present fragmentary Order.

I. SPYRIDIA. Harv.

Frond filiform, terete or compressed, decompoundly much branched, composed of a single, articulated, thick-walled filament, coated externally with a thin layer of small coloured cellules ; and more or less beset with slender, deciduous, articulated *ramelli*. *Conceptacles* at the ends of short branches or peduncles, involucreted with a few ramelli, containing within a closed, membranous pericarp, numerous *nucleoli* of oblong spores. *Tetraspores* formed along the ramelli, external, sessile, triangularly parted.

The few species of this genus yet known to botanists are all natives of the warmer parts of the ocean. *S. filamentosa* is the most widely dispersed of any, being found throughout the tropics of the Eastern and Western Hemisphere ; in the Mediterranean Sea, and along the Atlantic shores of Europe as far as the South of England ; and on the East coast of North America, from Florida as far North as Massachusetts Bay. As might be expected in a plant of such indifference to climate, it varies much both in the luxuriance of its filaments and the amount of their ramelli ; also, though in a less degree, in the primary ramification. Our var. *refracta* almost looks like a species.

1. SPYRIDIA *filamentosa*, Harv. ; frond filiform, decompoundly branched ; branches alternate, repeatedly divided, ramellose ; ramelli scattered, hair-like, articulate, end-

ing in a simple, acute point. *J. Ag. Sp. Alg.* 2, p. 340. *Harv. Phyc. Brit.* t. 46. *Conferva Griffithsiana*, *E. Bot.* t. 2312. β *refracta*; frond robust, sub-dichotomous, the branches divaricating, with very wide axils, arched; the terminal ones frequently revolute, all but the youngest branches bare of ramelli; ramelli as in the ordinary varieties. (TAB. XXXIV. A.)

HAB. Massachusetts Bay, *Capt. Pike*. Newhaven, *Mr. Hooper*. Stonington and Newport, *Prof. J. W. Bailey*. Red Hook, New York, *Mr. Walters*, &c. Greenport, Long Island, *W. H. H.* Key West, *Dr. Wurdeman*; *W. H. H.* β at Key West, *W. H. H.* (v. v.)

Very variable in size and ramification. *Frond* three to eight or ten inches long, sometimes only as thick as hog's bristle, sometimes twice or thrice as thick; generally much branched, but very irregular in the order of branching. *Branches* spreading, many times compounded, the younger ones especially beset with hair-like ramelli a line or two in length. These ramelli are articulated, each internode formed of a single cell which varies in proportionate length and breadth in different specimens; the nodes are coated with a ring of small cellules, from some of which the tetraspores are evolved in fertile specimens. *Conceptacles* pedicellate, terminating short branches, surrounded by a few involucreal ramelli, bi-trilobed, each containing several distinct clusters of spores. *Tetraspores* oval, clustering round the nodes of the ramelli. *Colour* a purplish-red, changing through various shades of brown to dingy yellow-white. *Substance* soft, but not lubricous. It does not adhere strongly to paper in drying, and is without gloss.

β is a very remarkable variety. The frond is of much greater diameter than in the ordinary American forms, and has thinner walls. Our fig. 1 is strictly characteristic of the extreme form of this variety; and I should have considered it specifically distinct, had not intermediate forms accompanied these strangely straggling ones, connecting them with the well-known European vars. *nudiuscula*, *repens*, &c. By Kützing, indeed, these and other varieties, in all some sixteen, are erected into species; but I fear, were the characters given by this author to be regarded as specific, it would be easy to quadruple the number of *such* species, if a sufficiently extensive suite of specimens were closely examined.

Plate XXXIV. A. *Fig. 1.* SPYRIDIA *filamentosa*, var. *refracta*; the natural size. *Fig. 2.* branchlet and ramelli; *fig. 3.* apex of a ramellus; *fig. 4.* small portion of the stem; *fig. 5.* the same cut open longitudinally; *fig. 6.* a transverse section of the same; more or less highly magnified.

2. SPYRIDIA *aculeata*, Kütz.; frond filiform, decomposedly much branched, branches excessively divided, ramellose; ramelli densely set, hair-like, articulate, having three or more uncinatè prickles at the extremity. *J. Ag. Sp. Alg.* 2, p. 342. *Kütz. Sp. Alg.* p. 668. (*Excl. Syn.*) *Spyridia Berkeleyana*, *Mont. Fl. Alg.* p. 141, t. 15, f. 6, *Kütz. l. c.*

HAB. At Sand Key, Florida, *W. H. H.* (74.) (v. v.)

*Fronde*s densely tufted, four to five inches long, as thick as sparrow's quill below, gradually attenuated, setaceous above, branched on every side, bushy, excessively divided. *Branches* virgate, two or three inches long, with a lanceolate outline, closely set with lateral, simple or alternately compounded lesser branches. All the younger parts of the frond are beset with scattered ramelli half a line to a line in length, articulated, the nodes more or less coated with accessory cells and the apex armed with three (or rarely four) hooked prickles, of which one is terminal and the others lateral. *Colour* a fine purplish lake. *Substance* soft, soon decomposing in fresh water. In drying, it adheres to paper.

A much more densely branched and more feathery plant than any variety of *S. filamentosa* which I have seen, and readily distinguished by the hooked spines which terminate the ramelli. On many of my specimens some of the branches are incrassated below the apex; the incrassated portion bare of ramelli and strongly revolute, forming a short tendril. They were not found attached, however, by these hooks to any neighbouring Algæ.

ORDER XIII. CERAMIACEÆ.

Ceramiceæ, *J. Ag. Sp. Gen. and Ord. Algarum*, vol. 2, p. 1. *Ceramiceæ*, *J. Ag. Alg. Med.* p. 69. (*in part*). *Endl. Gen. Pl. Suppl.* 3, p. 34. *Harv. Man. Ed.* 2, p. 156, &c.

DIAGNOSIS. Rosy or red brown sea-weeds, with a filiform, articulate, or partially or entirely corticated, monosiphonous frond; the outer coat (when present) formed of polygonal cells. *Conceptacles* naked or involucreted *favellæ*; that is, masses of roundish-angular congregated spores, enclosed in a hyaline gelatino-membranaceous saccate envelope. *Tetraspores* external or superficial, formed either from the ultimate ramuli of the simpler fronds, or the cortical cells of the coated ones.

NATURAL CHARACTER. *Fronde*s generally growing in dense tufts, sometimes solitary, rising either from creeping fibres or more commonly from discoid roots. In the simpler species, the frond consists of an articulated filament, formed of a number of cylindrical *cells* or *articulations*, placed end to end. This filament is

either dichotomously, or pinnately branched, the branches being similar to the main stem, and always springing from the upper part of each internode (or articulation) either from its shoulder, or from a short distance below that point. In some genera a number of such filaments anastomose together so as to form a net-work or sponge-like frond, each mesh of the net being usually formed by as many cells or articulations as it has sides; none with this habit, however, are yet known as North American. In the filiform species the primary, articulated, filamentous frond has either the simple structure described above, or it is more or less completely covered over and rendered opaque by cortical cellules, which are sometimes developed on the outer surface of the primary cell, but often formed within the thickened cell-walls. The formation of such cortical cells commences at the nodes and proceeds downwards; the lower part of the articulation being the last coated. These cells are frequently deposited in linear series, but sometimes form a honeycombed surface. In several *Callithamnia* the stem, which in the young frond is pellucidly articulate, becomes as the plant advances in age gradually opaque, by the development of numerous longitudinal articulated filaments within the transparent gelatino-cartilaginous cell walls. These filaments originate at the points from which the branches and ramuli spring, and grow downwards toward the base of the stem. They are indeed like *roots* to the branches; as if each branch sent forth many fibrous roots through the substance of the stem; and in their growth they illustrate, analogically, the similar development of wood tissue from the bases of leaves. In young specimens of *Cal. Baileyi*, the gradual progress of formation of these filaments may be readily seen.

In the more compound fronds, such as occur in the genera *Ptilota* and *Microcladia*, no articulation is visible in the stem, because the primary articulated filament is enclosed in a cellular coat, composed sometimes of many rows of small polygonal coloured cellules. It is only in the very youngest parts of these plants that articulations are partially visible; but, on dissection, the monosiphonous filament which characterises all the plants of this Order is found running, as an axis, through every part of the frond. These opaque species therefore only differ from the pellucidly articulated ones, by the greater development of the cortical cellules.

The *conceptacular* fruit is of the kind called by Agardh a *favella*. It is formed by the metamorphosis of one of the articulations or primary cells of a branch; either of the terminal cell of a shortened branch, or of one of the upper cells. The cell wall dilates, and becomes the transparent envelope or periderm to the *spores*, which are formed by the repeated sub-division of the endochrome of the cell. These *favellæ* are frequently in pairs or clusters, and are either naked or surrounded by short involucreal ramuli.

The *tetraspores* are usually tripartite, rarely cruciate, and still more rarely zonate. They are very frequently external, either sessile on the sides of the ramuli, or on little pedicels, in these cases originating in a transformation of the ultimate divisions of the frond. Sometimes they are half immersed, and rarely wholly sunk among the surface cellules of the compound fronds; in these cases being formed from some of the cortical cellules.

Antheridia have been found in several. They generally occupy the same position on the frond as the tetraspores, and consist of innumerable minute, hyaline cellules strung in moniliform filaments, radiating from a central point; each of these tufts of filaments being about the size of a tetraspore.

Seventeen or eighteen genera of this Order are known. Of these the following are represented on the North American Coasts.

SYNOPSIS OF THE NORTH AMERICAN GENERA.

TRIBE 1. CERAMIEÆ. *Tetraspores* (formed by a metamorphosis of some of the cortical cellules) more or less sunk in the frond.

I. MICROCLADIA. *Fron*d not obviously articulate.

II. CENTROCERAS. *Fron*d articulated, corticated; the cortical cells rectangular, longitudinally seriated.

III. CERAMIUM. *Fron*d articulated, more or less corticated; the cortical cells roundish, irregularly distributed.

TRIBE 2. CALLITHAMNIEÆ. *Tetraspores* (formed by a metamorphosis of a whole ramulus or of an articulation) external, sessile or pedicellate.

IV. PTILOTA. *Fron*d corticated, decompound-pinnate. *Favellæ* involucrate.

V. CROUANIA. *Fron*d gelatinous, articulated; the stem and branches moniliform, whorled with minute, densely set ramelli, among which the *favellæ* are sunk.

VI. HALURUS. *Fron*d cartilaginous, articulated; branches whorled with forked ramelli. *Favellæ* involucrate.

VII. GRIFFITHSIA. *Fron*d gelatino-membranaceous, articulate, dichotomous. *Favellæ* involucrate.

VIII. CALLITHAMNION. *Fron*d articulate, (the stem and branches occasionally subopaque). *Favellæ* naked.

I. MICROCLADIA. *Grev.*

Fronde compressed, decompound-dichotomous, or sub-pinnate, distichous, with an articulated axial filament, corticated, opaque; the cortical stratum formed internally of large angular cells, externally of minute ones. *Favellæ* sessile on the branches, subtended by a few involucrel ramuli, and containing, in a hyaline periderm, numerous angular spores. *Tetraspores* immersed in the ultimate segments, formed out of some of the superficial cells, triangularly divided.

This genus was founded by Dr. Greville on the *Fucus glandulosus* of the Banksian Herbarium, a little plant found along the European shores from the Coast of Ireland to the South of Spain, as well as in the Mediterranean Sea; and which possibly awaits discovery on the Atlantic shores of America. It closely resembles *Ceramium rubrum* in habit, but is evidently compressed, and much more opaque, the cortical layer being formed of several rows of coloured cells. To this original species I venture to add the two following from the Pacific Coast.

1. MICROCLADIA *Coulteri*; frond inarticulate, compressed, distichous, decompound-pinnate; branches alternate, elongate, simple, bi-tri-pinnate; pinnæ and pinnulæ plano-compressed, without evident articulation, the ultimate ramuli broadly subulate, acute; favellæ sub-globose or bilobed, sub-tended by two or three short ramuli. (TAB. XXXIII. A.)

HAB. California, *Dr. Coulter*. (v. s. in Herb. T. C. D.)

Fronde six or eight inches long, half a line in diameter, compressed, becoming more so upwards, slightly flexuous, undivided or slightly divided, set throughout, at distances of half an inch, with lateral, undivided, virgate branches. These branches are erecto-patent, pinnated with shorter branches or pinnæ, half an inch to an inch or more in length; the lowest shortest, the rest successively longer to the middle of the branch, and thence again shorter to the apex. The pinnæ are plano-compressed, about bi-pinnate, all the divisions alternate and erecto-patent, the ultimate ramuli subulate and acute; the apical laciniae hooked inwards. No articulation is externally visible in any part of the stem or ramuli when examined with a microscope, but the internal articulated axial filament may be seen in some places with a pocket lens. A section of one of the upper branches shows a large central tube, surrounded by several series of polygonal cells; the inner large, the rest successively smaller to the circumference, which is formed of minute cells. A cross section of the base of the stem has a very different aspect: it exhibits a large central tube, though considerably shrunk from that of the branches, surrounded by one or more circles of large cells, separated from the central tube and from each other by

wide interstices filled with minute, filiform cellules. The stem does not readily recover its form when moistened after having been dried, and this structure, attempted to be shown is *fig. 5*, is not correctly given; the specimen from which it was drawn not having opened sufficiently. This difference in structure between the branches and stem originates in causes exactly similar to those that operate in some *Callithamnia*, in which the branches at first consist of a string of transparent-walled cells, but afterwards have their walls filled from above with filaments, issuing from the butts of the branches and gradually accumulating toward the base of the frond. The *favellæ* are formed on slightly shortened pinnules, and are roundish, subtended by two or four subulate ramuli. *Colour* a purplish red.

This is so similar to some varieties of *Ceramium cancellatum* that I had at first referred it to that species; but it is much more robust, more opaque, of a different internal structure, and moreover the pinnae and pinnulæ, which are lanceolate in circumscription, are alternately rather than dichotomously compounded.

Plate XXXIII. A. *Fig. 1.* MICROCLADIA *Coulteri*, the natural size. *Fig. 2*, a pinna; *fig. 3*, a pinnule with *favella*; *fig. 4*, a longitudinal, and *fig. 5*, a transverse section of the base of the stem (not quite correct); the latter figures more or less highly magnified.

2. MICROCLADIA *borealis*, Rupr.; frond inarticulate, distichous, dichotomo-secund, many times compounded; branches arched, virgate, set along their upper sides with numerous, secund pectinato-dichotomous, twice or thrice secundly compounded branchlets; ultimate ramuli incurved, acute; tetraspores in the ultimate ramuli, irregularly scattered. *Rupr. Alg. Ochotsk. p. 259. Microcladia scorpioides, Harv. MS. in Herb.*

HAB. Una Nootka, *Dr. Scouler!* Fort Vancouver, 1826, *Garry!* Unalashka, *Wosnessenski!* Golden Gate, California, *Capt. Pike!* (v. s. in Herb. T. C. D.)

Densely tufted. *Fronds* three to four inches long, as thick as hog's bristle, so closely coated with peripheric cells that no articulation is visible in any part of the frond without dissection. Internal structure as in the genus. The branches and all their subsequent divisions, though formed on a dichotomous type, appear from the nearly constant regular suppression of one of the arms of the bifurcation to be secund. The main branches are arched backwards, long and virgate, and closely set with falcato-secund, distichous secondary branches, from half an inch to an inch in length, and about a quarter inch apart. Each of these carries on its upper side five or six secund ramuli, which are again once or twice compounded in a similar manner. This order of ramification seems perfectly regular, without a trace of proliferous growth. *Tetraspores* are abundantly scattered through the surface cells of the ultimate ramuli in *Capt. Pike's* specimen.

This appears to be a very distinctly characterised species and to belong to the present genus, although it bears some external resemblance to *Ceramium obsoletum*,

Ag. It is much more opaque than that species, with a smaller axial tube and shorter articulations, and the ramification is as orderly as in *Plocamium coccineum*.

CENTROCERAS. *Kütz.*

Fronde filiform, dichotomous, articulated, corticated with oblong cells, arranged round the internode in longitudinal lines. *Favellæ* sessile on the branches, subtended by a few involucreal ramuli, and containing, within a hyaline periderm, many angular spores. *Tetraspores* formed by a transformation of some of the cortical cells, projecting from the surface, roundish, triangularly divided.

Plants with the external habit of *Ceramium*, from which genus this chiefly differs in having the cells of the cortical layer arranged in longitudinal, striæform rows, instead of being irregularly placed. Of the following species, which has many varieties, and is dispersed very widely through the Atlantic and Pacific Oceans, Prof. Kützing has made no less than eight species.

1. *CENTROCERAS clavulatum*, Ag. ; frond capillary, rigid, dichotomous, fastigate, at length proliferous from the axils ; apices hooked inwards, lower internodes four to six times as long as broad, upper successively shorter ; nodes armed with a whorl of minute spines ; tetraspores whorled round the nodes of the lesser branches and ramuli ; favellæ geminate, involucreate. *J. Ag. Sp. Alg.* 2, p. 149. *Centroceras sp. omnes*, *Kütz. Sp. Alg.* 688. (Tab. XXXIII. C.) β *crispulum*, Mont. ; filaments variously curved and twisted, and beset with lateral, squarrose ramuli, *Mont. Cuba. t. 2, f. 1.*

HAB. Abundant at Key West, on rocks, on the foundations of the Fort and elsewhere near low water mark, *W. H. H.* (both varieties), *Prof. Tuomey, &c.* (v. v.)

Fronde densely tufted, two to four inches long, as thick as human hair, nearly of the same diameter throughout, repeatedly and regularly dichotomous, the apices fastigate ; branches straight and erect in var. α , variously twisted and spreading in β , naked, or furnished with lateral, proliferous, forked branchlets, which spring either from any node along the stem or often from the axils, especially the upper ones. *Fronde* articulated to the base ; the internodes in the lower part several times longer than broad, shorter above and very short towards the ends of the ramuli, coated with cells arranged in longitudinal striæform lines ; the cellules toward the apex of each internode short, quadrate, gradually longer toward the base, and

always longest in the older parts of the frond. The *nodes* are universally swollen, thicker than the internode above and below, each internode sitting in the one below it as in a little cup. In the young state each node is crowned with a whorl of minute spine-like processes, which are gradually obliterated in age, and are only to be found, in old plants, on the youngest branches. Young plants are also covered with copious, very slender hairs, afterwards deciduous. *Favellæ* subtended by three or four small branchlets. *Tetraspores* rather prominent, whorled round the nodes of the lateral ramuli. *Colour* a dark purple, passing into brick-dust-red in fresh water. *Substance* rigid and harsh. It does not adhere to paper in drying.

Plate XXXIII. C. *Fig. 1.* A tuft of *CENTROCERAS clavulatum*, the *natural* size. *Figs. 2 and 3,* portions of filaments of different ages; *fig. 4,* apex of a branch; *fig. 5,* internodes of the stem; all more or less *magnified.*

III. CERAMIUM. *Lyngb.*

Frond filiform, dichotomous or somewhat pinnate, articulate; the articulations either partially or wholly coated by small cells not arranged in lineal series. *Favellæ* sessile on the branches, subtended by a few involucrel ramuli, and containing, within a hyaline periderm, many angular spores. *Tetraspores* formed by a transformation of some of the cortical cells, more or less projecting from the surface, roundish, triangularly divided.

The fronds generally grow in dense tufts, seldom exceeding six inches in height, and often not half that measurement. The stems vary in diameter from the thickness of a hog's bristle, or rather more, to the fineness of a cobweb. Some species are so completely corticated with minute coloured cellules as to be nearly opaque; others are beautifully variegated with hyaline and coloured bands alternately placed; the coloured or corticated portion of each cell being that nearest to the node, the hyaline band occupying the central region of the internode. Many of the species, perhaps all, are, when young, clothed at the nodes with very fine, soft, hyaline hairs, which, as the frond advances in age, fall away, leaving the articulation quite smooth. Other species are armed at the nodes with thorn-like processes or prickles, but none of this section have yet been found in North America.

The number of *book*-species has been largely increased of late years, partly by the discovery of new forms, and partly by splitting into several the *specific ideas* (so to say) of the older botanists. Some of these newly proposed species are no doubt proper to be retained, but I fear the splitting process has been carried far beyond its legitimate limits. The North American species naturally divide into two sections, in the first of which the cortical cells cover over either the whole of the

articulation or the greater portion of it; in the second, they are confined to a definite band surrounding the nodes.

SECT. 1. RUBRA; *Fronde unarmed (not spinuliferous); the stratum of cortical cells decurrent from the nodes, and more or less completely clothing the surface of the internode.*

1. CERAMIUM *nitens*, J. Ag.; frond subsetaceous, slightly attenuated upwards, irregularly dichotomous, diffuse, the branches widely spreading and divaricating; upper branches zig-zag, with lateral, distant, frequently secund branches and ramuli; ultimate ramuli scattered, subulate, straight at the point; internodes clothed with cells on all parts of the frond, the lower ones twice as long as broad, the upper very short. *J. Ag. Sp. Alg.* 2, p. 130.

HAB. At Key West, Florida, *W. H. H., Prof. Tuomey*, No. 18, (v. v.)

Fronde four to eight inches long, not so thick as hog's bristle, dichotomously branched from the base, all the divisions very patent, often spreading at right angles, and sometimes with still greater divergence. The upper forks are equally wide with the lower, but are less regular; one arm of the dichotomy being frequently shortened to a branchlet. Thus the ramification becomes as it were alternately zig-zag or secund. Ramuli few or many, filiform, simple, acute, not forcipate at the extremity, distant and very patent. *Substance* rather firm. *Colour* a full red or brownish. *Fruit* unknown. *Internodes* uniformly coated with small cells, not much or at all contracted at the nodes.

I have not seen specimens of Agardh's plant, and may be wrong in the above reference. But be this as it may, I have no hesitation in regarding the plant here described as a distinctly marked species, differing from *C. rubrum* not merely in ramification, but essentially in structure. If cross sections of both plants be compared together under the microscope, the differences may be readily seen. In our *C. nitens* the walls of the monosiphonous frond are very thick, and the peripheric cells are set within the pellucid substance of the wall in dichotomous, radiating, horizontal series, whose apices constitute the superficial coating. In *C. rubrum* the surface cellules are of large size, not disposed in radiating lines, and a circle of empty, polygonal cells surrounds the central tube, as in *Microcladia*.

2. CERAMIUM *rubrum*, Ag.; frond robust, setaceous, gradually attenuated, dichotomous, sub-fastigiate, with or without lateral simple or forked ramuli; segments erecto-patent, the apices either slightly incurved or hooked; lower internodes twice or thrice as long as broad, contracted at the nodes, more or less densely covered with surface cellules; favellæ lateral, subtended by three or four short ramuli; tetraspores distributed round the nodes. *J. Ag. Sp. Alg.* 2, p. 127. *Kütz. Sp. Alg.*

p. 685. *Harv. Phyc. Brit.* t. 181. *Conferva rubra*, *E. Bot.* t. 1166. *Dillw. Conf.* t. 34.

β *decurrens*; the younger internodes naked in the middle, the older gradually covered over with cellules; frond either regularly dichotomous or furnished with lateral, forked ramuli. *Ceramium decurrens*, *Kütz. Sp.* p. 675. *Harv. Phyc. Brit.* t. 276.

γ *proliferum*; internodes densely covered with cells; frond dichotomous, beset on all sides with numerous, lateral, simple or forked branchlets. *Ceramium botryocarpum*, *Griff.*—*Harv. Phyc. Brit.* t. 215.

δ *secundatum*; similar to var. γ , except that the ramuli are very generally secund. *Cer. secundatum*, *Lyngb. Hyd. Dan.* t. 37, A.

ϵ *squarrosum*; frond of small size, regularly dichotomous, fastigiate, with very few and short lateral ramuli; lower forks distant, with patent axils; upper very close together, very patent, the segments divaricating and apices sometimes revolute.

HAB. Pacific Coast. Atlantic Coast from the Arctic Sea to Charleston, South Carolina. β , Prince Edward's Island, *Dr. Jeans*. Halifax, *W. H. H.* New Bedford, *Dr. Roche*. γ , Newport, *Prof. Bailey*. δ , Newfoundland. ϵ , growing on *Zostera*, Boston Harbour, *Mr. G. B. Emerson*. Lynn, *Mrs. Mudge*. (v. v.)

Frond two to ten inches long, thicker than hog's bristle below, attenuated upwards and capillary in the ultimate ramuli, pretty regularly dichotomous; the lower forks distant, the upper approximated, with rounded axils and erecto-patent slightly converging segments. Young specimens are generally simply dichotomous; older ones have often numerous lateral ramuli, half an inch in length, simple or forked. Sometimes these are very numerous, as in vars. γ and δ . In var. β , the stem and branches are beautifully variegated with alternate pale and coloured bands. In the other varieties the internodes are uniformly coloured. Our var. ϵ is a very remarkable form, two to three inches high, fastigiate, with very patent squarrose ramification. It almost looks like a distinct species, but seems traceable through varying specimens into the common form. *Colour*, varying through nearly every shade of red to orange, yellow, dirty white or greenish.

Many more varieties than those above enumerated occur on our coasts. The above are, however, the most distinctly marked.

SECT. 2. DIAPHANA; *Frond unarmed (not spinuliferous); the stratum of cortical cells confined to a definitely limited band round the nodes; the internodes diaphanous.*

3. CERAMIUM *Hooperi*; fronds rising from creeping surculi, densely matted below, erect, capillary, irregularly dichotomous; ramuli scattered, erect, subulate, straight, or slightly curved, (the ends of the branches frequently bearded at one side with a series of thick, root-like fibres, one rising from every node); articulations in all parts of the frond of equal length and breadth, the internode formed of

a single, naked, coloured cell; the node coated with a definite band of large cellules.

HAB. On perpendicular rocks, densely covered with Fuci, near low-water mark. Camden, Penobscot Bay, *Mr. J. Hooper*. Newburyport, *Capt. N. Pike*. (v. s. in Herb. T. C. D.)

This spreads over the surface of the rock in dense, root-like patches. The filaments are an inch or two in height, possibly more in full-grown specimens, irregularly dichotomous, and furnished with scattered, lateral ramuli, which are either straight, or slightly curved at the point. The stems spring from a mat of confervoid fibres; near the base the cortical layer of the nodes is very narrow, the internode being formed of a single, thick-walled cell, containing a dark purple endochrome. The nodes in the upper part of the filament have a wider, but always a strictly defined band of cortical cells, and the internodes throughout the filament consist of a single large cell filled with endochrome. Most of the branches in Mr. Hooper's specimens throw out from several of the nodes, below the tips, a number of secund, hyaline, root-like filaments, one-fourth of the diameter of the part from which they spring, one rising from the marginal cell of each node. *Fruit* at present unknown.

I have the more pleasure in naming this curious plant after its discoverer, Mr. J. Hooper of Brooklyn, because I believe it to be distinctly marked by the structure of its articulations, as well as by its creeping habit. The bearded extremities of the branches afford a very unusual character, but I fear to ground a diagnosis on them, as they do not occur in a specimen from Capt. Pike, which differs in no other respect from those collected by Mr. Hooper.

4. *CERAMIUM diaphanum*, Roth; filaments setaceous, attenuated upwards, rather flaccid, irregularly dichotomous; the branches set with short, lateral, dichotomous ramuli; internodes colourless, those of the main stems three or four times as long as broad, of the ramuli short; nodes swollen, coated with a definite band of purple cellules; favellæ near the ends of the branches or of small ramuli; tetraspores numerous in each node. *J. Ag. Sp. Alg.* 2, p. 125. *Harv. Phyc. Brit.* t. 193. *Hormoceras diaphanum*, *Kütz. Sp. Alg.* p. 675. *Conferva diaphana*, *E. Bot.* t. 1742. *Dillw. Conf.* t. 38.

HAB. Boston Bay, *Dr. Durkee*. Nahant, *Mrs. Mudge*. New Bedford, *Dr. Roche*. Providence, *Mr. Olney* and *Prof. Bailey*. New York Bay, *Messrs. Hooper, Walters, Pike, Calverley, &c.* Key West, *Mr. Binney, Dr. Blodgett, W. H. H.* (v. v.)

Fronde two to four inches high, variable in diameter, as thick as hog's bristle or as horse hair below, gradually attenuated upwards and nearly capillary above, irregularly dichotomous, with many lateral, dichotomous branchlets of various lengths; apices rarely fastigiate, but more so in some varieties than in others.

Ultimate ramuli forcipate at the apex. Sometimes the lateral branches are few, simply forked, and distantly scattered along the branches, either alternate, or secund; sometimes they are very numerous, springing from nearly every node. *Internodes* hyaline, destitute of cortical cells, those of the lower branches three or four times as long as broad, the upper ones successively shorter. *Favellæ* involucrate, mostly sessile near the ends of the lateral ramuli. *Tetraspores* either in the ramuli or the main branches, densely whorled round the node, prominent. *Colour* of the tuft a dark purple. *Substance* soft, adhering to paper in drying.

5. *CERAMIMUM subtile*, J. Ag.; "frond capillary, dichotomous, sub-alternately branched above, branches elongate, set with patent, forcipate ramuli; lower internodes twice or thrice as long as broad, upper successively shorter; nodes scarcely swollen; tetraspores secund on the outer edge of the segments, rather prominent." *J. Ag. Sp. Alg.* 2, p. 120.

HAB. Vera Cruz, Gulf of Mexico, *Liebman*.

Said to be allied to *C. gracillimum*; but is of greater diameter, with more patent, by no means fastigate ramuli, shorter lower articulations, less swollen nodes, and differently disposed tetraspores. I have not seen any specimens.

6. *CERAMIMUM tenuissimum*, Lyngb.; frond capillary, of equal diameter throughout, rigid, dichotomous, excessively divided, fastigate; the axils very patent; internodes colourless, those of the middle of the stem from four to six times as long as broad, the upper successively shorter; nodes swollen; tetraspores very prominent, secund on the outer edge of short lateral ramuli, one or more at each node; favellæ involucrate, near the tips of short ramuli. *J. Ag. Sp. Alg.* 2, p. 120. *Ceramium nodosum*, *Harv. Phyc. Brit.* t. 90. *Gongroceras nodiferum*, *Kütz. Sp. Alg.* p. 678, also *G. tenuissimum*, *Kütz. l. c.* p. 680.

HAB. Key West, Florida, *W. H. H., Prof. Tuomey, Mrs. Adams*. Key Biscayne, *Prof. Tuomey*. (v. v.)

Tufts two to three inches long, globose, fastigate. *Filaments* much finer than human hair, many times dichotomous with very patent angles and spreading branches and ramuli. *Apices* diverging, forcipate. The lower forks are distant, the upper gradually nearer. The lateral ramuli are either simple or forked, hooked in or forcipate at the ends. They bear the fructification of both kinds. *Colour*, a pale or dark purplish red, changing to ferruginous-red in fresh water. *Internodes* of the ramuli very short, of the lower branches successively longer, and 5—6 times as long as broad in the lower part of the plant. Nodes generally swollen.

The American specimens here described are destitute of fruit, and are so far, therefore, uncertain; but in other respects are very similar to European specimens.

7. *CERAMIUM fastigiatum*, Harv.; frond capillary, of equal diameter throughout, flaccid, dichotomous, level-topped; the axils acute; internodes pellucid, the lower ones nearly colourless, from four to six times as long as broad, the upper successively shorter, and filled with pale rose-coloured endochrome; nodes banded; favellæ sub-terminal, involucreted; tetraspores prominent, secund on the outer edge of the branches. *J. Ag. Sp. Alg.* 2, p. 119. *Harv. Phyc. Brit. t.* 255. *Gongroceras fastigiatum*, *Kütz. Sp. Alg.* p. 678.

HAB. Massachusetts Bay, *Dr. Durkee, Captain Pike.* Greenport, *W. H. H.* Newport, *Prof. Bailey, Mr. Olney, &c.* Longbranch, New Jersey, *Miss Morris.* (v. v.)

Tufts very dense, fastigate, soft. *Filaments* finer than human hair, many times regularly dichotomous, the lower axils sub-distant, the upper gradually nearer, not widely spreading. Apices of all the branches generally on a level, the ultimate divisions forcipate. Occasionally there are a few lateral ramuli. Internodes pellucid, but suffused with a pale blush, the uppermost ones filled with rosy endochrome. *Nodes* coated with a definite band of small cells. General colour of the tuft a bright lake-red, becoming in fresh water first scarlet and then orange.

The American specimens are very similar to those from the South of England and Ireland.

8. *CERAMIUM arachnoideum* (?) Ag.; tufts fastigate, dense; filaments capillary, attenuated upwards, many times regularly dichotomous; axils more or less patent, the lower distant, the upper close; apices forcipate, not strongly inflexed; internodes pellucid, the lower ones thrice or four times as long as broad (sometimes veiny), upper very short; favellæ lateral, subtended by elongating ramuli (at length axillary); tetraspores bursting from the outer edge of the nodes, especially of the upper branches, solitary or aggregated, very prominent. *J. Ag. Sp. Alg.* 2, p. 117. *β patentissimum*; of small size, the lower furcations distant and very patent; the branches ending in dichotomo-multifid, divaricating, corymboso-fastigate ramuli; internodes of the ramuli extremely short. (TAB. XXXIII. B.)

HAB. Boston Bay, *Dr. Durkee, Capt. N. Pike.* Newhaven, *Mr. J. Hooper.* Bay-side, New York Bay, *Mr. J. Hooper.* Hellgate, *Mr. Walters.* Var. *β*, Boston Bay, *Dr. Durkee and Capt. N. Pike.* New York Harbour, *Mr. Walters and Mr. Hooper.* (v. s. in Herb. T. C. D.)

*Fronde*s very dense, one to two inches in diameter, fastigate. *Filaments* rather thicker than human hair below, attenuated to the extremity, many times regularly dichotomous, the lower forks distant and rather patent, the upper successively closer and (except in var. *β*) more erect; the apices forked and slightly forcipate, sub-obtuse. *Nodes* coated with a band of cells, not swollen, sometimes constricted; lower internodes hyaline or occasionally striated with coloured, cobweb-like filaments which run through the walls, now and then anastomosing; upper inter-

nodes very short, not swollen, except the fertile ones. *Favellæ* lateral on the upper branches, not on lateral ramuli, subtended by two or three ramuli which at first are short, but afterwards lengthen and divide dichotomously, and then the favellæ seem sitting in a nest of branches. *Tetraspores* large and very prominent, bursting singly or in clusters from the outer margin of the nodes, especially those of the upper divisions. *Colour*, a brownish purple. *Substance*, flaccid, adhering to paper. Our var. β is a very remarkable form, and at first I looked upon it as a distinct species, but a further comparison of numerous specimens leads me to regard it as being merely an extreme variety. I have received it from several correspondents.

The reference to Agardh, whose plant comes from the Baltic Sea, requires confirmation, as I have seen no authenticated specimen. As a species our American plant is allied to *C. diaphanum*, from which it differs in size and in the mode of fruiting; and to *C. fastigiatum* and *tenuissimum*, from which the shorter internodes, unswollen nodes and more robust filaments separate it.

Plate XXXIII. B. *Fig. 1.* CERAMIUM *arachnoideum*, β *patentissimum*; the natural size. *Fig. 2,* part of a branch, *magnified.* *Fig. 3,* some of the nodes and internodes, highly *magnified.*

9. CERAMIUM *byssoideum*; filaments exceedingly slender ($\frac{1}{600}$ of an inch in diameter), soft, dichotomous; forks distant below, approximate above, the branches erecto-patent with acute angles; the upper branches having a few level-topped, forked, lateral ramuli; internodes hyaline, those of the principal stems six or eight times as long as broad, of the lesser thrice as long as broad, of the ramuli very short; internodes banded, definite, swollen, especially the upper ones; fruit unknown.

HAB. Parasitical on Gorgoniæ, at Key West, *W. H. H.* No. 77. (v. v.)

Tufts about an inch high, exceedingly soft. *Filaments* of almost cobwebby fineness, repeatedly and pretty regularly dichotomous, the axils all narrow and angles acute. Lateral ramuli on my specimens few. *Nodes* of the ramuli greatly swollen, bead-like, much thicker than the internode; those of the older branches less so, dark purple. *Colour* of the tuft rather pale.

This is by much the most slender of the genus. *Cer. gracillimum*, when placed beside it on the table of the microscope, looks large and coarse in comparison; nor is there the difference in diameter between the main branches and the ramuli, so observable in that species.

IV. PTILOTA. *Ag.*

Fronde cartilaginous, compressed, two-edged, decompose, pectinato-pinnate, distichous, opaque, having an articulated, monosiphonous axis enclosed in a thick

cortical stratum of cells ; the inner cells of the cortical layer roundish, the outer minute, coloured. *Favellæ* terminal on the lesser ramuli, involucreted with numerous ramelli, containing within a hyaline periderm, numerous angular spores. *Tetraspores* on the ultimate pinnules, external, sessile, solitary or aggregate, formed each from an internode of the ramulus, roundish, triangularly divided.

A beautiful genus, strongly marked by its decompose-pinnate, distichous, inarticulate, or, rather, internally articulate fronds, which are of larger size, firmer texture and more opaque than in most other genera of this Order. All are branched on a pinnate model. In some the pinnæ and pinnulæ are regularly alternate throughout the branches and lesser divisions. In others they are as regularly opposite ; but among those with opposite pinnæ two varieties of ramification must be carefully distinguished. In some the opposite pinnæ are of the same nature, either of equal length and exactly similar, or one longer than the other, a longer and shorter pinna alternating regularly at each side of the rachis. In others, the opposing pinnæ are of different natures ; one of them phyllodium-like, always remaining unchanged after having once been formed, either entire, serrate or pectinate ; the other branch-like, pinnately-compound, at first shorter and simpler, afterwards lengthened and decompose in similar manner to the larger branches of which it is a pinna. The pinnæ opposite the phyllodia are often abortive or little developed ; whence arises an irregularity of ramification in most species. Often too they are very much reduced in size and converted into racemes of fructification.

SECT. 1. DIVERSIFOLLÆ : *Pinnæ opposite, of different nature, one leaf-like undivided, the other (sometimes obsolete) branch-like, pinnately-compound.*

1. *PTILOTA densa*, Ag. ; frond plano-compressed, two-edged, decompose pinnate ; pinnæ opposite, unlike ; one undivided, falcate, inciso-pectinate along its outer edge ; the other compound, either lengthening out into a branch, or minute and ramuliform ; branches linear, densely set with the falcate pectinifid pinnæ and opposing minute multifid ramuli ; tetraspores in oblong glomerules alternating with the pinnulæ of the multifid ramuli. *J. Ag. Sp. Alg.* 2, p. 98. *Ptilota pectinata*, Harv. in *Beech. Voy.* p. 164. (TAB. XXXII. B.)

HAB. California, *Lay and Collie.* (v. s. in Herb. T. C. D.)

Frond several inches long, half a line in diameter, more or less compressed, decompose-pinnate, but very irregular in the development of its major pinnæ, though perfectly regular in the system of construction. Sometimes the major pinnæ are closely set and furnished with a second or third series also closely placed together ; sometimes (as in the specimen we have figured) they are widely distant and very unequal in length. Both the larger and lesser branches are opposed, at

their insertion, to falcate, incurved, leaf-like ramuli, a line or two in length, pectinate or deeply inciso-dentate along the outer edge. Similar distichous pinnæ border all the branches at distances of a line or two apart, alternating with each other, but opposing minute, multifid ramuli of equal length or very much shorter. These ramuli, carelessly examined, appear to be mere heads of densely crowded divaricato-multifid ramelli; but are really composed on the same pinnated type as the rest of the frond, one pinnule being falcate and pectinate, the other pinnato-multifid, or if fertile, altered into a glomerulus of tetraspores. *Colour*, a full red, brownish when dry. *Substance* rigid, not adhering to paper.

A very remarkable and distinct species. I have examined an authentic fragment of Agardh's *P. densa*, preserved in Sir Wm. J. Hooker's Herbarium, and find it to agree perfectly with my more recently named *P. pectinata*. The latter name is therefore suppressed.

Plate XXXII. B. *Fig. 1.* *PTILOTA densa*; the natural size. *Fig. 2.* portion of a branch, with pectinate pinnæ, and opposing multifid, fertile ramuli; *fig. 3.* a ramulus, with clusters of tetraspores; *fig. 4.* tetraspores; the latter figures more or less magnified.

2. *PTILOTA hypnoides*, Harv.; frond plano-compressed, two-edged, decompose-pinnate; pinnæ opposite, unlike; one undivided, leaf-like, lanceolate or ovato-lanceolate, acute, very entire; the other elongated, pinnated with similar lanceolate acute pinnæ opposing ramuliform processes; tetraspores aggregated in oblong glomerules, alternating with the pinnules of the lesser branches. *Harv. in Bot. Beech. p. 164. J. Ag. Sp. Alg. 2, p. 97. Kütz. Sp. Alg. p. 670. (TAB. XXXII. A.)*

HAB. California, *Messrs. Lay and Collie.* (v. s. in Herb. T. C. D.)

*Fronde*s six to eight inches long, or probably much more, half a line in diameter at the base, compressed, two-edged, decompose-pinnate; the primary branches of very unequal lengths, long and short intermixing together, closely pinnated throughout at distances of a line or two. One of the pinnæ is a simple, leaf-like, lanceolate or ovato-lanceolate, acute ramulus, a line in length, never altering with age; the opposite pinna is a branchlet which is either abortive and rudimentary, or lengthens out into a branch which is closely pinnated with lanceolate leaf-like pinnules (like those of the larger branches) opposed to minute, pinnulated branchlets of their own length or shorter. These latter occasionally elongate, and are compounded in a similar manner to the larger branches; and thus the frond continues to be developed. When fertile, however, they remain short, and consist then of lanceolate pinnellæ alternating with stalked, oblong clusters of tetraspores. *Colour*, a rosy purple. *Substance*, cartilaginous and firm. In drying, it does not adhere to paper.

A beautiful species, and perhaps not rare; but as yet very few specimens have found their way to Europe. It was first found by Hænke, whose specimens were

confounded by the elder Agardh with *P. asplenioides*, from which this species is abundantly distinct.

Plate XXXII. A. *Fig. 1.* *PTILOTA hypnoides*; the natural size. *Fig. 2.* portion of a larger and lesser branch, with fertile ramuli; *fig. 3.* a fertile ramulus, with oblong clusters of tetraspores; *fig. 4.* tetraspores; *fig. 5.* transverse section of the base of the stem; the latter figures more or less highly magnified.

3. *PTILOTA asplenioides*, Ag.; frond plano-compressed, two-edged, decompound-pinnate; pinnæ opposite, unlike; one undivided, serrulated, the other (abortive or) pinnately parted; pinnulæ erecto-patent, decurrent, scymitar-shaped, incurved, acute, serrulate, areolate; fruits marginal, supra-axillary, the tetraspores in dense, roundish, pedicellate glomeruli; the favellæ involucrate, the branches of the involucre pinnellated with articulate, single-tubed ramelli. *J. Ag. Sp. Alg. 2, p. 98.* *Rhodocallis asplenioides*, Kütz. *Sp. Alg. p. 674.* *Fucus asplenioides*, Turner, *Hist. Fuc. t. 62. Esper. Ic. t. 147.*

HAB. Northern Pacific Ocean. Prince William Sound, Russian America, *Mr. Menzies.* (v. s. in Herb. T. C. D.)

*Fron*d twelve to eighteen inches long, a line or more in breadth, with a strongly compressed stem, which is slightly winged above, two-edged below, very firm, opaque and cartilaginous in its lower part, gradually flatter and thinner toward the summit, single or divided into several principal branches or secondary fronds. The mode of branching is pinnate; the pinnation repeated many times in large specimens after a uniform system, which is easily understood by examining one of the lesser branches of an old plant, or the apex of the main stem in a younger plant. Such branch has a plano-compressed rachis, distichously pinnate with normally opposite, but very different looking pinnæ. One pinna of each pair is undivided, about two lines long and half a line wide, cultriform, acute, erecto-patent and somewhat incurved, more or less distinctly serrated or serrulated, rarely nearly entire, its lamina vertical (in the same plane as the flat rachis) the lower edge decurrent or gradually fining off into the rachis. The opposing pinna when developed, for it is frequently abortive, is many times longer and is again pinnated on a similar plan. In the subsequent divisions of the frond the undivided-cultriform pinnæ and pinnules are often alone perfected, and these constantly alternate with each other; the place of the pinnately-parted pinnæ being merely indicated by a minute ramulus or even reduced to a rapidly obliterated process. In such specimens the frond seems alternately pinnatifid, as figured and described by Turner, but the examination of a young branch shows that this is a deceptive appearance. The pinnæ and pinnulæ are coated with a uniform surface of small polygonal cells. When held between the eye and the light, and examined with a pocket lens, a slender medial line (the axial filament) is seen running through the frond, and sending off branches to each pinnule; this line of cells, in the pinnule, running nearer to the upper than to the inferior margin. The serratures of the margin are very variable

in different specimens. *Fruit* of both kinds is borne along the margin, either on the rachis, above the axil of the pinnules, or, very frequently, along one or both edges of the pinnule itself. The *tetraspores* are densely crowded in little pedicellate heads. The *favellæ* are likewise stalked, and surrounded by involueral pinnated ramelli. *Colour*, a dark brownish red. *Substance*, cartilaginous. It does not adhere to paper in drying.

Discovered by Mr. Menzies on the North West Coast of America, but seemingly much more common in North Eastern Asia, particularly in Kamtschatka, from which country I possess several specimens.

4. *PTILOTA Californica*, Rupr. ; frond plano-compressed, two-edged, virgate, decompound-pinnate ; pinnæ and pinnulæ opposite, unlike ; one undivided denticulate or serrate, the other (abortive or) pinnately parted ; pinnulæ broadly sword-shaped, slightly narrowed at base, erecto-patent, incurved, acute, more or less denticulate, especially toward the apex, areolated with cells ; fruits marginal, the tetraspores (?) in densely paniculate, pedicellate glomeruli alternating with the pinnulæ ; favellæ similarly placed, involucrate, the branches of the involucre entire or dentate. *β concinna* ; pinnules sharply inciso-serrate.

HAB. North California, *Wosnessenski!* Golden Gate, *Capt. Pike!* Var. *β*, with the preceding, *Capt. Pike.* (v. s. in Herb. T. C. D.)

*Fronde*s six or eight inches long, repeatedly pinnate, the primary and secondary pinnæ long and virgate, the rest short, ramuliform. Branches strongly compressed, half a line wide, erecto-patent, much attenuated at their insertion. *Pinnulæ* between lanceolate and sword-shaped, slightly narrowed, not the least decurrent at base, incurved, acute, sometimes almost entire, but generally sharply denticulate, or unequally serrate. *Favellæ* pedicellate, marginal, solitary or numerous in the spaces between the pinnules. *Tetraspores* appear to occupy the same place, but I have not seen perfectly formed ones : in my specimens there are minute, paniculately branched glomeruli, but whether intended for antheridia or tetraspores I have not determined. *Colour*, dark purple-red.

This species is very nearly allied to *P. asplenioides*, from which it chiefly differs in the narrower, not decurrent pinnules, evidently narrowed at the base. It differs from *P. serrata* more in its virgate habit and dark colour than by any very precise characters, unless that noticed in the glomeruli of tetraspores may be constant. The serratures of the pinnulæ are exceedingly variable, each of *Capt. Pike's* specimens differing in the degree of incision.

5. *PTILOTA serrata*, Kütz. ; frond plano-compressed, two-edged, decompound-pinnate ; pinnæ and pinnulæ opposite, unlike ; one undivided serrated, the other (abortive or) pinnately parted ; pinnulæ broadly subulate, very patent, acute, sharply serrated, especially on the outer edge, areolated with cells ; fruits marginal,

the tetraspores in conical, pedicellate glomeruli, alternating with the serrated pinnulæ; favellæ similarly placed, involucrate, the branches of the involucre entire or coarsely toothed, cellular. *Kütz. Bot. Zeit.* 1847, p. 36. *J. Ag. Sp. Alg.* 2, p. 96. *Ptilota plumosa* β *asplenioides*, *Lyngb. t.* 9, f. 2. (*Excl. Syn.*)

HAB. Pacific Coast at Sitcha, *Ruprecht*. Greenland and Newfoundland, *J. Agardh*. Arctic Coast, *Sir John Richardson*. Halifax, *W. H. H.* Boston Bay, *Dr. Asa Gray*, *Mrs. Mudge*, *Mr. Emerson*, *W. H. H.*, &c. (v. v.)

Fronde four to six inches long, the stem plano-compressed, half a line in breadth, distichously much branched, the branches decompose-pinnate, all divisions of the frond very patent, almost issuing at right angles. *Pinnæ* and pinnulæ of every series exactly opposite, except by accidental suppression, but of different size and aspect: one of each pair a line long, horizontal, broadly subulate, sharply serrated especially on the outer edge, acute, seldom lengthening and never much lengthened, in the older parts of the frond generally broken, or worn: the other pinna elongate, pinnated and lengthening out into a branch which becomes again compounded by its pinnæ also lengthening in a similar manner. In this way the frond finally consists of several series of short-serrated, and of longer-pinnated opposing pinnæ. The *favellæ* are formed in the apices of the pinnated (or compound) ramuli, which are then abbreviated to a line or two in length; the branches of their involucre are subulate, either entire or with three or four coarse teeth. *Tetraspores* in dense conical heads, also formed from suppressed branches, alternating with the serrated pinnæ. *Substance*, cartilaginous. *Colour*, a deep, full red, becoming brighter in fresh water. In drying, it does not adhere to paper.

This has the colour, size, and general aspect of *Pt. plumosa*, with which I have been hitherto accustomed to unite it, nor am I very certain that the characters here pointed out as distinguishing it are to be relied upon as sufficient. The strongest character will perhaps be found in the tetrasporic fruit: that in the ramification is, I fear, less constant. The elder *Agardh* at one time, and *Lyngbye* both referred it to *Pt. asplenioides*, from which it is readily distinguished. *Agardh* afterwards made it a variety of *Pt. plumosa*. *Kützing* in 1847 first gave it a specific name, but subsequently, in 1849, reduced it again as a variety, under *Pt. plumosa*. Professor *J. Agardh*, however, restores the species, and points out with his usual acumen the characters by which it may be known from *Pt. plumosa*.

These characters, so far as they depend on ramification, are not perfectly satisfactory to me, for I find the serrated ramuli of *Pt. serrata* showing an occasional disposition to lengthen into branches; and again, on *Pt. plumosa* one of the opposing ramuli is, in the younger branches, frequently abortive, in which case the ramuli are alternately unequal, as in *Pt. serrata*. If the ramulus which is formed were always clearly pinnated as it ought to be in *Pt. plumosa*, there would be no doubt of the validity of *Pt. serrata*; but though this is commonly the case, yet I have specimens of the former species in which slightly serrated, or nearly entire ramuli alternate with pinnated ones in some parts of the frond. Both species occur together in Norway, but *Pt. serrata* has not yet been found in Britain. Almost all the

American specimens before me are clearly referable to *Pt. serrata*; nevertheless, Sir John Richardson collected on the Arctic coast both the true *Pt. plumosa* and *Pt. serrata*. Finally, and this is rather puzzling, I have a specimen from Prince Edward's Island somewhat intermediate in character between both species, but having the preponderance in favour of *Pt. plumosa*, and yet being unlike any European specimen of that species which I have seen.

On the whole I am disposed, for the present, to adopt this species, considering it more critically characterised in doubtful cases by its fructification than by its ramification.

SECT. 2. SIMILIFOLLÆ: *Pinnæ opposite, of similar nature, either both of the same length or one longer, one shorter than the other; the longer alternating on the rachis.*

6. *PTILOTA plumosa*, Ag.; frond plano-compressed, two-edged, decompose pinnate; pinnæ and pinnulæ opposite, similar in form, but one frequently shorter than the other, the shorter pinna simply pinnate, not altering; the longer developing into a branch, becoming compound; ultimate pinnated ramuli, by suppression of the opposing ramuli, frequently alternate; pinnellæ subulate, areolated with cells, acute; favellæ formed either on the pinnæ or pinnellæ, involucrate, the branches of the involucre subulate, entire; tetraspores on marginal processes of the pinnellæ. *J. Ag. Sp. Alg.* 2, p. 96. *Harv. Phyc. Brit. t.* 80. *Fucus plumosus*, L.—*Turn. Hist. t.* 60. (*excl. var. β.*), *E. Bot. t.* 1308.

HAB. Parasitical on the stems of *Laminariæ*, &c. Prince William's Sound, North West America, 1787, *Mr. Menzies*! Arctic Sea Coast, *Sir John Richardson*! Prince Edward's Island, *Dr. Jeans*. (v. v.)

Very like the preceding in aspect, and only to be known by the characters detailed in the above descriptions and remarks. The different position of the tetraspores is perhaps the most valid character.

The true *Pt. plumosa* is of very rare occurrence in America. That which commonly passes under this name, in collections made to the North of Cape Cod, is *Pt. serrata*; that in those made to the south of that head-land is *Pt. elegans*. I have examined and compared specimens of the true *Pt. plumosa* from the above localities, with European individuals, and consider them specifically identical.

7. *PTILOTA elegans*, Bonnem.; frond flaccid, filiform, terete, decompose-pinnate; pinnæ and pinnulæ opposite, similar, both pinnately parted, the opposing one either of equal size or one smaller than the other; the younger pinnæ and all the ultimate pinnules articulate, composed of a single series of large, sub-quadrangle cells, obtuse, linear (not attenuated); tetraspores terminating the ramuli, at length polysporous; favellæ binate, naked, or sub-involucrate, on the pinnæ. *Bonnem. Hydr. p.* 22. *Kütz. Phyc. p.* 378. *J. Ag. Sp. Alg.* 2, p. 94. *Pt. sericea*, *Harv. Phyc. Brit. t.* 191.

HAB. Generally on rocks, rarely on the stems of the littoral Fuci. Boston Bay, at Beverley, *W. H. H.* Newport, *Prof. Bailey, Mr. Olney, &c.* Squan Beach, New Jersey, *Miss Morris.* (v. v.)

Fronde three to six inches long and as much in the expansion of the branches, as thick as hog's bristle at the base, attenuated upwards, terete, not compressed or two-edged, decompound-pinnate; the larger branches irregularly alternate and of unequal length, the lesser close together, opposite, either of equal length or one of each pair short, the other longer and more compound. The lesser branches are linear-oblong or somewhat obovate in outline, their upper subdivisions being successively longer than the lower; they are twice or thrice pinnated. All the divisions, except by suppression, are strictly opposite, but towards the extremities one of the opposing pinnæ is often imperfectly formed. The pinnules and all the younger pinnæ are articulate, composed of a single row of large, quadrate or slightly oblong cells; they are slightly incurved, of equal diameter throughout, very obtuse, and those along the outer edge of the rachis are generally longest, and are frequently pinnellated at the tips. *Tetraspores* borne on the tips of the ultimate pinnules, at first containing four sporules, afterwards eight or a larger number, when they resemble favellæ. *Colour* a brownish purple, rather dark; a clear purple-lake under the microscope. *Substance* soft. In drying, it closely adheres to paper.

A smaller and softer plant than any of the preceding and readily known by its articulated pinnules.

V. CROUANIA. *J. Ag.*

Fronde filiform, gelatinous, nodoso-moniliform, alternately decompound, consisting of an articulated, monosiphonous primary filament (or axis) emitting at the nodes densely whorled, minute, dichotomo-fastigiate, gelatinous, free ramelli. *Favellæ* near the ends of the branches sub-solitary, affixed at the base of the whorled ramelli and covered by them, containing, within a hyaline periderm, numerous roundish spores. *Tetraspores* fixed at the base of the ramelli, partly hidden by them, roundish, triangularly parted or transversely bi-parted.

Very flaccid, gelatinous Algae of small size with moniliform branches, resembling in habit the species of the fresh water genus *Batrachospermum*. In artificial character they nearly coincide with the species of *Halurus*, but differ essentially in the position of the fructification, and in the substance of which the frond is composed. The young branches are nearly cylindrical, the whorled ramelli forming a scarcely interrupted periphery. As the frond increases in age, the whorls are

removed further apart by the elongation of the internodes, and the branches become beaded at intervals.

1. *CROUANIA attenuata*, J. Ag.; frond attenuated upwards; the tetraspores solitary, triangularly parted. *J. Ag. Sp. Alg.* 2, p. 105. *Harv. Phyc. Brit. t.* 106. *Callithamnion nodulosum*, Kütz. *Sp. Alg.* p. 651. (TAB. XXXI. D.)

HAB. Key West, *W. H. H.*, 68, 69; *Dr. Blodgett*, 56, 61. (v. v.)

Fronde tufted, one to two inches long, capillary or setaceous, irregularly branched; branches lateral, alternate or secund, or sub-dichotomous, more or less divided; the lower ones moniliform, the upper more and more cylindrical from the greater closeness of the whorls of ramelli; the apices attenuated to a fine point. *Colour*, a dull, dark purple.

The Key West specimens are much infested with calcareous matter and do not recover well after having been dried. The magnified sketch in our figure was made on the spot, from fresh specimens.

Plate XXXI. C. *Fig.* 1. *CROUANIA attenuata*; a tuft, the natural size. *Fig.* 2, a branch; *fig.* 3, one of the ramelli from the same; *fig.* 4, occasionally trichotomous apices of a ramellus; the latter figures more or less highly magnified.

VI. HALURUS. Kütz.

Frond cartilaginous, filiform, articulated, monosiphonous, irregularly branched; branches clothed at the nodes with short, incurved, dichotomous, whorled ramuli. *Favellæ* generally several in a cluster, borne on the apex of a shortened branch, and sub-tended by a whorl of involueral ramuli, containing, within a hyaline periderm, numerous angular spores. *Tetraspores* attached to the interior side of the branches of an involucre formed of dichotomous ramelli, numerous, spherical, triangularly parted.

This genus has been separated by Kützing from *Griffithsia*, with which it nearly but not exactly agrees in the fructification, and from which it differs in external habit. The plants of the present group have, except in colour, very much the appearance externally of the *Cladostephi*.

1. *HALURUS equisetifolius*, Kütz.; frond irregularly branched, the branches directed to every side; whorled ramuli incurved, forked or dichotomous, densely set, their

articulations four to eight or twelve times as long as broad. *Kütz. Sp. Alg. p. 662.*
J. Ag. Sp. Alg. 2, p. 90. *Griffithsia equisetifolia, Ag.—Harv. Phyc. Brit. t. 67.*
Conferva equisetifolia, E. Bot. t. 1479. Dillw. t. 54.

HAB. (A specimen sent to me by Mr. Hooper, of Brooklyn, without locality marked; *W. H. H.*)

Stems six or eight inches long, robust, much and very irregularly branched; the branches alternate or fascicled, undivided, but set with one or more series of lateral branches. All the parts of the frond are clothed with ramelli. On the older parts of the stem and branches these form an irregular shaggy coating; but on the younger portions they are regularly whorled at the nodes, once or twice or many times forked, imbricated, with the apices generally incurved. The articulations vary much in length in different specimens. *Colour*, when recent, a fine dark, crimson-lake. *Substance* firm. It gives out a carmine tint when plunged for a short time in fresh water.

I regret that I cannot say from what part of the American Coast Mr. Hooper procured this plant, of which I have as yet seen but a small fragment; but it is sufficient for identification.

VII. GRIFFITHSIA. *Ag.*

Frond filiform, dichotomous, articulated, monosiphonous, naked. *Favellæ* generally several in a cluster, subtended by a regular involucre formed of numerous incurved ramelli, sessile or pedunculate, containing, within a gelatinous periderm, numerous angular spores. *Tetraspores* contained within an involucre formed of incurved ramelli, spherical, attached to the inner faces of the ramelli, at length triangularly parted.

A large genus of rose-red or crimson, filiform, articulated Algæ of a delicately membranaceous or sub-gelatinous substance, soon decomposing in fresh water. The frond consists of a single series of large, elongated cells, with very transparent walls, forming a broad limbus to the brilliantly coloured bag of endochrome contained within. The branching is on a dichotomous model, occasionally varied by the production of lateral branches, or converted partially into a trichotomous type. The species are dispersed through the Northern and Southern Hemispheres. I can claim only the following as yet for the North American Flora.

1. *GRIFFITHSIA corallina* ? Ag.—*J. Ag. Sp. Alg.* 2, p. 78, &c. Var. β *globifera* ; filaments capillary, the lower articulations many times longer than broad, but slightly swollen ; the upper and terminal ones inflated, pyriform or globose. *Griffithsia globifera*, *Harv. MS.* (TAB. XXXV. A.)
 Var. γ , *tenuis* ; of small size, all the articulations slender, but slightly swollen upwards, the terminal ones attenuated.

HAB. Vars. β and γ on *Zostera*, at Greenport, Long Island, *Prof. Bailey* and *W. H. H.* Providence, *Mr. Olney*. New Bedford, *Dr. Roche*. Port Jefferson, *Mr. Lounsbury*. Key West, (a fragment only) *W. H. H.* (v. v.)

In var. β the frond is capillary or setaceous, two to three inches high, densely tufted, many times dichotomous, more or less fastigiate, the upper branches sometimes, by abortion, alternate or secund ; the lower axils patent, the upper more erect. *Internodes* more or less swollen upwards, the lower ones many times longer than their diameter and little swollen ; the upper shorter, either pyriform or elliptical ; the terminal very frequently globose, much inflated, twice or thrice the diameter of that immediately below it. *Favellæ* sessile on the apex of an internode of the branches, especially of the upper ones, occupying the position of a suppressed arm of a dichotomy, subtended by a few short ramelli, one or more favellæ in each involucre. *Colour* rose-red, rapidly discharged in fresh water. *Substance* soft, gelatinoso-membranaceous, closely adhering to paper in drying.

In var. γ , the frond is one to four inches high, the lower articulations very long, some of them cylindrical, others slightly pyriform ; the upper articulations more frequently pyriform, and the terminal ones slender, the branches often tapering to a fine point. I have not seen fruit on this variety.

These two varieties appear distinct enough *on paper*, not merely from each other, but from the common European state of *Griff. corallina* ; and at first I had set aside var. β as a species, characterised by the terminal, vesicular cell. Afterwards on gathering a large number of specimens of both forms at Greenport, where they are common in August, I found some that had the peculiarities of var. β and γ combined on the same frond, and others that approached in essential characters to the ordinary *G. corallina*. None, however, that I have seen from America can be said to be absolutely similar to those from Europe, as all, however much they may put on the characters, are much more slender than any European specimens I have seen. Possibly future observations may require the establishment of a new species for these American varieties.

Plate XXXV. A. *Fig. 1.* *GRIFFITHSIA corallina*, var. *globifera*, the natural size. *Fig. 2,* a portion of the frond *magnified.* *Fig. 3,* apex with favella ; and *fig. 4,* spores ; highly *magnified.*

VIII. CALLITHAMNION. *Lyngb.*

Fronde filiform, branched, articulated, monosiphonous, the stem and branches (in many species) at length rendered opaque by the development of decurrent filaments in the walls of the primary cells; ramuli always articulated, monosiphonous. *Favellæ* generally binate, axillary or sessile on the branches, naked or nearly so, containing, within a hyaline periderm, numerous angular spores. *Tetraspores* naked, sessile or pedicellate, distributed along the ramuli, oblong or globose, triangularly or cruciately parted.

A very large genus of beautiful Algæ, sometimes minute, never of large size, rarely exceeding six inches in length. The fronds in the least developed species are but slightly branched, a line or two long, parasitical, forming a down-like covering to the plants on which they grow. Others, a little more perfect, grow on rocks, on which they form dense, cushion-like tufts, from a quarter inch to an inch in height. Some few have their smaller branches and ramuli dichotomously multifid. The greater number, however, are branched on a more or less regularly pinnate type; the pinnæ and pinnulæ either opposite or alternate, rising singly or in pairs from the upper extremity of every internode. In some species every part is exactly distichous: in others the lower branches and larger divisions spread to all sides, while the lesser ones are distichous: and again, in others all the branches and their subdivisions spread in every direction. In the smaller species the whole frond is pellucidly articulate, composed of a single series of thick-walled, endochromatic cells arranged end to end; and such is the structure of the young frond in all. In the larger species, as the frond increases in age, filaments, originating in the bases of the branches, begin to be developed longitudinally in the substance of the walls of the frond. At first they are few and short, afterwards numerous and prolonged in a downward direction, and at last they completely fill the wall, rendering it opaque and concealing the articulations completely. In the strongest growing species the walls become at length very much thicker than the enclosed tube, and completely filled with such decurrent filaments.

The species are often very difficult of determination, forming numerous and most puzzling varieties. They often require very copious materials to work on before they can be well understood, and in some cases I labour under the disadvantage of having received imperfect materials. Some of the following species present so many forms, that before I had compared together very extensive suites, I was disposed to separate into four or five what I now regard as a single species. And though my friend Prof. Agardh has considerably curtailed the species as described by other writers, I fear that of the sixty-three which his work still admits, several should be struck off. To come to right conclusions on this point, the species should be studied on the sea shore, before the specimens have been dried, for the characters of many are of so delicate a nature, that they are apt to be saved or lost, according as the

specimen is well or ill dried. For the convenience of easy reference, I divide the American species into the following six sections :—

SECT. 1. FRUTICOSA : *Fronde shrub-like, the stem and branches more or less filled with veins, imperfectly articulate. Ramuli pectinate or pinnate, the pinnæ alternate or secund.*

1. CALLITHAMNION *Pikeanum* ; frond robust, fruticose, with an undivided, opaque stem, set with alternate, similar branches directed to every side ; branches alternately decomposed, opaque, the lesser divisions densely beset on all sides with minute, imbricated, articulated ramuli ; ramuli divaricate, pectinate or bi-pectinate on the outer side (the naked side directed to the rachis), the ultimate divisions spreading at right angles, subulate, sub-acute ; articulations of the ramuli once and half as long as broad ; tetraspores tri-partite, sessile, one or more together on the ultimate ramuli.

HAB. Golden Gate, California, *Capt. Nicholas Pike.* (v. s. in Herb. T. C. D.)

Fronde solitary ? *Stem* four to five inches high, half a line in diameter at the base, undivided, slightly attenuated upwards, opaque, set with similar, opaque, alternate branches, which again bear a second or third series of similar, but smaller branches. *Branches* directed to every side, the larger ones either naked or clothed with minute, hair-like ramuli, the lesser ones very densely set on all sides with minute, multifid ramuli, one to two lines in length. These ramuli alone are pellucidly articulate, the articulations once or twice as long as broad. They are set at right angles to the branches from which they spring, but are curved or arched inwards, so as to present to the branch the concave face, which is bare of ramelli ; the convex or outward face being pectinated with horizontally patent or divaricated, spine-like, simple or again pectinellated ramelli. *Tetraspores* roundish, triangularly-parted, sessile, or borne on the ultimate divisions of the ramuli. *Favellæ* I have not seen. The *colour* is a dark, vinous purple. The *substance* is firm and rather rigid. It imperfectly adheres to paper in drying.

This species is very different from any American one known to me, but is nearly related to the European *C. Arbuscula*, and still more closely to the South African *C. purpuriferum*, J. Ag. ; but appears to be distinct from both. It is a stronger growing plant than *C. Arbuscula*, with more squarrose and thicker ramuli. From *C. purpuriferum* it differs in colour, in the ramification of the ultimate ramuli, in the much greater opacity of the stem and branches, the structure of the tetraspores, &c. I have pleasure in bestowing on it the name of Captain Nicholas Pike, of Brooklyn, an ardent student of marine plants, to whom I am indebted for a very interesting collection of Californian Algæ, among which was this species.

2. CALLITHAMNION *tetragonum*, Ag. ; frond ultra-setaceous, shrub-like, with a per-

current stem and pyramidal outline ; branches lateral, directed to every side, simple or alternately decomposed, densely clothed with short, pinnato-multifid, fastigate plumules ; ramuli divaricate, subulate ; articulations of the stem and larger branches veiny, once or twice as long as broad, of the ramuli about twice as long as broad, cylindrical or contracted at the nodes ; tetraspores very minute, tripartite, near the tips of the ramuli. *J. Ag. Sp. Alg.* 2, p. 53. *Harv. Phyc. Brit.* t. 136. *Phlebothamnion tetragonum*, *Kütz. Sp. Alg.* p. 654. *Callithamnion brachiatum*, *Harv. Phyc. Brit.* t. 137. *Conferva tetragona*, *Dillw. Conf.* t. 65. *E. Bot.* t. 1690.

HAB. Newport, Rhode Island, *Mr. Olney, Dr. Durkee.* Narragansett Pier, *Mr. Hunt.* Seconnot, *Mr. C. Congdon.* Greenport, *Prof. Bailey.* (v. v.)

Fronds three to four inches high. *Colour*, a fine lake or red brown. *Substance* gelatinoso-cartilaginous.

The American specimens here described are not quite so robust as the European plant, but some of them are in other respects very similar. Others, again, show a tendency to pass into *C. Baileyi*, and almost shake my opinion of the validity of that species ; and yet its *extreme* forms are so different from the *nearest* form of *C. tetragonum*, that I dare not, as species are at present understood, unite them.

3. CALLITHAMNION *Baileyi*, Harv. ; frond setaceous, shrub-like, with a percurrent stem ; branches lateral, directed to every side, simple or alternately decomposed, densely ramulose ; lesser branchlets spirally inserted, somewhat plumulate, or fasciculato-multifid, zig-zag ; ramuli alternate, subulate, incurved, acute ; articulations of the lower stem veiny, twice or thrice as long as broad, of the branches swollen at the nodes, thick-walled, without veins, three or four times as long as broad ; of the ramuli cylindrical, about thrice as long as broad ; tetraspores solitary, elliptical, on the inner faces of the ramuli ; favellæ binate. *Harv. in Bail. list of Algæ, Sill. Journ.* vol. 4, 2d. Ser., p. 38. (TAB. XXXV. B.) Var. β *boreale* ; stem pellucidly articulate, its medial articulations four or five times as long as broad, those of the branches cylindrical, and of the ramuli longer than in var. *a*. Var. γ *Rochei* ; more slender than usual and very plumose ; the ramuli elongate, patent, crowded at the ends of the branches. Var. δ *squarrosus* ; plumules short and little divided ; ramuli short, squarrose.

HAB. New Brighton, *Prof. Bailey.* Abundant in New York Bay, *Prof. Bailey.* Messrs. Hooper, Pike, &c., W. H. H. β , Boston Bay in various places, *Mrs. Mudge, Dr. Durkee, Miss Brewer, &c.* γ , New Bedford, *Dr. Roche.* δ , Red Hook, *Mr. Hooper.* (v. v.)

Fronds tufted or solitary, shrub-like. *Stems* as thick as hog's bristle, two to three inches long, generally undivided and closely beset on all sides with similar, undivided, long lateral branches, the lowest of which are longest, the rest successively shorter, so that the outline of the frond is pyramidal. In luxuriant specimens

these primary branches bear a second or third series of similar lesser branches. *Branches* densely set with short, spirally inserted branchlets, the lowest of which are simple or bifid, the upper more compound or somewhat plumulate; the *plumule* either pinnate or bi-pinnate, the upper pinnules being frequently pinnellate. *Ramuli* subulate, mostly incurved, tapering to a fine point. *Articulations* variable in length; those of the main stem generally veiny, sub-opaque; those of the branches destitute of veins except in very old specimens, swollen at the nodes, with narrow endochrome and thick, hyaline walls; those of the ramuli from three to four or five times as long as broad. *Tetraspores* mostly solitary, near the middle of the ramuli. *Favellæ* in pairs on shortened plumules. *Colour*, a fine, dark red. *Substance* rather soft. It closely adheres to paper in drying.

The original specimens received from Prof. Bailey appeared, when I first examined them, to constitute a well marked species, readily distinguishable from all others; and specimens sent to me from various correspondents, and others collected by myself at New York, agree with them in all essential characters. But many other specimens have also reached me which vary greatly from the type, especially in the length of the articulations, and yet which are too closely connected with the first specimens to warrant their specific separation. In our var. β *boreale*, which is the common form of the species in Massachusetts Bay, the frond is more pellucid, of a brighter colour, with longer internodes. But the most delicately beautiful feathery specimens are those received from Dr. Roche of New Bedford, which are so unlike the New York plant, that but for the Boston variety just mentioned, I should hardly have ventured to unite them. Again, the most robust forms, with shortest joints, approach *inconveniently* near to *C. tetragonum*, from which species the more delicate ones appear widely different. Future observations may perhaps show that Dr. Roche's specimens should be separated; but if this be done, what I now regard as a single species must be split into four or five.

Plate XXXV. B. *Fig. 1.* CALLITHAMNION *Baileyi*; the *natural* size. *Fig. 2.* plumule and part of lesser branch of the var. β *boreale*; *fig. 3.* favellæ from the same; *fig. 4.* part of stem of the normal variety (*a*); *figs. 5 and 7.* plumules from the same; *fig. 6.* a ramulus, with tetraspores; the latter figures more or less *magnified*.

SECT. 2 ROSEA: *Fronds capillary or byssoid, densely tufted, articulated throughout, (the older parts of the stem veiny, but not opaque) decompose-pinnate; pinnæ and pinnules alternate.*

4. CALLITHAMNION *squarrulosum*; frond setaceous, distichous; stem and larger branches veiny toward the base, but visibly articulate throughout, percurrent, set with lateral, flexuous, alternate branches, which are naked or with a few squarrose ramuli below and alternately decompose beyond the middle; secondary branches of unequal lengths, very patent, laxly set with alternate, simple, bifid or pinnulate divaricating, obtuse ramuli; articulations four or five times as long as broad, the cell-walls thick and endochrome narrow.

HAB. Golden Gate, California, *Capt. N. Pike*. (v. s. in Herb. T. C. D.)

Fronde two to three inches high, as thick as hog's bristle below, tapering to a capillary diameter above. *Stem* percurrent, slightly flexuous, set with alternate, distichous, sub-horizontal branches, the lowest of which are longest. General outline of the frond ovate. *Branches* flexuous, naked in the lower half or with a few squarrose ramuli, alternately branched beyond the middle; the secondary branches of very unequal lengths, ziz-zag, simple or variously decomposed, sometimes resolved into an intricate, thorny, bushy head. *Ramuli* all very patent, alternate, variously compound, some quite simple, some bifid or trifid, and some pinnulate, the pinnelli divaricating. *Stem* veiny below, but not opaque. *Articulations* of nearly uniform length in all parts of the frond, except toward the base of the stem. *Cell* walls remarkably thick. No fruit seen.

Of this apparently distinct species I have seen but a single specimen, and probably the specific character and description may require to be revised and corrected. Had the specimen come from the Atlantic Coast I should hardly have ventured to propose a species on such imperfect materials.

5. *CALLITHAMNION Borreri*, Ag.; fronds densely tufted, capillary, pellucidly articulate to the base, pinnately or flabellately branched; branches beset in their lower part with spirally inserted, mostly simple, elongate ramuli, distichously plumulate above; plumules fan-shaped, bare of ramuli in the lower half, simply pinnate beyond the middle; the pinnæ patent or incurved, not much tapered, obtuse; articulations of the branches two to six times, of the pinnæ twice or thrice as long as broad; tetraspores numerous on the inner face of the pinnæ. *J. Ag. Sp. Alg.* 2, p. 49. *Harv. Phyc. Brit.* t. 159. *Kütz. Sp. Alg.* p. 643. *Conferva Borreri*, *E. Bot.* t. 1741.

HAB. New Bedford, *Dr. Roche*. Newport and Newhaven, *Dr. Durkee*. Seconnot, *Mr. Congdon*. New York, *Messrs. Walters, Hooper, Calverley, &c.* (v. v.)

Tufts one to three inches high, dense, sub-fastigiate. *Filaments* decomposed from the base, the lower branches spreading to all sides, often of nearly equal length; the lesser branches irregularly inserted, either naked in their lower half, or beset with long, simple, hair-like ramuli, distichously plumulate beyond the middle. The *plumules* are petiolate, or naked below, pinnate above. Pinnæ spreading, obtuse. *Articulations* throughout the plant (except rarely near the base of the stem) destitute of veins; those of the stem very variable in length in different specimens, sometimes only twice or thrice, sometimes four to six times as long as broad; those of the ramuli more uniform, and mostly contracted at the nodes. *Tetraspores* on the inner face of the ramuli, sometimes few, sometimes many.

More slender and softer than the common European form; and had my attention been confined to Mr. Congdon's specimens I should possibly have described them as a

distinct species. But Dr. Roche's specimens above noticed seem to connect Mr. Congdon's with some European varieties of this variable species.

At Greenport, Long Island, I collected a *Callithamnion*, infested by parasites and otherwise in bad order, which at present I doubtfully refer to *C. Borreri*. These specimens are more robust than the other North American ones, but not more so than European states of the species, and despite some minor peculiarities I hesitate to pronounce them different. Possibly more perfect specimens would compel us to separate them.

6. *CALLITHAMNION polyspermum*, Ag.; fronds densely tufted, capillary, much branched, pellucidly articulate nearly to the base, decompose pinnate; main branches either naked or ramulose below, distichously plumulate above; plumules linear or oblong in outline, simply pinnate; pinnæ incurved, obtuse, cylindrical, nearly equal in length, the uppermost sometimes pinnulate near the tips; articulations of the stem mostly veinless, three or four times, of the pinnæ twice or thrice as long as broad; tetraspores elliptical, solitary, or two or more together near the base of the pinnæ. *J. Ag. Sp. Alg.* 2, p. 48. *Harv. Phyc. Brit. t.* 231. *Phlebothamnion polyspermum*, Kütz. *Sp. Alg.* p. 653.

HAB. Hellgate, New York, Mr. J. Hooper. Jackson Ferry, Messrs. Walters and Pike. Sullivan's Island, Charleston, Prof. L. W. Gibbes and W. H. H. St. Augustine, Florida, Prof. J. W. Bailey. (v. v.)

Tufts two to three inches high. Filaments capillary, irregularly branched from the base, the main branches frequently naked below and distantly divided, their divisions decompose-pinnate or closely plumulate in the upper half. Plumules distichous, broadly oblong or linear, rounded at the top, scarcely petiolate, the lowest pinnæ generally springing from the second articulation counting from the base of the rachis; pinnæ simple, linear and obtuse, the upper ones not remarkably shorter than the lower. Tetraspores frequently solitary on the second or third joint from the base, elliptical, sometimes two or three or more on the same pinnule. Favellæ, near the ends of shortened plumules, in pairs. Colour, a fine purplish-red, given out in fresh water. Substance, soft, but not gelatinous. It closely adheres to paper in drying.

A variable species, allied on the one hand to *C. Borreri*, and on the other to *C. roseum*. The above description is taken exclusively from American specimens, which, though not strictly agreeing with the typical state, figured in *Phyc. Brit.*, are very similar to many specimens from the South of England; particularly to those from Plymouth Harbour.

7. *CALLITHAMNION byssoideum*, Arn.; fronds densely tufted, of extreme tenuity, very flaccid and tender, pellucidly articulate nearly to the base, excessively

branched; lower branches irregularly divided, the upper decompose-pinnate and plumulate; plumules flexuous, distantly and rather irregularly pinnate, the pinnæ alternate or secund, slightly tapering, obtuse, often ramulose toward the point; articulations of the branches six or eight times, of the ramuli three to six times as long as broad; tetraspores elliptical, tripartite, secund, several on each pinna; favellæ binate. *J. Ag. Sp. Alg.* 2, p. 40. *Harv. Phyc. Brit. t.* 262. *Phlebothamnion byssoides*, *Kütz. Sp. Alg.* p. 657. *Callith. arachnoideum*, *Ag. Sp. Alg.* p. 181. Var. β *unilaterale*; of smaller size and still greater tenuity than the ordinary form; the branches and ramuli very frequently secund, the plumules irregular, sometimes alternately pinnate, sometimes secundly pectinate. *Cal. unilaterale*, *Harv. MSS.* (not of Zanard.) Var. γ *fastigiatum*; branches fastigiate, the lesser ones densely ramulose at the tips. Var. δ *Waltersii*; more rigid than usual, the upper branches distichously decompose-pinnate, ramuli remarkably patent.

HAB. New York Harbour, in several places from Hellgate to Port Hamilton, *Messrs. Hooper, Walters, Congdon, Calverley, &c.* Var. β , Massachusetts Bay, *Mrs. Mudge, Dr. Durkee, Miss Mitchell, Capt. Pike, &c.* Greenport, *Prof. Bailey, W. H. H. &c.* (v. v.)

Tufts large and dense, one to three inches high. *Filaments* much finer than human hair, excessively flaccid, soft and sub-gelatinous, collapsing into a clot when removed from the water, much branched; the lower branches very irregular, sometimes close together and dividing at short intervals, sometimes more distantly branched; the upper branches repeatedly decompose-pinnate. *Plumules* sometimes long and virgate, narrow, simply pinnate or having the upper pinnules pinnellate or secundly ramulose; sometimes shorter and more ovate, and frequently with a flexuous rachis. *Articulations* destitute of veins, except near the base of the stem, many times longer than broad in the larger branches, four or five times or more in the smaller, cylindrical. *Tetraspores* on the inner face of the pinnulæ, few or several, secund, elliptical. *Favellæ* not seen on American specimens. *Colour*, a fine purplish rose-red. *Substance* very tender.

Var. β is smaller and still more slender than the common form, with longer internodes, and its typical state is readily known by the strong tendency to secund ramification; but this character is very variable.

In some of the numerous and beautifully preserved specimens with which Mr. Walters has favoured me, the ends of the upper branches are remarkably fastigiate and densely ramulose, and the external aspect is strikingly similar to that of *C. corymbosum*. Another specimen from the same gentlemen, dated July 6, 1851, has, to the naked eye, the aspect of *C. gracillimum*, the upper branches being distichously decompose-pinnate, with an ovate outline; all the ramuli remarkably patent and even recurved, the ultimate ones very generally secund. The substance appears rather more rigid than usual; and had I received this specimen alone it might possibly have passed for a distinct species; but after comparison with a large number of North American specimens of *C. byssoideum*, I fear its distinctive

characters are not sufficiently marked. Meantime I indicate it above as var. δ *Waltersii*.

8. *CALLITHAMNION Dietziæ*, Hooper ; fronds capillary, pellucidly articulate nearly to the base, the lower part of the percurrent, distichously-pinnate stem veiny ; branches alternate, simple, set at each node with short, alternate, sub-simple or pinnato-dichotomous plumules, and often terminated by a dense fascicle of ramuli ; rachides zig-zag ; articulations of the stem six or eight times, of the rachides three or four times, of the ramuli eight or ten times as long as broad ; apices sub-attenuate, obtuse, or sub-acute ; tetraspores elliptical, tripartite, solitary on the uppermost ramuli.

HAB. Greenport, *Mrs. Dietz*. (v. s. in Herb. Hooper.)

Fronds tufted, two to three inches long, as thick as human hair. *Stem* either simple or divided near the base into several, long, simple, erect, main divisions, set throughout with alternate, patent, elongate, simple branches, which, in luxuriant specimens, probably bear a second set of similar smaller ones. Outline of the frond ovato-lanceolate. *Branches* alternate or sometimes secund, sub-distichous, articulate, each node bearing at alternate sides of the branch, a pinnato-dichotomous branchlet or plumule. *Plumules* with a zig-zag rachis, either short with three or four pinnæ, or lengthening out, simply pinnate in the lower half, bi-pinnato-dichotomous above, each pinnule ending in a dense tuft of undeveloped ramuli. *Articulations* of the lower part of the stem three or four times as long as broad, veiny, with a narrow tube ; of the branches with thick, pellucid walls, six or eight times ; of the rachides of the plumules shorter, but of the ultimate pinnules six to eight or ten times as long as broad. *Colour*, a beautiful rosy-red. *Substance* soft, closely adhering to paper. *Tetraspores* tripartite, elliptical, solitary on the ultimate ramuli, formed from the suppressed arm of a furcellation.

Of this plant I have yet seen but few specimens ; too few to form a decided opinion on its specific validity. Notwithstanding its pinnate habit I am not without fears that a more extensive suite of specimens may show it to pass off into one of the forms of *C. corymbosum* or *C. versicolor*. The specific name is bestowed by Mr. Hooper in honour of its discoverer, *Mrs. Dietz* of New York.

SECT. 3. CORYMBOSA ; *Fronds setaceous or byssoid, alternately decomposed ; the secondary branches and ramuli dichotomous, corymboso-fastigiate.*

9. *CALLITHAMNION corymbosum*, Ag. ; fronds tufted or solitary, flabelliform, pellucidly articulate throughout ; stem and lower branches setaceous below, attenuated upwards to a byssoid fineness, decomposed, much branched ; upper branches byssoid, excessively flaccid, pinnato-dichotomous or alternately or secondly decom-

pound; the lesser and ultimate divisions dichotomously multifid and fastigate; articulations of the branches six or eight times as long as broad, of the ramuli shorter; tetraspores solitary on the ramuli, tripartite. *J. Ag. Sp. Alg.* 2, p. 41. *Harv. Phyc. Brit. t.* 272. *Phlebothamnion corymbosum*, *Kütz. Sp. Alg.* p. 657. *Conferva corymbosa*, *E. Bot. t.* 2352. Var. β *secundatum*; lesser branches very frequently secund, less compound than usual, and the ultimate ramuli very irregular, scarcely corymbose.

HAB. Frequently growing on *Zostera*. Halifax, *W. H. H.* Boston Bay in several places, *Dr. Durkee*, *Mrs. Mudge*, *Capt. Pike*, &c. New London, *Miss French*, *Mr. Congdon*. Providence, *Prof. J. W. Bailey*. β , Massachusetts Bay, *Mrs. Mudge*. Greenport, *Mr. Hooper*. (v. v.)

*Fronde*s either densely tufted, as is often the case when growing on the leaves of *Zostera*, or solitary, as sometimes occurs in rockpools or on a sandy bottom. *Stems* as thick as hog's bristle at the base, soon divided, and then alternately decompound. The larger branches are setaceous below, attenuated upwards, and at length reduced, near the summit, to a cobwebby fineness; they are very much branched, the primary divisions between alternately pinnate and dichotomous, the secondary and tertiary somewhat zig-zag and set with alternate or secund, dichotomo-multifid branchlets. These dichotomous branchlets are usually fastigate or level-topped; the ends, owing to the crowded ramuli, looking dark when displayed on paper, and resembling so many little corymbs; whence the specific name. The articulations are visible to the base of the stem; those in the lower part are short, sometimes a little veiny, thick-walled, with a slender tube; those of the middle and upper portions are very long. The *tetraspores* are always solitary, scattered on the upper ramuli, being formed out of a suppressed arm of a furcellation. *Favellæ*, binate. *Substance*, somewhat gelatinous. *Colour*, a beautiful rosy red, rapidly given out in fresh water.

10. *CALLITHAMNION seirospermum*, *Griff.*; fronds solitary or somewhat tufted; stem setaceous, veiny, gradually attenuated upwards, undivided, set with alternate, lateral, setaceo-capillary, veiny, undivided branches, which are clothed with lateral, spirally inserted, dichotomo-multifid, secondary branchlets; articulations of the stem and branches opaque, of the lesser branches and ramuli pellucid, three to four times as long as broad; the ultimate ramuli frequently converted into bead-like strings of seirospores. *Harv. Man. Ed.* 1, p. 113. *J. Ag. Sp. Alg.* 2, p. 42. *Phlebothamnion seirospermum*, *Kütz. Sp. Alg.* 2, p. 657. *Seirospora Griffithsiana*, *Harv. Phyc. Brit. t.* 21. *Cal. versicolor*, var. *seirospermum*, *Harv. in Hook. Joam, Bot.* 1, p. 302.

HAB. Salem, Massachusetts, *Mr. J. Hooper*. New Bedford, *Dr. Roche*. Nantucket, *Dr. Durkee*. Shores of Rhode Island, *Prof. J. W. Bailey*. (v. v.)

Stem, three to five inches high, as thick as hog's bristle below, capillary above,

undivided, running through the frond, set throughout with alternate, spirally-inserted, lateral, sub-horizontal branches directed to all sides, the lowest longest, the rest successively shorter; the whole frond pyramidal. Both the stem and primary branches are filled with veins, which render their articulations more or less obscure. *Branches* undivided, one to two inches long, attenuated upwards, and copiously furnished throughout with short, very flaccid, capillary or byssoid, dichotomo-multifid branchlets directed to every side; the ultimate divisions of these are almost cobwebby. I have not seen proper *tetraspores*; but their place is generally supplied by the conversion of the ultimate ramuli into strings of spores; affording a mark by which this species is most easily recognised. When first I described this fructification (in *Hook. Journ. l. c.*) I regarded it as an abnormal development, and perhaps correctly, though more recently (in the *Phycologia Britannica*) I adopted another opinion, and thereon founded the genus *Seirospora*. If the strings of *seirospores* be abnormal, however, they are, so far as I know, only found in this species, and are very constant, characterising it on the shores of England, Ireland, Scotland and Sweden, as well as on those of North America. I am indebted to Dr. Roche of New Bedford for most beautiful specimens, which are identical with the most luxuriant of my English ones.

SECT. 4. CRUCIATA : *Fronde setaceous or capillary, alternately decomposed, articulate; each node bearing a pair of opposite, minute, simple or compound ramuli. Tetraspores cruciate.*

11. CALLITHAMNION *plumula*, Lyngb.; stems alternately decomposed or sub-dichotomous, articulated; each articulation bearing a pair of short, recurved, pectinate or bi-pectinate ramuli; tetraspores borne on the tips of shortened ramuli, cruciate. *J. Ag. Sp. Alg.* 2, p. 29. *Harv. Phyc. Brit.* t. 242. *Kütz. Sp. Alg.* 2, p. 647. *Conferva Plumula*, Ellis.—*Dillw.* t. 50. *Conf. Turneri*, *E. Bot.* t. 1637.

HAB. Longbranch, New Jersey, *Miss E. C. Morris.* (v. v.)

Of this beautiful species I have only seen a solitary, ill-dried and faded North American specimen. It is at once known from *C. Americanum*, which is sometimes mistaken for it by collectors, by the very patent or recurved ramuli, closely *pectinated* on their upper margin only, with secund pinnellæ.

12. CALLITHAMNION *Americanum*; filaments elongate, capillary, many times alternately decomposed, closely and densely or sub-distantly branched, plumose; ramuli in pairs from every node, opposite, patent, very slender, pinnellate or bi-pinnellate, the pinnules opposite or secund; lower articulations of the stem eight or ten times, upper four or five times as long as broad; articulations of the ramuli four to six times as long as broad; tetraspores elliptical, cruciate, sessile; favellæ in pairs on the upper branches. (TAB. XXXVI. A.)

HAB. Prince Edward's Island, *Dr. Jeans*. Halifax, *W. H. H.* Boston, *Mrs. Asa Gray*. Lynn, *Mrs. Mudge*. Portsmouth, *Dr. Durkee*. New Bedford, *Dr. Roche*. New York Bay, *Mr. Hooper*. (v. v.)

Filaments three to four inches long, capillary, densely tufted, much and finely branched, alternately decomposed; the lower divisions sub-distant, the upper close together, all rather patent, the secondary branches elongate, the tertiary and succeeding short. Every part of the filament is pellucidly articulate, without veins. Each articulation bears a pair of very slender, byssoid, opposite ramuli one to two lines long, very patent and oppositely pinnate or bi-pinnate; the pinnules sometimes abortive or abbreviated, when the branching becomes irregularly alternate or sub-secund. *Apices* attenuate, acute. *Articulations* in the lower part of the stem and branches many times longer than broad, in the lesser branches five or six times, in the ramuli frequently six or eight times, but sometimes only four or five times as long as broad. *Tetraspores* sessile, near the base of the pinnæ on the ramuli, elliptical, cruciate. *Favellæ* near the ends of the lesser branches, large, berry-like, in pairs or threes. *Colour*, a brilliant, rosy red. *Substance*, very flaccid and delicate. It closely adheres to paper in drying.

A very beautiful species, not uncommon on the East Coast of North America from Nova Scotia to New York.

Plate XXXVI. A. *Fig. 1.* *CALLITHAMNION Americanum*; the natural size. *Fig. 2,* part of a larger branch, with lateral branches, and pinnate, opposite ramuli; *fig. 3,* part of a branch with *favellæ*; *fig. 4,* the same with *tetraspores*; *fig. 5,* a fertile, lower pinna from the preceding; the latter figures more or less highly *magnified*.

13. *CALLITHAMNION Pylaisci*, Mont.; filaments elongate, ultra-capillary, alternately decomposed; branches distant, erecto-patent; ramuli in pairs, opposite at every node, pinnate or bi-pinnate, the pinnæ opposite or rarely secund; lower articulations of the stem many times longer than broad, upper two to four times; articulations of the ramuli once or twice as long as broad; tetraspores elliptical, sessile on the ramuli, cruciate. *Mont. Ann. des Sc. Nat. 2nd Ser. vol. viii. p. 351.* *Wrangeia Pylaisci*, *J. Ag. Sp. Alg. 2, p. 705.* *Callith. intermedium*, *Harv. MSS.* (TAB. XXXVI. B.)

HAB. Newfoundland, *De la Pylaie*! South Boston, *Dr. Durkee*! (v. s. in Herb. T. C. D.)

Filaments three to four inches, rather thicker than human hair, alternately four or five times decomposed, the lower branches distant, the upper gradually nearer; every part pellucidly articulate. From a short distance below each node of the stem and branches springs a pair of opposite ramuli about half a line in length, some of them simply pinnate, some few secundly pectinate, but the greater number bi-pinnate, ovate in outline, all the pinnules tapering to an acute point. Lower

articulations of the stem six to eight or ten times as long as broad ; upper much shorter, and those near the ends of the branches but twice or thrice as long as broad. The articulations of the ramuli are very short. *Tetraspores* numerous on the pinnæ of the ramuli, sessile, cruciate. *Favellæ* unknown. *Colour* a fine crimson.

This plant has the external aspect of *Cal. floccosum*, but is more robust, and is readily distinguished by its compound ramuli. It is more closely related to *C. Americanum*, but the ramuli are shorter and more densely branched, with much shorter internodes. The differences between these species may more readily be understood, by comparing the figures we have given than by a detailed description.

Until the favellæ of this plant be discovered, some doubt may rest upon its generic position, yet I cannot but think it more nearly related to *C. Americanum* and *C. floccosum*, between which it is nearly intermediate in character, than to *Wrangelia multifida*, with which Professor Agardh associates it.

Plate XXXVI. B. *Fig. 1.* *CALLITHAMNION Pylaisæi* ; the natural size. *Fig. 2.* portion of a branching stem, *magnified.* *Fig. 3.* internode of a branch, with opposite, bi-pinnate, fertile ramuli ; *fig. 4.* pinnule from the same, with *tetraspores* ; more highly *magnified.*

14. *CALLITHAMNION floccosum*, Ag. ; frond capillary, very flaccid, remotely much branched ; branches alternate, erecto-patent, articulated ; every node emitting a pair of opposite, simple, subulate, erecto-patent, minute, ramuli ; tetraspores elliptical, pedicellate on the ramuli near the base. *J. Ag. Sp. Alg. 2, p. 27. Harv. Phyc. Brit. t. 81. Kütz. Sp. Alg. p. 646.*

HAB. South Boston, very rare, *Dr. Durkee.* (v. s. in Herb. T. C. D.)

Filaments capillary, four to six inches long, alternately or sub-dichotomously branched, the lower divisions distant, from half an inch to an inch or more apart, the upper gradually closer together. Secondary and lateral branches repeatedly divided alternately ; the general outline lanceolate or somewhat rhomboid. *Ramuli* opposite, a pair springing from every internode of the frond at a short distance below the node, distichous, a quarter to half a line long, erecto-patent, quite simple spine-like, subulate, tapering to an acute point. *Articulations* in the lower part of the stem six or eight times as long as broad, without veins ; in the upper branches gradually shorter, near the apices twice or thrice as long as broad, the terminal ones shorter than their breadth. *Articulations* of the ramuli once and half or twice as long as broad.

I have as yet seen but a solitary American specimen, and it is without fruit.

15. *CALLITHAMNION cruciatum*, Ag. ; filaments short, in globular tufts, sub-fastigiate, alternately decomposed ; branches erect ; ramuli at every node in pairs

or fours, densely crowded at the tips of the branches, opposite, very erect, pinnate; pinnæ opposite, very erect, cylindrical, obtuse, scarcely tapering; articulations of the stem and branches variable, of the ramuli three or four times as long as broad; tetraspores terminating the lower, abbreviated pinnæ of the ramuli, cruciate. *J. Ag. Sp. Alg.* 2, p. 27. *Harv. Phyc. Brit. t.* 164. *Kütz. Sp. Alg.* p. 549. β *tenue*; slender, with more distant, less compound and shorter ramuli.

HAB. New York Bay, at Red Hook, *Messrs. Walters and Hooper.* (v. v.)

Tufts dense, globose and somewhat level-topped, an inch to an inch and half high. *Filaments* capillary, alternately divided, but not much branched, the branches erectopatent, the upper ones shorter and closer together, the lower distant. *Ramuli* at every node two opposite or four in a whorl, half a line to a line in length, densely crowded at the ends of the branches, rarely more than simply pinnated. *Pinnæ* very erect, opposite or, by suppression of one, alternate or secund, the inner pinnæ being most commonly abortive, cylindrical, or slightly tapering to an obtuse point. *Internodes* of the stem and branches four to six times as long as broad, of the upper branches twice or thrice, of the ramuli about thrice as long as broad. *Fruit* rare and not yet observed on American specimens. *Colour*, a brownish-red, inclining sometimes to purple. *Substance* soft, but not very flaccid. It adheres closely to paper in drying.

As yet I am only aware of the single American station for this species above given. Mr. Walters's specimens of both varieties are very similar to those found in the South of England.

SECT. 5. REPENTIA. *Fronds* (of small size) rising from prostrate creeping matted threads. - *Favellæ involucrate.*

16. CALLITHAMNION *Turneri*, Ag.; filaments (densely tufted) rising from prostrate, creeping fibres, simple or repeatedly branched, once or twice pinnated with opposite or alternate spreading, simple ramuli; articulations very variable in length, 5—10 times as long as broad; tetraspores clustered, sub-racemose or corymbose, on abbreviated ramuli; favellæ involucrate. *J. Ag. Sp. Alg.* 2, p. 23. *Harv. Phyc. Brit. t.* 179. *Kütz. Sp. Alg.* p. 649. *Conferva Turneri*, *Dillw. t.* 100, *E. Bot. t.* 2339. β *variabile*; branches and ramuli alternate or secund. *Callithamnion variabile*, *Ag. Cal. roseolum?* *J. Ag. Sp. Alg.* 2, p. 21. *Conferva repens*, *Dillw.* 18, *E. Bot. t.* 1608.

HAB. Parasitical on various Algæ. Rhode Island, on *Cladostephus*, *Prof. J. W. Bailey.* β Boston, *Dr. Durkee.* Key West, *W. H. H.* (v. v.)

Filaments rising from decumbent, creeping, matted fibres, densely tufted, half an inch to an inch in height, capillary, flaccid, sub-simple, or once or twice oppositely branched; stem, branches and ramuli all nearly of the same diameter, and all pel-

cidly articulate, with thick hyaline cell-walls. *Articulations* very variable in length in different specimens and in different parts of the same specimen, four to twelve times as long as broad, the upper ones shortest. *Branches* and ramuli patent, scarcely attenuate, obtuse, in some specimens regularly opposite, in others frequently alternate or secund. *Tetraspores* almost always pedicellate (terminating depauperated ramuli), solitary or clustered, spherical, tripartite, with broad perispores. *Colour*, a rosy or brownish red. *Substance* soft. It adheres to paper.

Our var. β closely agrees with specimens of *Cal. roseolum*, Ag. communicated to me by Prof. Areschoug; but I think it also passes insensibly into the *Cal. variabile*, Ag. which Prof. J. Agardh now agrees with me in uniting to *C. Turneri*. In Prof. Bailey's specimens the ramuli are almost always opposite; in Dr. Durkee's as constantly alternate or secund; each agrees with a corresponding British form of this variable species.

SECT. 6. PUSILLA: *Root a small callus. Fronds, minute, tufted, irregularly decom- pound, erect, growing on rocks, or parasitical.*

17. CALLITHAMNION *Rothii*, Lyngb.; tufts widely spreading, dense, velvety; filaments very slender, short, erect, dichotomous or irregularly branched; branches long, straight, very erect or appressed; articulations about twice as long as broad; tetraspores clustered, borne on short, sub-terminal, corymbose ramuli. *J. Ag. Sp. Alg.* 2, p. 17. *Kütz. Sp. Alg.* p. 640 *Harv. Phyc. Brit.* t. 120. *B. Conferva Rothii*, *Dillw. Conf.* t. 73, *E. Bot.* t. 1702. *Byssus purpurea*, *E. Bot.* t. 192. *Dillw. Conf.* t. 43.

HAB. On submarine rocks near high water-mark. Halifax, *W. H. H.* Penobscot Bay, *Mr. Hooper*. Rhode Island, *Prof. Bailey.* (v. v.)

Filaments about a quarter inch in height, spreading in a continuous, velvety pile, resembling crimson plush, over rocks and stones in patches from a few inches to many feet in extent. The plant is more or less luxuriant as it grows in deep or shallow water. The depauperated state called *Byssus purpurea*, *E. Bot.* grows at the extreme limit of the tide, in places where it is merely wet by the spray at high water.

The American specimens are not in fruit, but in other respects are the same as British ones.

18. CALLITHAMNION *luxurians*, J. Ag.; filaments minute (2—3 lines high), excessively branched from the base, sub-dichotomo-multifid or secundly decom- pound; branches rather patent, very long, attenuated, with secund, whip-like, secondary branches and few ramuli; articulations four times as long as broad; tetraspores elliptical, pedicellate, scattered. *J. Ag. Sp. Alg.* 2, p. 14. *Kütz. Sp. Alg.* p. 639.

HAB. On *Zostera* at Newhaven, Connecticut, *Mr. Hooper*. (v. s. in Herb. Hooper).

Filaments forming a dense, deep-purple fringe, two or three lines in length, to the leaves of *Zostera*, excessively branched in a manner between alternate and dichotomous, the lesser divisions very generally secund. *Branches* flexuous, flabelliform.

The American specimens seen are faded. In other respects they agree with an authentic specimen received from Prof. J. Agardh; but I must add that this species appears to me to border too closely on the following, which is of earlier date.

19. *CALLITHAMNION virgatulum*, Harv.; filaments minute (2—3 lines high), flabellately much branched from the base; branches alternately decomposed, fastigiate; secondary ones few, erect, straight, rod-like, frequently secund; ramuli short, secund, often rising from every node; articulations about three times as long as broad; tetraspores elliptical, pedicellate, scattered on the branches. *Harv. in Hook. Br. Fl.* 2, p. 349. *Harv. Phyc. Brit. t.* 313.

HAB. Parasitical on *Dasya elegans*, at Hellgate, New York, *Mr. Walters*. (v. v.)

*Fronde*s forming a dense velvety pile, nearly of the same colour as the byssoid ramelli of the *Dasya*, and therefore likely to be overlooked. *Filaments* alternately or secundly decomposed, all the angles acute and branches and their divisions straight and erect. *Ramuli* bud-like, secund, along the branches.

20. *CALLITHAMNION Daviesii*, Ag.; filaments minute (2—3 lines high), tufted, much branched; branches curved, scattered, patent; ramuli elongate, fascicled or crowded toward the axil of the secondary branches; tetraspores pedicellate, on sub-axillary ramuli. *J. Ag. Sp. Alg.* 2, p. 11. *Harv. Phyc. Brit. t.* 314. *Kütz. Sp. Alg.* p. 638. *Conferva Daviesii*, *E. Bot. t.* 2329.

HAB. Parasitical on *Ceramium rubrum*. Boston Bay, *Miss E. Brewer*, *Dr. Durkee*. (v. v.)

Filaments about a line in height, generally forming a fleecy down on the *Ceramium*, more or less branched; sometimes sub-simple. *Colour*, a pinky-red.

... in the ... of the ...

The ... of the ... is ...

APPENDIX.

GENERA INCERTÆ SEDIS.

[The following genera cannot be satisfactorily referred to their proper places in the system until their fruit shall have been discovered. *Wurdemannia* may perhaps belong to *Gelidiaceæ*; and *Pikea*, either to *Sphaerococcoideæ* or to *Ceramiaceæ*.]

WURDEMANNIA. (*Nov. Gen.*)

Fronde filiform, terete, irregularly branched, composed of three strata; the medullary of numerous, slender, cylindrical, seriated cells, disposed in sub-parallel, closely packed, longitudinal filaments; the intermediate of oblong, longitudinal cells gradually shorter towards the periphery, which consists of minute, vertical cellules, in a nearly single row. *Conceptacles* (unknown.) *Tetraspores* oblong, zonate, immersed in the peripheric cells of the swollen apices of the branches.

The little plant on which I venture to found the present genus has puzzled me a good deal. In its aspect it resembles *Caulacanthus*, but has a structure more nearly agreeing with that of *Gelidium* than of any other genus with which I have compared it. From *Gelidium*, however, it differs essentially in the zonate tetraspores. I had at one time thought of placing it, provisionally, in *Dicranema*, but after having consulted with my friend Prof. Agardh, who is equally unable with myself to point out its true affinities, I have determined to propose it as the type of a new genus, though its claims cannot be fully substantiated until the conceptacles shall be discovered. Meanwhile I inscribe it with the name of the late DR. WURDEMAN, a most meritorious naturalist, who first explored the marine botany of the Florida Keys, and from whom (through Prof. Lewis R. Gibbes) I received specimens of this plant, among many others.

Owing to the tenuity of the frond, it is difficult to obtain a longitudinal section. The structure above described has been ascertained by viewing small portions which had been treated with muriatic acid, and then strongly pressed between pieces of glass.

1. *WURDEMANNIA setacea* ; frond capillary, densely tufted, slightly branched, sub-dichotomous ; branches simple, naked, divaricating, the apices obtuse ; tetraspores zonate, lodged in the incrassated, club-shaped apices, or in club-shaped, apical, clustered ramuli.

HAB. Key West, abundant, *Dr. Wurdeman, W. H. H. (53.)* (v. v).

*Fronde*s densely tufted, covering other Algæ, corals and Gorgoniæ with a shaggy coat, 2—3 inches high, as thick as horse-hair, rigid, matted together, not much branched. *Branches* irregularly dichotomous or secund, widely spreading and divaricate, equal in diameter throughout, their lesser divisions few, and similar in every respect. *Ramuli* very few, a line long, and mostly towards the ends of the branches. *Tetraspores* zonate, crowded in the apical, club-shaped, somewhat flattened and frequently fasciculate ramuli. *Colour*, a dark red. *Substance*, rather rigid. It scarcely adheres to paper in drying.

PIKEA. (*Nov. Gen.*)

Frond plano-compressed, linear, cartilaginous, internally costate, distichously decomposed, composed of three strata : the *axis* being a single, articulated, per-current filament ; the *intermediate stratum* consisting of slender, longitudinal, densely packed, anastomosing filaments ; the *cortical* very narrow, formed of minute cells. *Fructification* unknown.

In the absence of all knowledge of the fructification of this curious plant, it is impossible to speak with certainty of its affinities. Notwithstanding its inarticulate frond, I am disposed to refer it to *Ceramiaceæ*, near *Carpoblepharis* ; but this opinion is grounded as much on external habit as on the internal structure. Mere outward form, however, is a most fallacious guide to natural affinities ; and there are certain *Sphærococcoideæ* and *Cryptonemiaceæ* (especially *Prionitis*), to which, outwardly, our plant has considerable likeness. I am not acquainted with any Alga exactly agreeing in structure with it, and therefore propose it as the type of a new genus, which I inscribe to CAPT. NICHOLAS PIKE of Brooklyn, from whom I received the specimens, and whose many contributions of materials to the present volume are recorded under the species received from him.

1. *PIKEA Californica* ; frond linear, more or less strongly compressed, flabelliform, distichous, sub-fastigiata ; branches irregularly disposed, repeatedly com-

pound, irregularly pinnate or secundly ramulose, the divisions erecto-patent, sometimes opposite, frequently secund, the upper ones plano-compressed; ultimate ramuli filiform or subulate, acute, not tapering at base, very erect, unequal, long and short intermingled.

HAB. Golden Gate, *Capt. Pike*. (50 in part, 78.) (v. s. in Herb. T. C. D.)

Fronde 3 or 4 inches high, and as much in the expansion of the branches, stipitate, distichously branched in a palmato-flabelliform manner for a short distance above the base. *Branches* half a line to a line in breadth, compressed, sometimes nearly flat, sometimes approaching terete, very irregular in position, spreading, sub-simple and rather naked in the lower part, closely branched and repeatedly divided above. Lesser branches opposite, alternate or secund, small and large branches irregularly consecutive, somewhat pinnate, once or twice compounded. *Ramuli* very frequently secund, of very unequal lengths, filiform or setaceous, acute, very erect. *Colour*, a brown-red. *Substance*, cartilaginous and firm. *Fruit* unknown. A cross section of a small branch is a narrow ellipse, somewhat attenuated at the ends of the longer axis; there is a large central or axial tube, and two or more lesser tubes in the line of the longer axis; there is a narrow rim of minute, peripheric cells, and the whole of the interior space is filled with minute, endochromatic cells, being the cross cutting of longitudinal filaments. A longitudinal section shows a central long-jointed filament; a thin periphery of two other rows of minute coloured cells; and the intervening space formed of a very dense plexus of longitudinal filaments passing off towards the periphery into an imperfectly defined stratum of small, angular coloured cells. The central tube easily escapes observation in a longitudinal slice, unless the cutting be exactly through the middle of the frond.

ALPHABETIC INDEX OF NAMES.

[The systematic names in capitals are those which are adopted. The names in *italic* indicate synonyms, whilst the vulgar names are in roman. The asterisks refer to the page of description.]

- Acanthocladia*, 182.
 ———— *hamulosa*, 182.
 ———— *muricata*, 182.
 ACANTHOPHORA, 11, 15, 17.*
 ———— DELILEI, 18.*
 ———— *militaris*, 17, 18.
 ———— *muscoides*, 17, 18.
 ———— THIERII, 17.*
 ACROTYLUS, 161, 196.*
 ———— CLAVATUS, 196.*
 ———— PRISMATICUS, 196, 197.
 ACTINOCOCCUS, 129.
Aglaiophyllum, 92, 103.
 ———— *Americanum*, 92.
 ———— *ocellatum*, 104.
 AHNFELTIA, 159, 167.*
 ———— GIGARTINOIDES, 168.*
 ———— PINNULATA, 169.*
 ———— PPLICATA, 168.*
 ALSIDIUM, 11, 14.*
 ———— BLODGETTI, 16.*
 ———— SEAFORTHII, 15.
 ———— *tenuissimum*, 21.
 ———— TRIANGULARE, 15.*
 AMANSIA, 11, 12.*
 ———— MULTIFIDA, 13.*
 ANPHIROA, 82, 85.*
 ———— CALIFORNICA, 86.*
 ———— CRETACEA, 86.*
 ———— DEBILIS, 86.*
 ———— FRAGLISSIMA, 85.*
 ———— *Hookeri*, 86.
 ———— TUBERCULOSA, 87.*
 APOPHLEA, 81.
 ARTHROCARDIA, 86.*
 ASPARAGOPSIS, 68.
 BATRACHOSPERME, 137.
 BATRACHOSPERMUM, 225.
 BONNEMAISONIA, 68, 69.
 BONNEMAISONIEE, 69.*
 BOSTRYCHIA, 12, 54.*
 ———— CALAMISTRATA, 55, 56.
 ———— HOOKERI, 55.
 ———— MONTAGNEI, 55.*
 ———— RADICANS, 55.
 ———— RIVULARIS, 55, 57.*
 ———— TUOMEYI, 55, 58.*
 ———— VAGA, 55.
 BOTRYOCLADIA, 187, 191.*
 ———— UVARIA, 191.
 BOTRYOGLOSSUM, 90, 99.*
 ———— BINDERIANUM, 101.
 ———— PLATYCARPUM, 100,* 102.
Bryothamnion triangulare, 15.
 CALLIBLEPHARIS, 91, 105.*
 ———— CILIATA, 105.*
 ———— JUBATA, 106.
 CALLITHAMNIEE, 208.*
 CALLITHAMNION, 208, 229.*
 ———— AMERICANUM, 238.*
 ———— *arachnoideum*, 235.
 ———— ARBUSCULA, 230.
 ———— BAILEYI, 231.*
 ———— BORRERI, 233.*
 ———— *brachjatum*, 231.
 ———— BYSSOIDEUM, 234.*
 ———— CORYMBOSUM, 235, 236.*
 ———— CRUCIATUM, 240.*
 ———— DAVIESII, 243.*
 ———— DIETZIE, 236.*
 ———— FLOCCOSUM, 240.*
 ———— GRACILLIMUM, 235.
 ———— *intermedium*, 239.
 ———— LUXURIANS, 242.*
 ———— *nodulosum*, 226.
 ———— PIKEANUM, 230.*

CALLITHAMNION PLUMULA, 238.*
 ——— POLYSPERMUM, 234.*
 ——— PURPURIFERUM, 230.
 ——— PYLAISEI, 239.*
 ——— *roseolum*, 241.
 ——— ROTHII, 242.*
 ——— SEIROSPERMUM, 237.*
 ——— SQUARRULOSUM, 232.*
 ——— TETRAGONUM, 230.*
 ——— TURNERI, 241.*
 ——— *unilaterale*, 235.
 ——— *variabile*, 241.
 ——— *versicolor*, β , 237.
 ——— VIRGATULUM, 243.*
 CALLOPHYLLIS, 159, 170.*
 ——— *cristata*, 151.
 ——— LACINIATA, 171.*
 CALOGLOSSA, 98.*
 CATENELLA, 161, 201.*
 ——— OPUNTIA, 201.
 ——— PINNATA, 201.*
 CAULACANTHUS, 114.
 CENTRO CERAS, 208, 211.*
 ——— CLAVULATUM, 211.*
 CERAMIACEÆ, 8, 206.*
 CERAMIEÆ, 208.
 CERAMIUM, 208, 212.*
 ——— ARACHNOIDEUM, 217.*
 ——— *botryocarpum*, 214.
 ——— BYSSOIDEUM, 218.*
 ——— CANCELLATUM, 210.
 ——— *decurrens*, 214.
 ——— DIAPHANUM, 215.*
 ——— FASTIGIATUM, 217.*
 ——— GRACILLIMUM, 216.
 ——— HOOPERI, 214.*
 ——— NITENS, 213.*
 ——— *nodosum*, 216.
 ——— OBSOLETUM, 210.
 ——— RUBRUM, 209, 213.
 ——— *secundatum*, 214.
 ——— SUBTILE, 216.*
 ——— TENUISSIMUM, 216.*
 Ceylon Moss, 90.
 CHÆTANGIUM, 114.
 CHAMPIA, 68, 69, 75.*
 ——— AFFINIS, 76.
 ——— COMPRESSA, 75.
 ——— LUMBRICALIS, 75.
 ——— NOVÆ ZEALANDIÆ, 76.
 ——— PARVULA, 75, 76.*
 ——— SALICORNOIDES, 75, 76.*
 ——— TASMANICA, 75.
 CHONDRIA, 12, 19, * 70.

CHONDRIA ATROPURPUREA, 22.*
 ——— BAILEYANA, 20.*
 ——— CAPENSIS, 23.
 ——— DASYPHYLLA, 20.*
 ——— LITTORALIS, 22.*
 ——— *papillosa*, 74.
 ——— SEDIFOLIA, 19.*
 ——— TENUISSIMA, 21.*
Chondroclonium canaliculatum, 174.
 CHONDRUS, 160, 180.*
 ——— AFFINIS, 181.*
 ——— CRISPUS, 181.*
 ——— *dubius*, 167.
 ——— *linearis*, 167.
 ——— *norvegicus*, 167.
 CHRYSYMENIA, 69, 161, 187.*
 ——— ACANTHOCLADA, 191.*
 ——— AGARDHII, 189.*
 ——— DICHOTOMA, 189.
 ——— *divaricata*, 185.
 ——— ENTEROMORPHA, 187.*
 ——— HALYMENIOIDES, 188.*
 ——— RAMOSISSIMA, 190.*
 ——— *rosea*, 186.
 CHYLOCLADIA, 69, 160, 185.*
 ——— ARTICULATA, 69.
 ——— BAILEYANA, 185.*
 ——— CLAVELLOSA, 69, 186.
 ——— *divaricata*, 185.
 ——— *kaliformis*, 78.
 ——— *parvula*, 76.
 ——— ROSEA, 186.*
 ——— UNCINATA, 186.
Chylocladia, 68, 75, 77.
 CLADHYMENIA, 69.
Coccotylus Brodiaei, 164.
 COMPSOTEIA, 59.*
Conferva atrorubescens, 48.
 ——— *Borreri*, 233.
 ——— *corymbosa*, 237.
 ——— *Daviesii*, 243.
 ——— *diaphana*, 215.
 ——— *equisetifolia*, 227.
 ——— *fucoides*, 49.
 ——— *Griffithsiana*, 205.
 ——— *Plumula*, 238.
 ——— *polymorpha*, 54.
 ——— *repens*, 241.
 ——— *Rothii*, 242.
 ——— *rubra*, 214.
 ——— *simplex*, 30.
 ——— *stricta*, 33.
 ——— *tetragona*, 231.
 ——— *Turneri*, 238.

- Conferva Turneri*, 241.
 CONSTANTINEA, 160, 173.*
 — SITCHENSIS, 173.*
 CORALLINA, 82, 83.*
 — OFFICINALIS, 83.*
 — *tuberculosa*, 87.
 CORALLINACEÆ, 7, 80.*
 CORALLINEÆ, 81, 82.*
 CORALLOPSIS, 91, 111.*
 — SALICORNIA, 112.*
 CORDYLECLADIA, 147, 155.*
 — ERECTA, 156.
 — HUNTII, 155.*
 — IRREGULARIS, 156.*
 Corsican Moss, 68.
 CROUANIA, 208, 225.*
 — ATTENUATA, 226.*
 CRUORIA, 129.
 CRYPTARACHNE, 187, 189.*
 — AGARDHII, 189.
 — RAMOSISSIMA, 190.
 — ACANTHOCLADA, 191.
 CRYPTONEMIA, 160, 184.*
 — CRENULATA, 184.*
 CRYPTONEMIACEÆ, 8, 156.
 CRYPTONEMIEÆ, 160.*
Cryptopleura Americana, 92.
 — *lacerata*, 104.
 CYSTOCLONIUM, 159, 169.*
 — PURPURASCENS, 170.*
 DASYA, 12, 59.*
 — ARBUSCULA, 64.
 — *chordalis*, 65.
 — ELEGANS, 60.*
 — GIBBESII, 59.*
 — GUNNIANA, 60.
 — LAURENCIANA, 60.
 — LOPHOCLADOS, 65.*
 — MOLLIS, 62.*
 — MUCRONATA, 63.*
 — PLUMOSA, 66.*
 — RAMOSISSIMA, 61.*
 — TUMANOWICZI, 64.*
 — WURDEMANNI, 64.*
 DELESSERIA, 90, 93.*
 — ALATA, 95.*
 — *Americana*, 92.
 — *angustissima*, 95.
 — *chordalis*, 121.
 — CORYMBOSA, 96.*
 — DENTICULATA, 94.*
 — FIMBRIATA, 94.*
 — HYPOGLOSSUM, 96.*
 — *interrupta*, 163.
 — DELESSERIA INVOLVENS, 97.*
 — LEPRIEURII, 98.*
 — *platycarpa*, 100.
 — ROSTRATA, 96.*
 — RUSCIFOLIA, 97.
 — *sanguinea*, 93.
 — SERRATA, 95.*
 — SINUOSA, 93.*
 — TENUIFOLIA, 97.*
 DELESSERIEÆ, 90.*
 DELISIA, 68.
 DESMIOSPERMEÆ, 7.*
 DIGENIA, 12, 29.*
 — SIMPLEX, 30.*
 — *Wulfeni*, 30.
 Dillisk, 148.
Dudresnaia divaricata, 133.
 Dulse, 148.
Dumontia furcata, 183.
 — *saccata*, 79.
 — *sobolifera*, 194.
 ENDOCLADIA, 160, 182.*
 — MURICATA, 182.*
 ENDOCLADIEÆ, 160.*
Epineuron multifidum, 13.
 EUBOSTRYCHIA, 55.*
 EUCEUMA, 113, 115, 118.*
 — ISIFORME, 118.*
 EUGIGARTINEÆ, 160.*
Eupogonium, 59.
 EUTHORA, 146, 150.*
 — CRISTATA, 150.*
Fucus acanthophorus, 17.
 — *alatus*, 95.
 — *articulatus*, 185.
 — *asplenioides*, 221.
 — *bracteatus*, 178.
 — *Brodiaxi*, 164.
 — *capillaris*, 202.
 — *cartilagineus*, 117.
 — *cervicornis*, 107.
 — *ciliatus*, 105.
 — *clavellus*, 185.
 — *coccineus*, 153.
 — *confervoides*, 108.
 — *cordatus*, 180.
 — *corneus*, 116.
 — *crispus*, 181.
 — *cristatus*, 151.
 — *dasyphyllus*, 20.
 — *dentatus*, 14.
 — *divaricatus*, 186.
 — *filicinus*, 200.
 — *floccosus*, 24.

- Fucus Floresius*, 193.
 ——— *glandulosus*, 209.
 ——— *globulifer*, 25.
 ——— *granateus*, 107.
 ——— *Hypoglossum*, 96.
 ——— *kaliformis*, 78.
 ——— *laceratus*, 104.
 ——— *laciniatus*, 171.
 ——— *larix*, 24.
 ——— *linearis*, 167.
 ——— *lumbricalis*, 195.
 ——— *Lycopodium*, 30.
 ——— *membranifolius*, 165.
 ——— *muscifformis*, 123.
 ——— *naiadiformis*, 18.
 ——— *Norvegicus*, 167.
 ——— *obtusus*, 72.
 ——— *palmatus*, 148.
 ——— *Palmetta*, 149.
 ——— *pilulifer*, 25.
 ——— *pinnatifidus*, 70.
 ——— *platycarpus*, 100.
 ——— *plicatus*, 168.
 ——— *plumosus*, 224.
 ——— *Poitei*, 110.
 ——— *punctatus*, 104.
 ——— *purpurascens*, 170.
 ——— *ramentaceus*, 194.
 ——— *rotundus*, 128.
 ——— *sinuosus*, 93.
 ——— *squamarius*, 130.
 ——— *subfuscus*, 26.
 ——— *tenuissimus*, 21.
 ——— *thyrsoides*, 74.
 ——— *triangularis*, 15.
 ——— *venosus*, 101.
 FURCELLARIA, 127, 161, 195.*
 ——— FASTIGIATA, 195.*
 ——— *lumbricalis*, 128.
Gastridium, 77.
 GASTROCARPÆ, 160.*
Gastroclonium uvarium, 191.
 GELIDIACEÆ, 7, 112.*
 GELIDIEÆ, 115.
 GELIDIUM, 113, 115,* 197.
 ——— CARTILAGINEUM, 117.*
 ——— CORNEUM, 116.*
 ——— COULTERI, 117.*
 ——— *crassifolium*, 198.
 ——— *lanccolatatum*, 197.
 ——— SERRULATUM, 117.*
 GIGARTINA, 160, 174.*
 ——— CANALICULATA, 174.*
 ——— EXASPERATA, 177.*
 GIGARTINA *Gaditana*, 121.
 ——— MAMILLOSA, 175.*
 ——— MICROPHYLLA, 176.*
 ——— MOLLIS, 175.*
 ——— *muricata*, 182.
 ——— *ornithorhynchos*, 177.
 ——— *papillata*, 178.
 ——— RADULA, 178.*
 ——— SPINOSA, 177.*
 GIGARTINEÆ, 159.*
Ginannia furcellata, 136.
 GLOIOCLADEÆ, 132.*
 GLOIOPELTIS, 160, 183.*
 ——— FURCATA, 183.*
 GLOIOSIPHONIA, 161, 202.*
 ——— CAPILLARIS, 202.*
Gongroceras fastigiatum, 217.
 ——— *nodiferum*, 216.
 ——— *tenuissimum*, 216.
 GONGYLOSPERMÆ, 8.*
 GRACILARIA, 91, 106.*
 ——— ARMATA, 109.*
 ——— BLODGETTII, 111.*
 ——— CAUDATA, 111.*
 ——— CERVICORNIS, 107.*
 ——— COMPRESSA, 108.*
 ——— CONFEROIDES, 108.*
 ——— DAMÆORNIS, 110.*
 ——— DIVARICATA, 109.*
 ——— *erecta*, 155.
 ——— MULTIPARTITA, 107.
 ——— POITEI, 110.*
 GRATELOUPIA, 161, 197, 198.*
 ——— CUNEIFOLIA, 200.*
 ——— CUTLERIÆ, 200.
 ——— FILICINA, 199, 200.*
 ——— GIBBESII, 199.*
 ——— PROLONGATA, 200.*
 ——— VERSICOLOR, 200.*
 GRIFFITHSIA, 208, 227 *
 ——— CORALLINA, 228.*
 ——— *equisetifolia*, 227.
 ——— *globifera*, 228.
 GRINNELLIA, 90, 91.*
 ——— AMERICANA, 92.*
 GYMNOGONGRUS, 159, 165.*
 ——— *fastigiatum*, 168.
 ——— *gigartinoïdes*, 168.
 ——— LINEARIS, 167.*
 ——— NORVEGICUS, 166,*
 ——— *plicatus*, 168.
 ——— TENUIS, 166.*
 ——— TORREYI, 166.*
Halarachnion ligulatum, 192.

- HALICHRYSIS, 187.
 HALOCELIA, 194.*
 HALOSACCION, 161, 193.*
 ——— FUCICOLUM, 194.*
 ——— HYDROPHORA, 194.*
 ——— RAMENTACEUM, 194.*
 HALURUS, 208, 225, 226.*
 ——— EQUISETIFOLIUS, 226.*
 HALYMENIA, 161, 192.*
 ——— FLORESIA, 193.*
 ——— LIGULATA, 189, 192.*
 HELMINTHOCLADEÆ, 8, 131.*
 HELMINTHORA, 132, 133.*
 ——— DIVARICATA, 133.*
 HEMINEURA, 92.
 HILDENBRANDTIA, 129.
Hormoceras diaphanum, 215.
 HYMENENA, 91, 101.*
 ——— FIMBRIATA, 102.*
 ——— FISSA, 101.*
 HYPNEA, 113, 115, 122.
 ——— CERVICORNIS, 125.*
 ——— CORNUTA, 125.*
 ——— *Coulteri*, 154.
 ——— CRINALIS, 124.*
 ——— DIVARICATA, 124.*
 ——— MUSCIFORMIS, 123.*
 ——— PANNOSA, 125.*
 ——— *purpurascens*, 170.
 ——— *Wurdemanni*, 119.
 HYPNEACEÆ, 115.*
Hypnophycus musciformis, 123.
 HYPOGLOSSUM, 96.*
Hypoglossum alatum, 95.
 ——— *Leprieurii*, 98.
 ——— *serratum*, 95.
 ——— *Woodwardi*, 96.
 IRIDÆA, 160, 178.*
 ——— CORDATA, 180.*
 ——— LAMINARIOIDES, 179.*
 ——— MINOR, 179.*
 ——— PINNATA, 180.*
 ——— PUNICEA, 180.*
 ——— *stiriata*, 177.
 JANIA, 82, 83.*
 ——— ANTENNINA, 85.
 ——— CAPILLACEA, 84.*
 ——— CUBENSIS, 84.*
 ——— RUBENS, 84.*
 KALLYMENIA, 159, 171.*
 ——— PENNYI, 172.*
 KALLYMENIÆ, 159.*
 LAURENCIA, 19, 68, 69, 70.*
 ——— *Baileyana*, 20.
 LAURENCIA CERVICORNIS, 73.*
 ——— *dasyphylla*, 20, 70.
 ——— FORSTERI, 73.
 ——— *Forsteroides*, 72.
 ——— GEMMIFERA, 73.*
 ——— IMPLICATA, 72.*
 ——— OBTUSA, 72.*
 ——— PAPILLOSA, 74.*
 ——— PINNATIFIDA, 70.*
 ——— SCOPARIA, 74.*
 ——— *spectabilis*, 71.
 ——— *tenuissima*, 21, 70.
 ——— TUBERCULOSA, 75.*
 ——— VIRGATA, 71.*
 LAURENCIACEÆ, 7, 67.*
 LIAGORA, 133, 137.*
 ——— CERANOIDES, 139.*
 ——— LEPROSA, 139.*
 ——— PINNATA, 138.*
 ——— VALIDA, 138.*
 LIAGOREÆ, 133.*
 LOMENTARIA, 68, 69, 75, 77.*
 ——— *articulata*, 78.*
 ——— *Coulteri*, 78, 79.
 ——— MEDITERRANEA, 77.
 ——— OVALIS, 78,* 192.
 ——— *parvula*, 76.
 ——— SACCATA, 79.*
 LOMENTARIÆ, 69.*
 LOPHOTHALIA, 64.*
Lophura cymosa, 26.
 ——— *floccosa*, 25.
 ——— *gracilis*, 26.
 ——— *larix*, 24.
 MASTOCARPUS, 175.*
Mastocarpus corymbiferus, 178.
 ——— *Harveyanus*, 176.
 ——— *mamillosus*, 176.
 ——— *spinosus*, 177.
 MASTOPHORA, 81.
 MELOBESIA, 83, 87.*
Mertensia, 75.
 MICROCLADIA, 208, 209.*
 ——— BOREALIS, 210.*
 ——— COULTERI, 209.*
 ——— GLANDULOSA, 209.
 ——— *scorpioides*, 210.
Myelomium furcellatum, 136.
 NEMALION, 132, 134.*
 ——— *divaricatum*, 133.
 ——— MULTIFIDUM, 135.*
 ——— VIRENS, 135.*
 NEMASTOMEÆ, 161.*
Neurocaulon Söchense, 173.

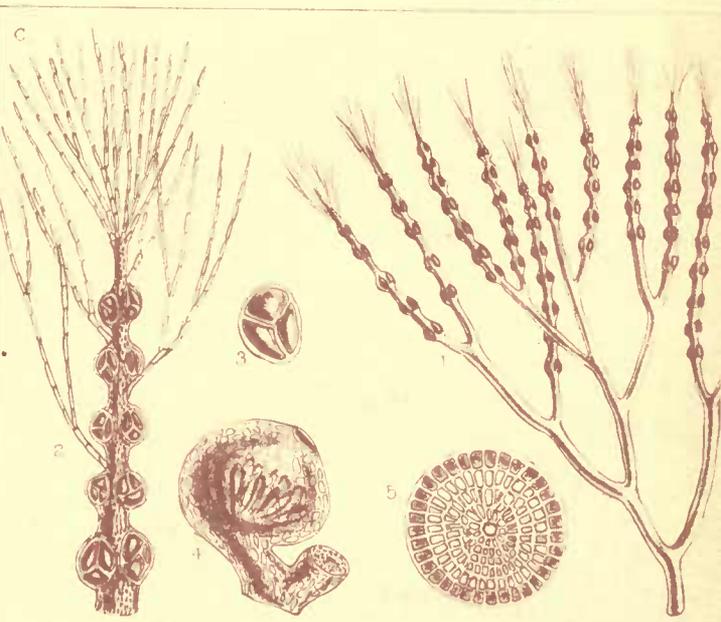
- Neuroglossum Binderianum*, 100.
 Nigger Hair, 41.
 NITOPHYLLUM, 91, 102.*
 ——— LACERATUM, 104.*
 ——— *ocellatum*, 104.
 ——— PUNCTATUM, 104.*
 NULLIPOREÆ, 81, 83.*
 ODONTHALIA, 11, 13.*
 ——— ANGUSTIFOLIA, 14.
 ——— DENTATA, 14.*
 ——— KAMTCHATICA, 14.
 ——— *multifida*, 13.
 OLIGOSIPHONIA, 31.*
Oncotylus Norvegicus, 167.
 Pepper Dulse, 68.
 PETROCELIS, 129.
 PEYSSONNELIA, 129.*
 ——— DUBYI, 130.*
 ——— IMBRICATA, 131.*
 PHACELOCARPUS, 81.
Phlebothamnion byssoides, 235.
 ——— *corymbosum*, 237.
 ——— *polyspermum*, 234.
 ——— *seirospermum*, 237.
 ——— *tetragonum*, 231.
 PHYCODRYS, 93.*
 ——— *sinuosa*, 93.
 PHYLLOPHORA, 159, 164.*
 ——— BRODLEI, 164.
 ——— *crenulata*, 184.
 ——— MEMBRANIFOLIA, 165.*
Phyllotylus membranifolius, 165.
Phycophora triangularis, 15.
 PIKEA, 246.*
 ——— CALIFORNICA, 246.*
 PLOCAMIUM, 145, 146, 152.*
 ——— COCCINEUM, 153,* 211.
Plocaria, 106.
 POLYIDES, 128.*
 ——— *lumbricalis*, 128.
 ——— ROTUNDUS, 128,* 195.
 POLYSIPHONIA, 12, 30.*
 ——— *affinis*, 49.
 ——— *Agardhiana*, 48.
 ——— *arietina*, 41.
 ——— ATORRUBESCENS, 48.*
 ——— BINNEYI, 37.*
 ——— BREVIARTICULATA, 36.*
 ——— BRODLEI, 27, 44.
 ——— CALIFORNICA, 48.*
 ——— DICTYURUS, 53.*
 ——— *Durkeei*, 50.
 ——— ECHINATA, 38.*
 ——— ELONGATA, 42.*
 POLYSIPHONIA EXILIS, 47.*
 ——— FASTIGIATA, 54.*
 ——— FIBRILLOSA, 43.*
 ——— FLEXELLA, 42.
 ——— FORMOSA, 33.*
 ——— FRACTA, 38.*
 ——— *fucoides*, 49.
 ——— HAPALACANTHA, 39.*
 ——— HARVEYI, 41.*
 ——— HAVANENSIS, 34.*
 ——— *Hooperi*, 33.
 ——— *littoralis*, 36.
 ——— *lophocladus*, 66.
 ——— NIGRESCENS, 49.*
 ——— OBSCURA, 47.
 ——— OLNEYI, 37, 40.*
 ——— PARASITICA, 46.*
 ——— *patens*, 31.
 ——— PECTEN VENERIS, 46.*
 ——— *physarthra*, 36.
 ——— RAMENTACEA, 42.
 ——— SECUNDA, 35.*
 ——— SUBTILISSIMA, 34.*
 ——— SUBULIFERA, 38.
 ——— TENUISTRIATA, 49.
 ——— THYRSIGERA, 53.*
 ——— URCEOLATA, 31.*
 ——— VARIEGATA, 45.*
 ——— VERTICILLATA, 58.*
 ——— VIOLACEA, 27, 44.*
 ——— WOODII, 52.*
 RHABDONIA, 121, 145, 146, 153.*
 ——— *Baileyi*, 122.
 ——— COULTERI, 154.*
 ——— TENERA, 122.
Rhodocallis asplenioides, 221.
 RHODOMELA, 12, 23.*
 ——— FLOCCOSA, 24,* 51.
 ——— GRACILIS, 26.*
 ——— LARIX, 24.*
 ——— PILULIFERA, 25.*
 ——— ROCHEI, 27.*
 ——— SUBFUSCA, 26.*
 RHODOMELACEÆ, 7, 9.*
 RHODONEMA, 60.*
 ——— *elegans*, 61.
 RHODOPHYLLIS, 146, 151.*
 ——— VEPRECUA, 106, 152.*
 RHODOSPERMEE, 1.*
 RHODYMENIA, 146, 147.*
 ——— *cervicornis*, 107.
 ——— *ciliata*, 105.
 ——— *cristata*, 151.
 ——— INTERRUPTA, 149.*

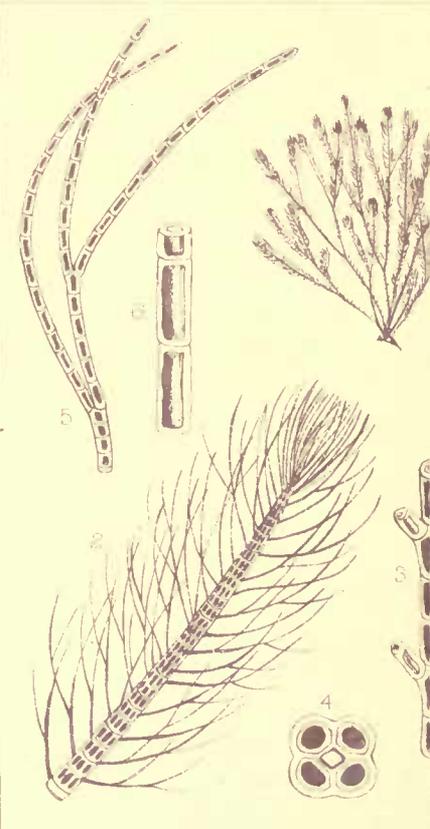
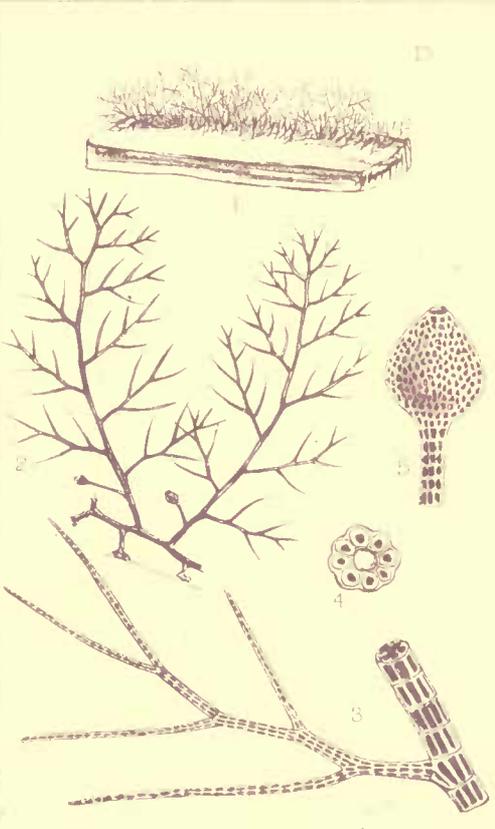
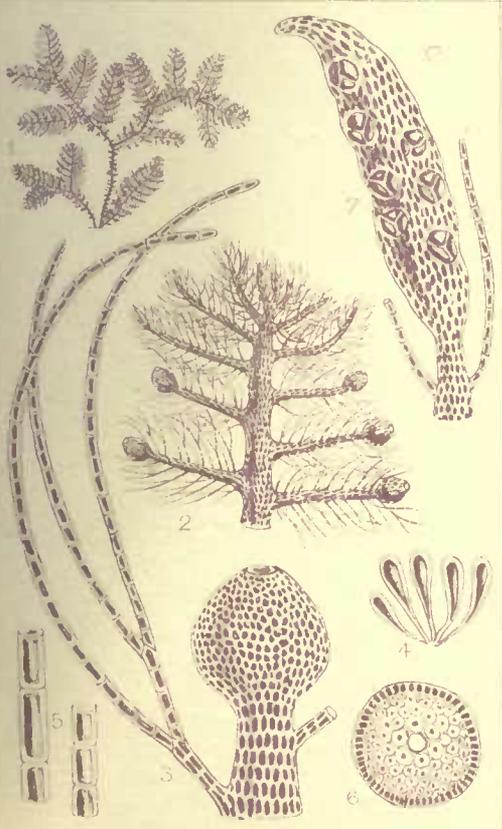
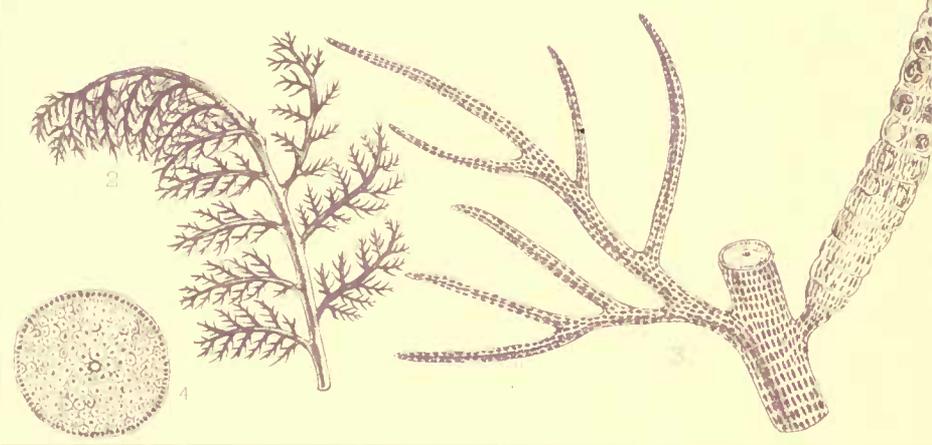
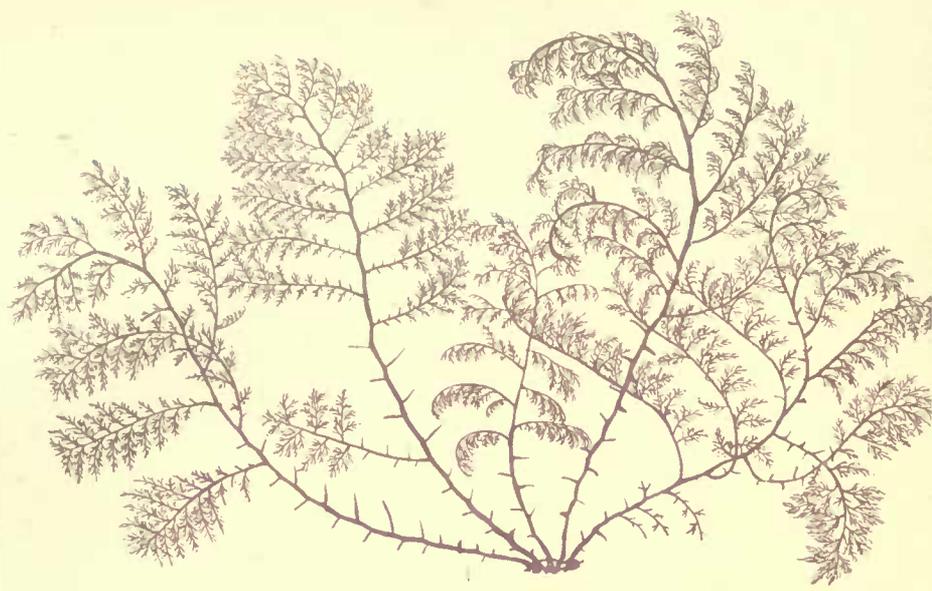
- RHODYMENIA *laciniata*, 171.
 ———— *microphylla*, 176.
 ———— PALMATA, 148.*
 ———— PALMETTA, 149.*
 ———— PERTUSA, 147.*
 ———— *Wilkesii*, 147.
 RHODYMENIACEÆ, 8, 144.*
 RYTIPHLEA, 12, 28.*
 ———— BAILEYI, 29.*
 ———— COMPLANATA, 29.
Schizoglossum, 103.
 SCINAIA, 133, 135.*
 ———— FURCELLATA, 136.*
 SCINAIEÆ, 133.*
Scirospora Griffithsiana, 237.
 SOLIERIA, 113, 115, 120,* 154.
 ———— CHORDALIS, 121.*
 SPHEROCOCCEÆ, 91.*
 SPHEROCOCCOIDEÆ, 7, 88.*
Sphaerococcus armatus, 109.
 ———— *cervicornis*, 107.
 ———— *isiformis*, 119.
 ———— *lichenoides*, 108.
 ———— *palmatus*, 148.
 ———— *Palmetta*, 149.
 ———— *pilulifer*, 25.
 ———— *polycarpus*, 107.
 ———— *Torreyi*, 166.
 SPONGIOPARPEÆ, 7, 126.*
Spongiocarpus rotundus, 128.
 SPYRIDIA, 204.*
 ———— ACULEATA, 205.*
 ———— *Berkeleyana*, 205.
 ———— FILAMENTOSA, 204.*
 SPYRIDIAEÆ, 8, 203.*
 SQUAMARIEÆ, 8, 128.*
 STENOGRAMMA, 159, 162.*
 ———— *Californica*, 163.
 ———— INTERRUPTA, 163.*
 STICHOCARPUS, 66.*
 STICTOSIPHONIA, 57.*
 SUHRIA, 114.
Thamnophora triangularis, 15.
 THOREA, 137.
 THYSANOCLADIA, 69.
 TYLOCARPEÆ, 159.*
Ulva furcellata, 136.
 ———— *ligulata*, 192.
 ———— *rubra*, 192.
 WORMSKIOLDIA, 93, 145.
 WRANGELIA, 141, 142.*
 ———— PENICILLATA, 143.*
 ———— PLEBEIA, 144.*
 ———— *Pylaisii*, 239.
 WRANGELIACEÆ, 8, 141.*
 WURDEMANNA, 245.*
 ———— SETACEA, 246.*

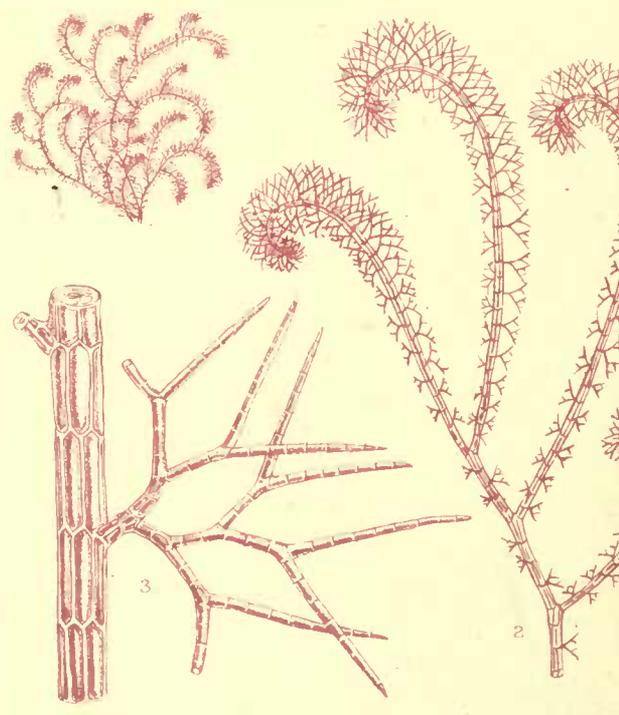
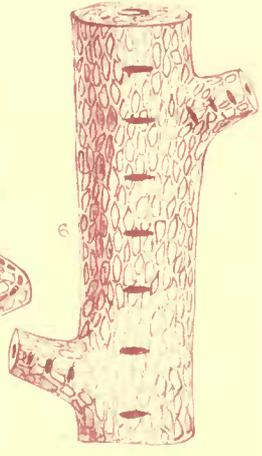
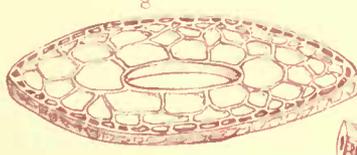
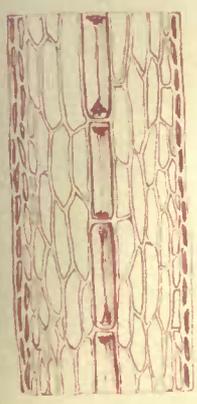
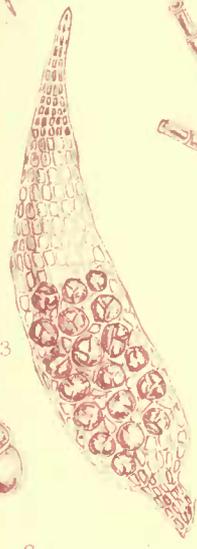
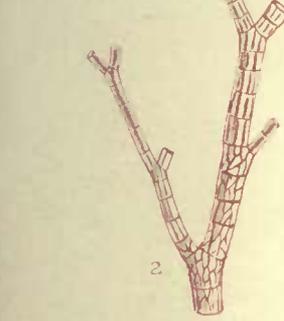
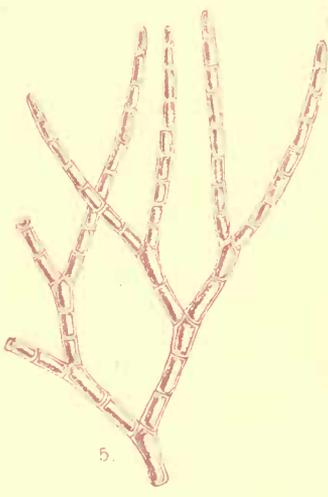
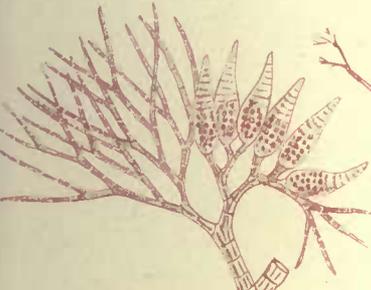
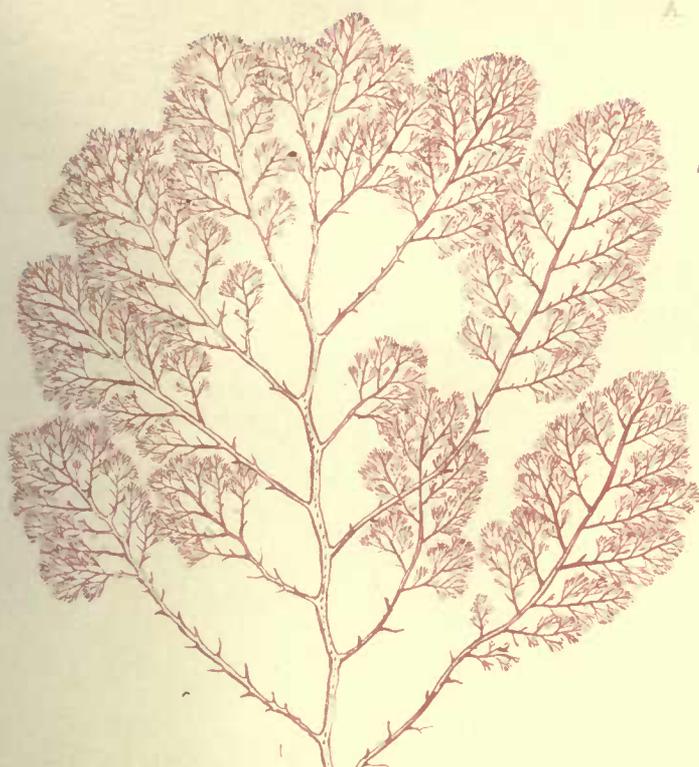
REFERENCES TO THE PLATES.

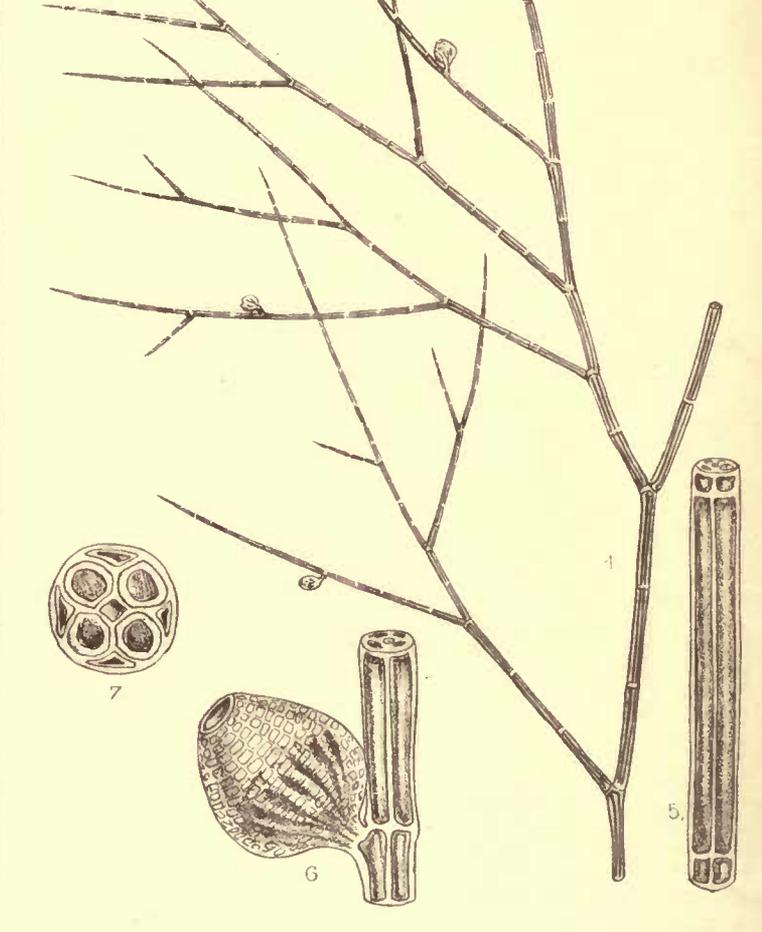
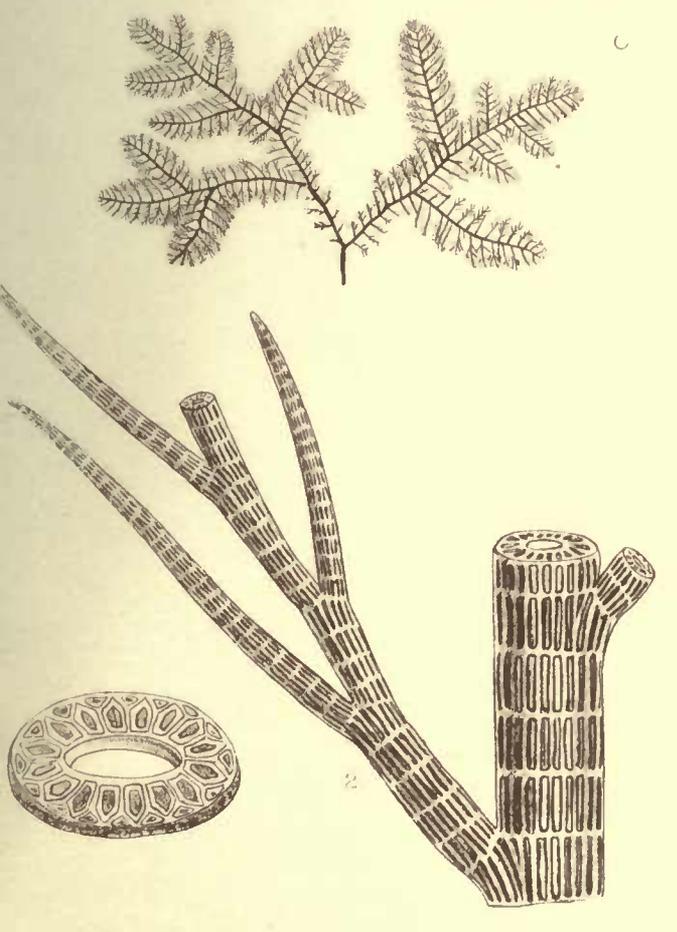
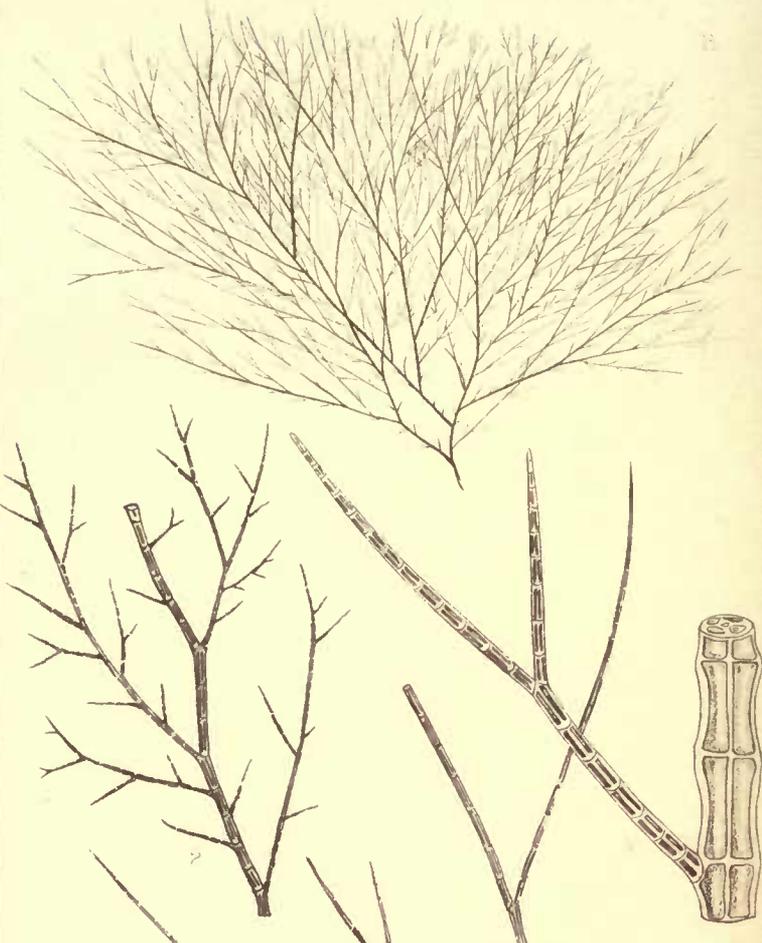
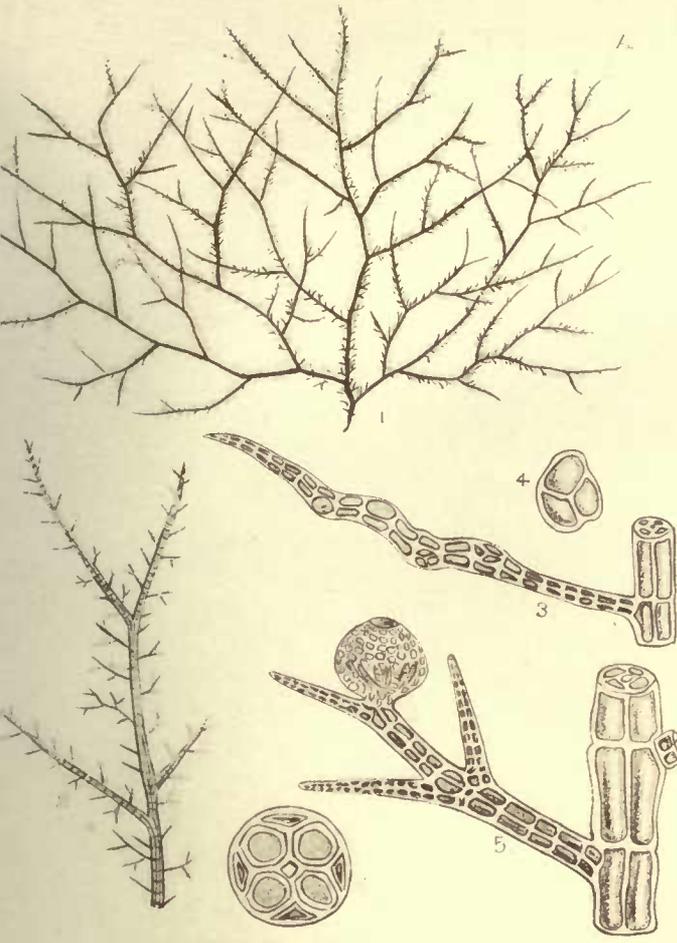
-
- PLATE XIII. A.—*Alsidium triangulare*, J. Ag. p. 15.
 B.—*Rhodomela Rochei*, Harv. p. 27.
 C.————— *gracilis*, Kütz. p. 26.
 D.—*Digenia simplex*, Ag. p. 30.
- XIV. A.—*Acanthophora Thierii*, Lamour. p. 17.
 B.—*Bostrychia Montagnei*, Harv. p. 55.
 C.————— *calamistrata*, Mont. p. 56.
 D.————— *rivularis*, Harv. p. 57.
 E.————— *Tuomeyi*, Harv. p. 58.
- XV. A.—*Dasya Gibbesii*, Harv. p. 59.
 B.—*Alsidium Blodgettii*, Harv. p. 16.
 C.—*Dasya Wurdemanni*, Bail. p. 64.
- XVI. A.—*Polysiphonia ramentacea*, Harv. p. 42.
 B.————— *breviarticulata*, J. Ag. p. 36.
 C.————— *Pecten Veneris*, Harv. p. 46.
 D.————— the same, var. β . p. 46.
- XVII. A.————— *Harveyi*, Bail. p. 41.
 B.————— *Olneyi*, Harv. p. 40.
 C.————— *nigrescens*, var. *Durkeei*, Harv. p. 50.
- XVIII. A.—*Chondria Baileyana*, Mont. p. 20.
 B.—*Laurencia gemmifera*, Harv. p. 73.
 C.————— *cervicornis*, Harv. p. 73.
 D.————— *implicata*, J. Ag. p. 72.
 E.—*Chondria atropurpurea*, Harv. p. 22.
 F.————— *tenuissima*, Ag. p. 21.
 G.————— *sedifolia*, Harv. p. 19.
- XIX. A.—*Lomentaria ovalis*, var. *Coulteri*, Harv. p. 78.
 B.—*Champia salicornoides*, Harv. p. 76.
 C.—*Stenogramma interrupta*, Mont. p. 163.
- XX. A.—*Chrysiomenia Halymenioides*, Harv. p. 188.
 B.————— *waria*, J. Ag. p. 191.
 C.—*Chylocladia Baileyana*, Harv. p. 185.

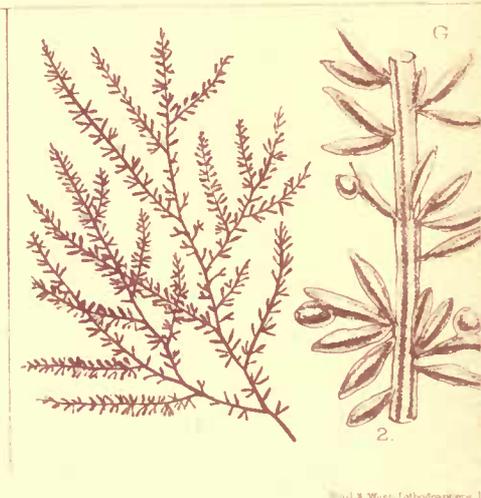
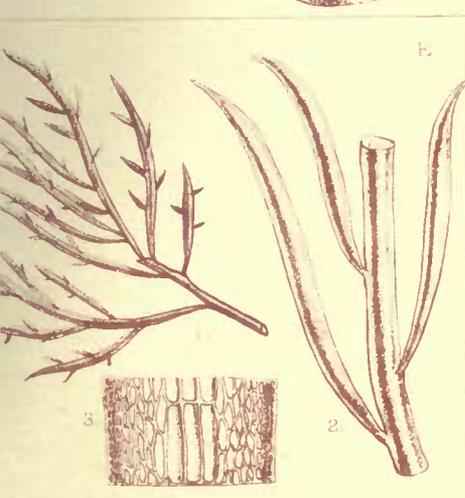
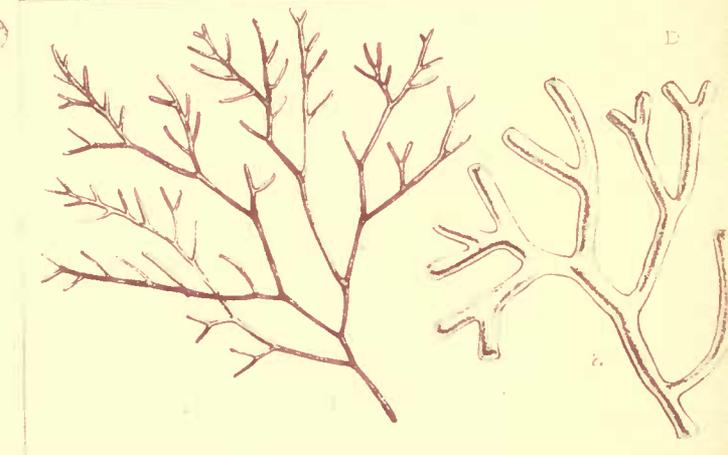
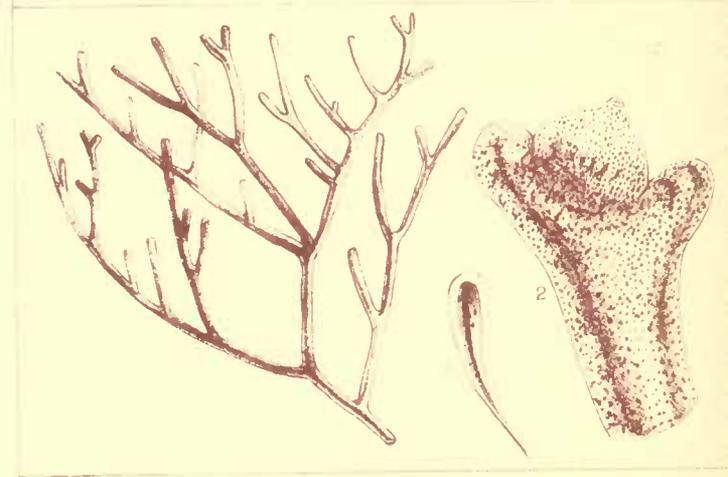
- PLATE XXI. A.—*Botryoglossum platycarpum*, Kütz. p. 100.
 B.—*Grinnellia Americana*, Harv. p. 92.
- XXII. A.—*Delesseria involvens*, Harv. p. 97.
 B.————— *tenuifolia*, Harv. p. 97.
 C.————— *Leprieurii*, Mont. p. 98.
- XXIII. A.—*Solieria chordalis*, J. Ag. p. 121
 B.—*Rhabdonia Coulteri*, Harv. p. 154
- XXIV. *Eucheuma isiforme*, J. Ag. p. 118.
- XXV. *Chrysymenia acanthoclada*, Harv. p. 191.
- XXVI. *Grateloupia Gibbesii*, Harv. p. 199.
- XXVII. A.—*Prionitis lanceolata*, Harv. p. 197.
 B.—*Endocladia muricata*, J. Ag. p. 182.
 C.—*Gigartina canaliculata*, Harv. p. 174.
- XXVIII. A.————— *microphylla*, Harv. p. 176.
 B.————— *spinosa*, Kütz. p. 177.
- XXIX. A.—*Halosaccion ramentaceum*, J. Ag. p. 194.
 B.—*Catenella pinnata*, Harv. p. 201.
 C.—*Nemalion multifidum*, J. Ag. p. 135.
- XXX. A.—*Chrysymenia Agardhii*, Harv. p. 189.
 B.————— *ramosissima*, Harv. p. 190.
- XXXI. A.—*Liagora valida*, Harv. p. 138.
 B.————— *pinnata*, Harv. p. 138.
 C.————— *leprosa*, J. Ag. p. 139.
 D.—*Crouania attenuata*, J. Ag. p. 226.
- XXXII. A.—*Ptilota hypnoides*, Harv. p. 220.
 B.————— *densa*, Ag. p. 219.
- XXXIII. A.—*Microcladia Coulteri*, Harv. p. 209.
 B.—*Ceramium arachnoideum*, var. *patentissimum*, Harv. p. 217.
 C.—*Centroceras clavulatum*, Ag. p. 211.
- XXXIV. A.—*Spyridia filamentosa*, var. *refracta*, Harv. p. 205.
 B.—*Wrangelia penicillata*, Ag. p. 143.
- XXXV. A.—*Griffithsia corallina*, var. *globifera*, Harv. p. 228.
 B.—*Callithamnion Baileyi*, Harv. p. 231.
- XXXVI. A.————— *Americanum*, Harv. p. 238.
 B.————— *Pylaisai*, Mont. p. 239.

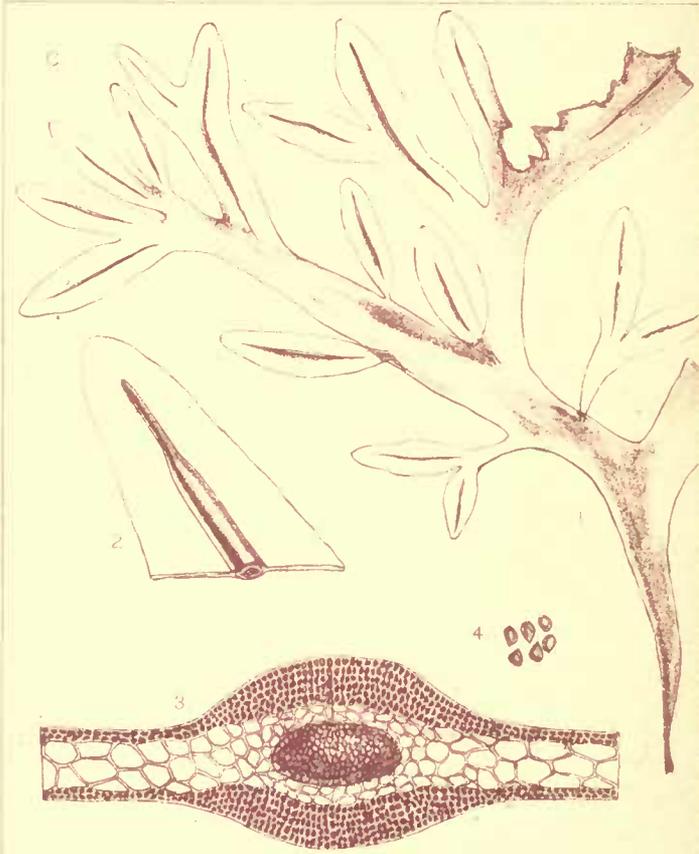
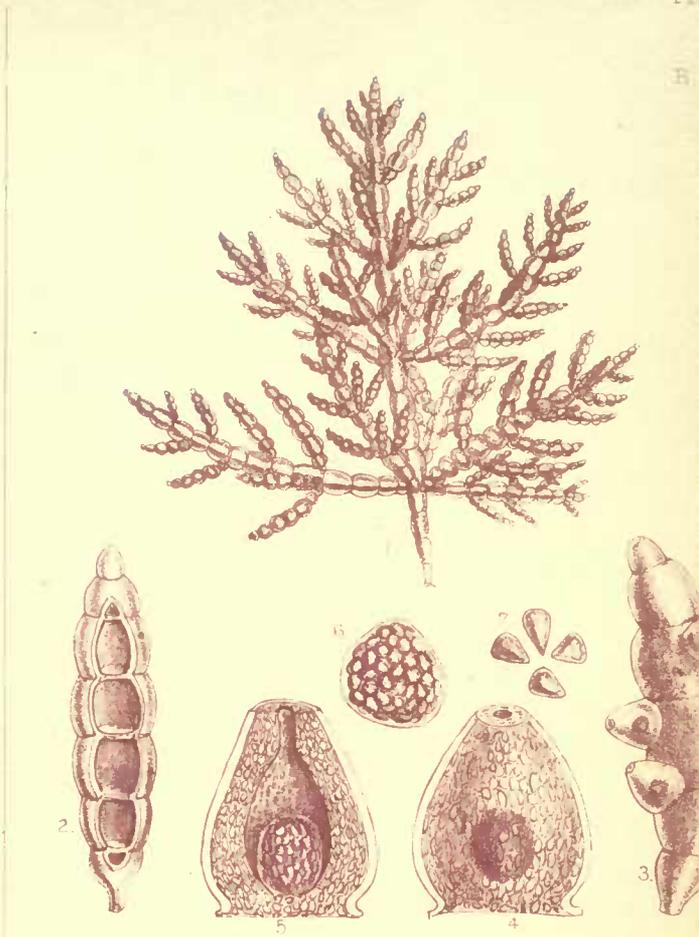
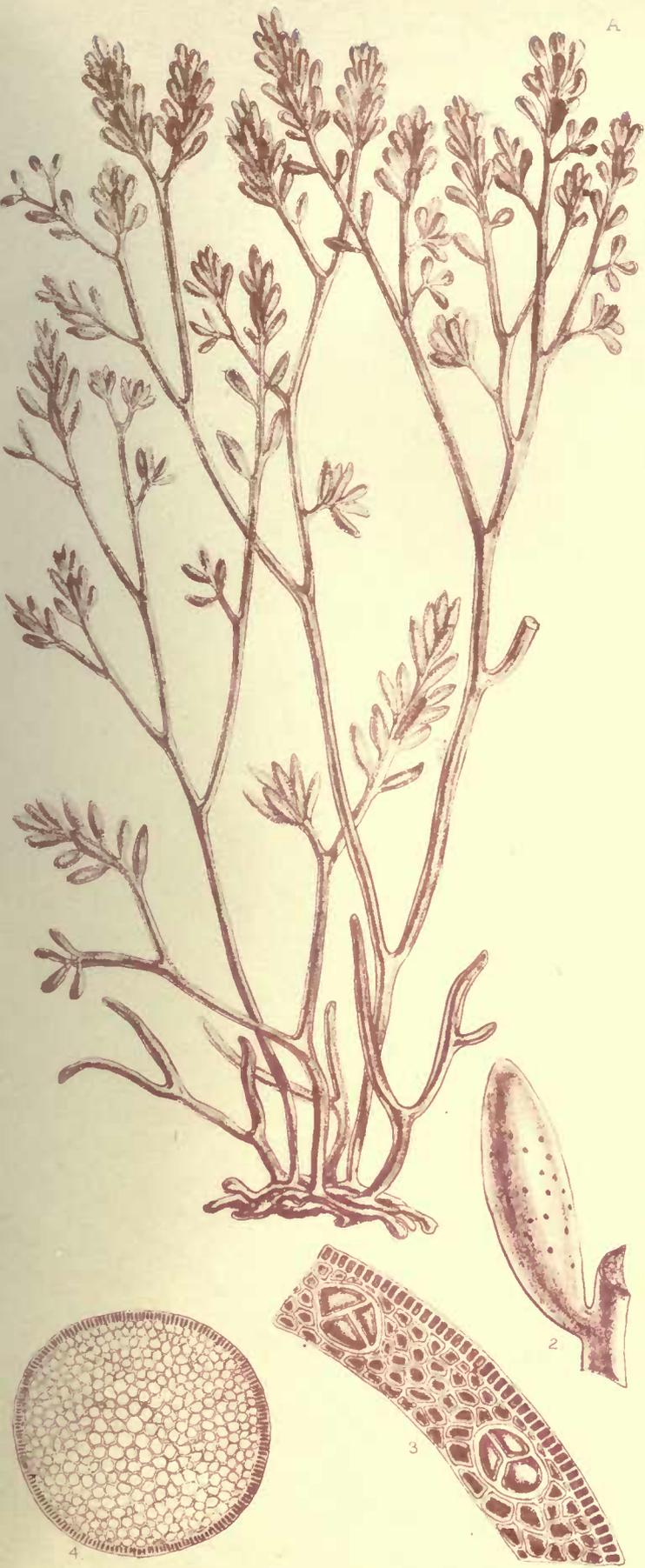


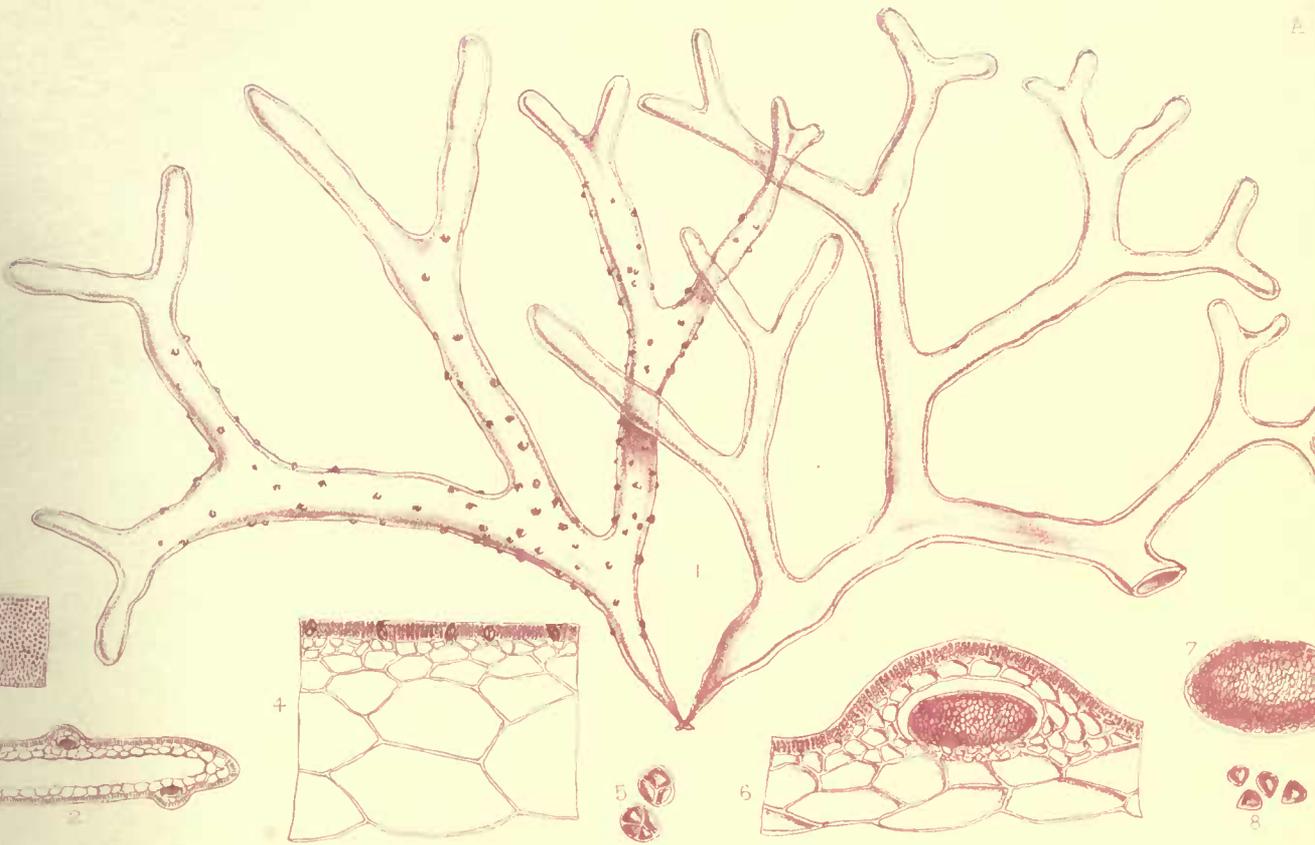


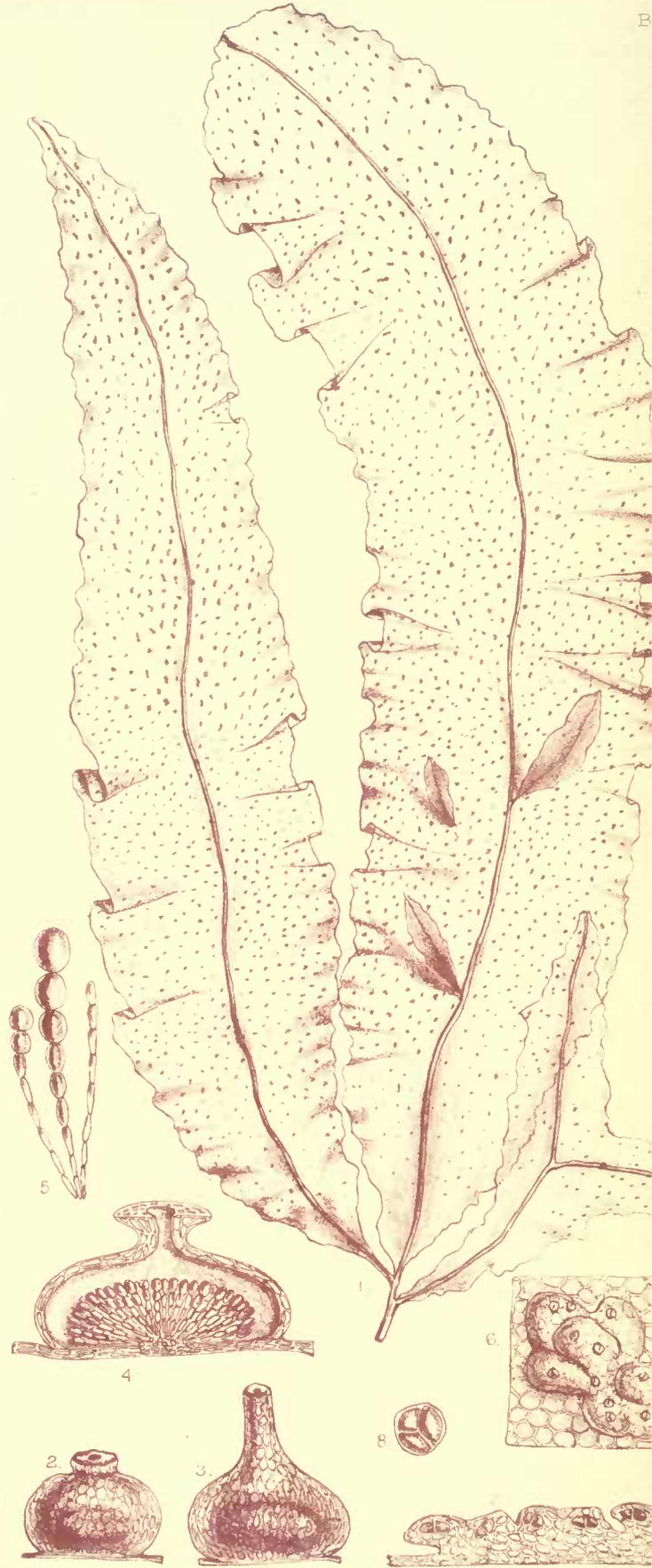


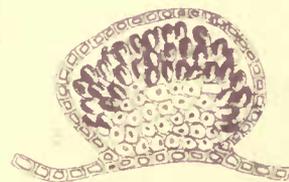
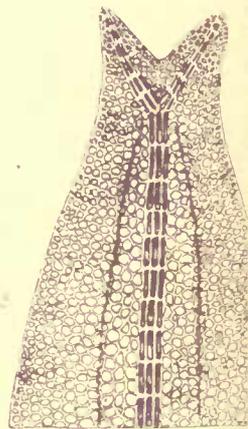
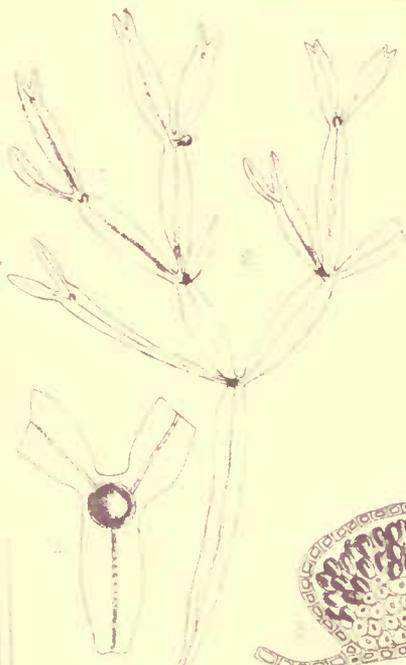
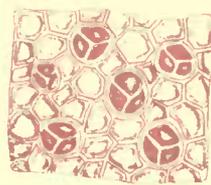
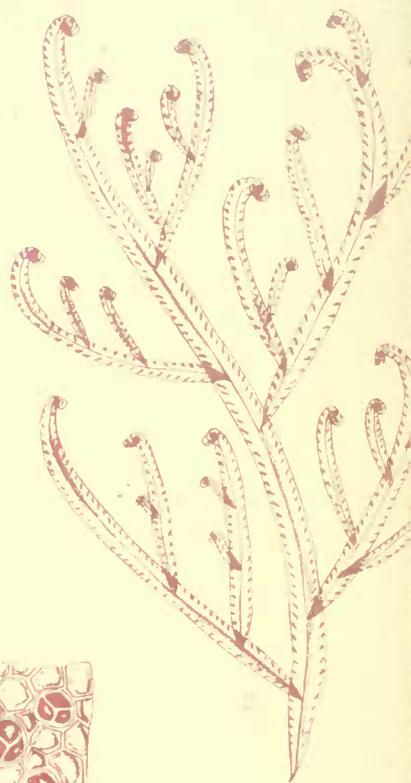
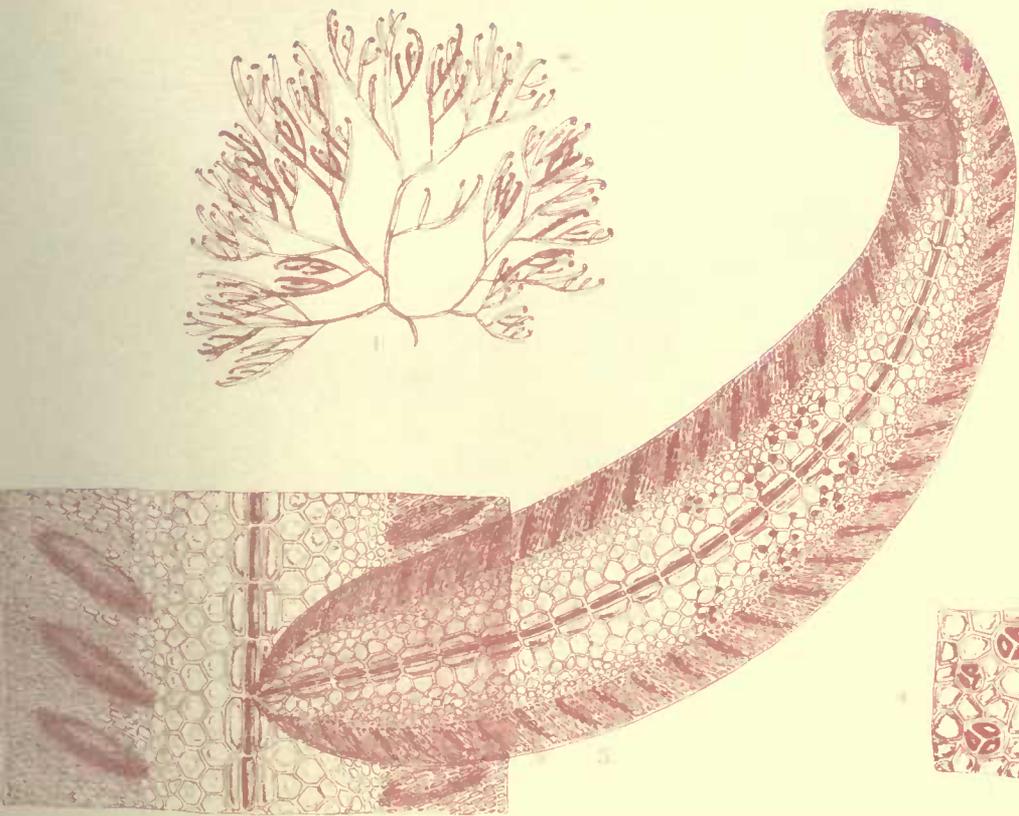
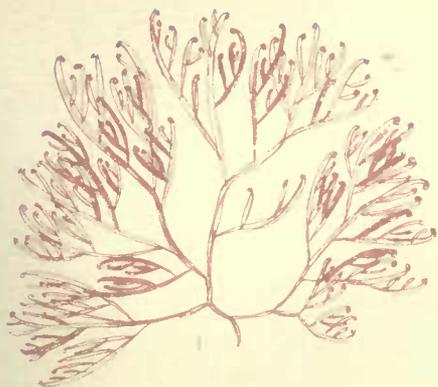


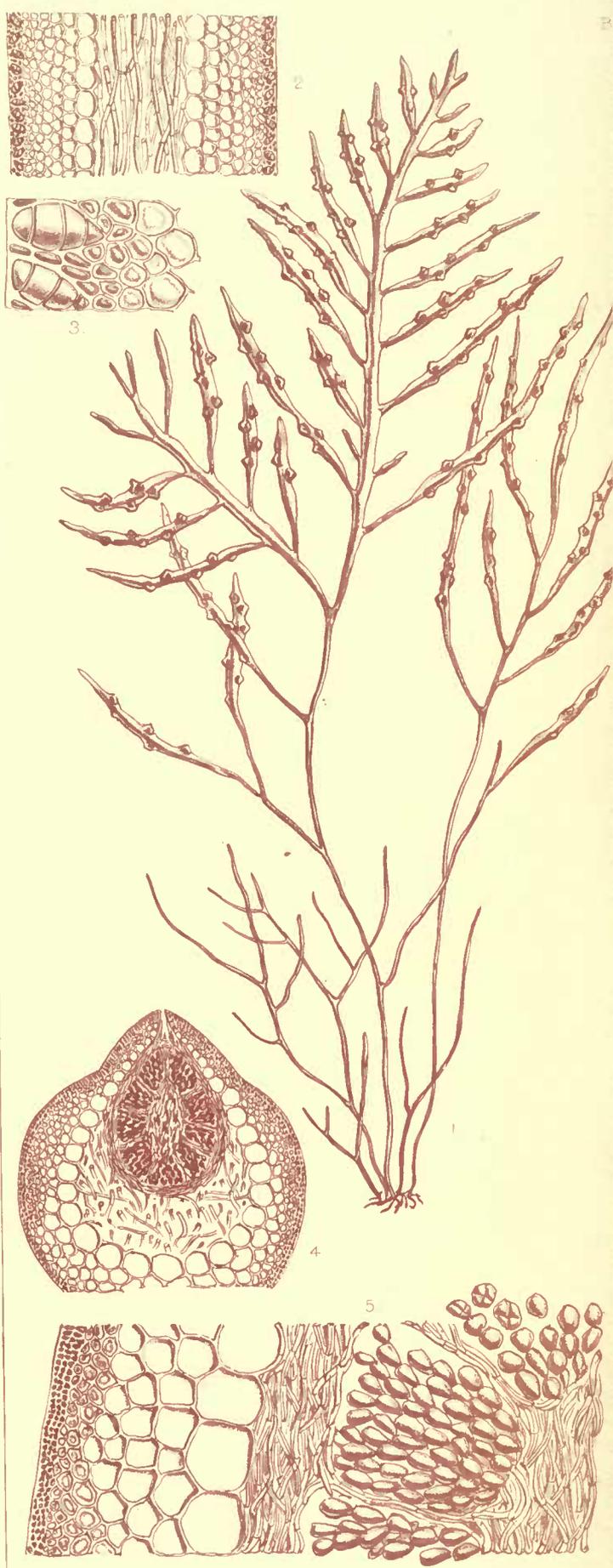


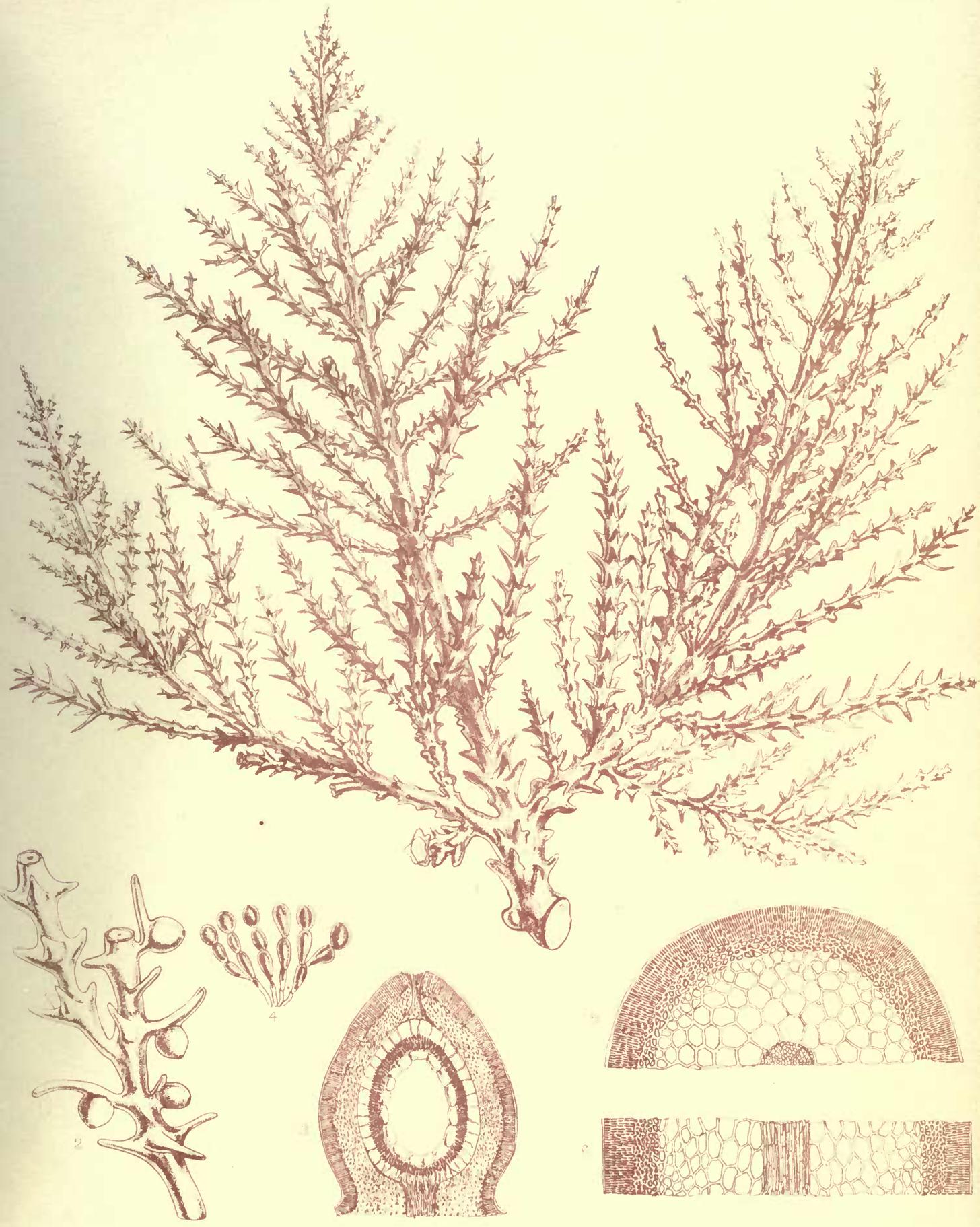


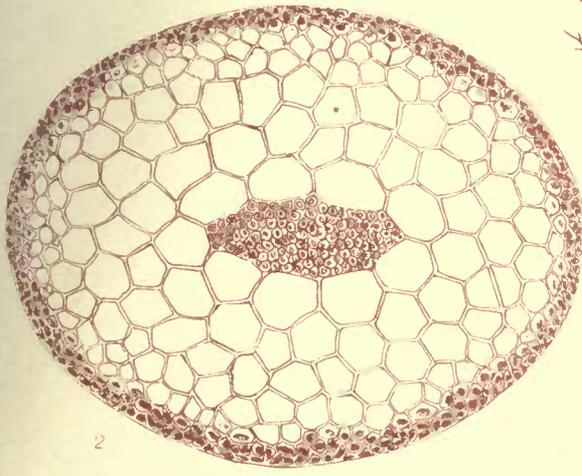
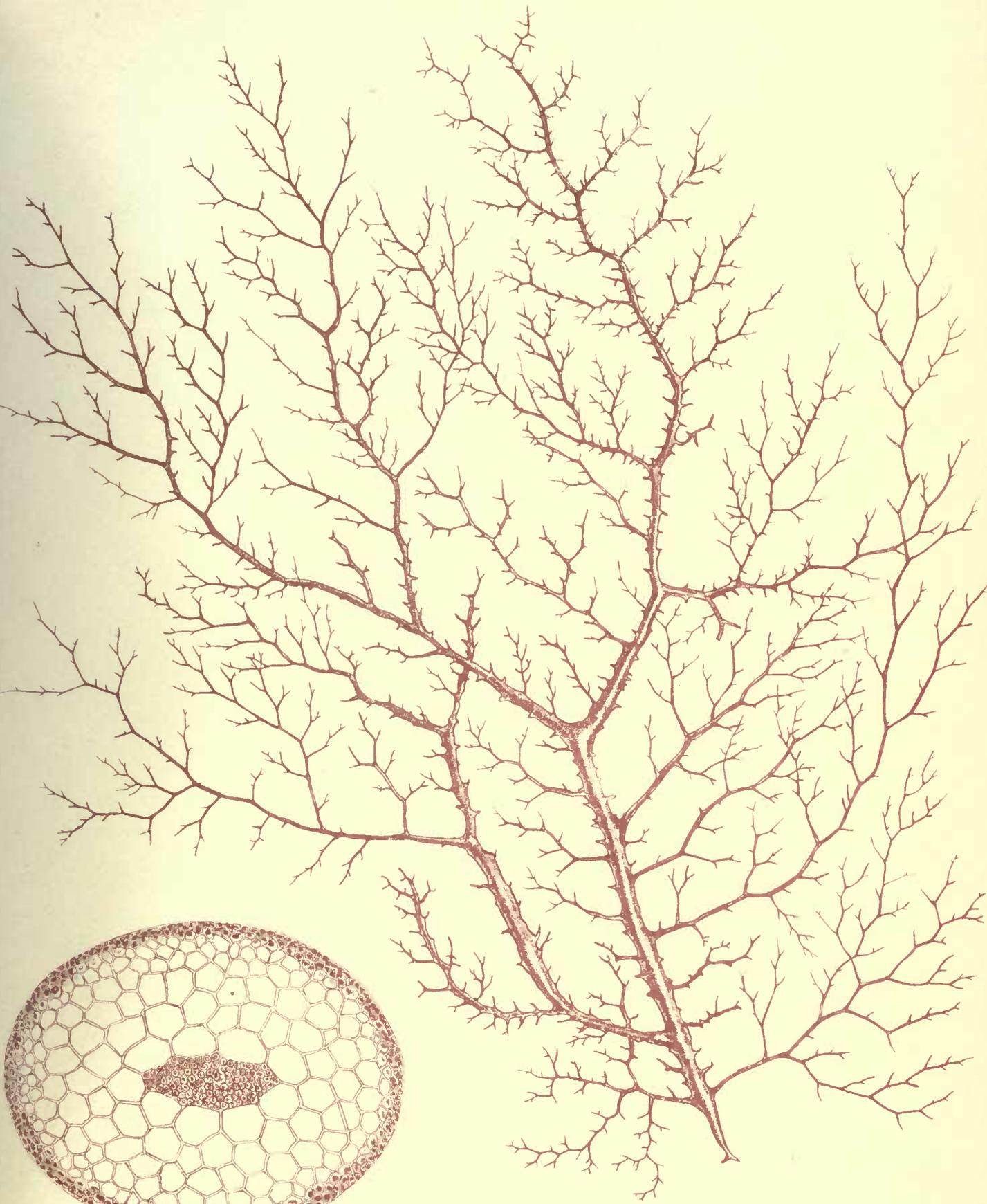




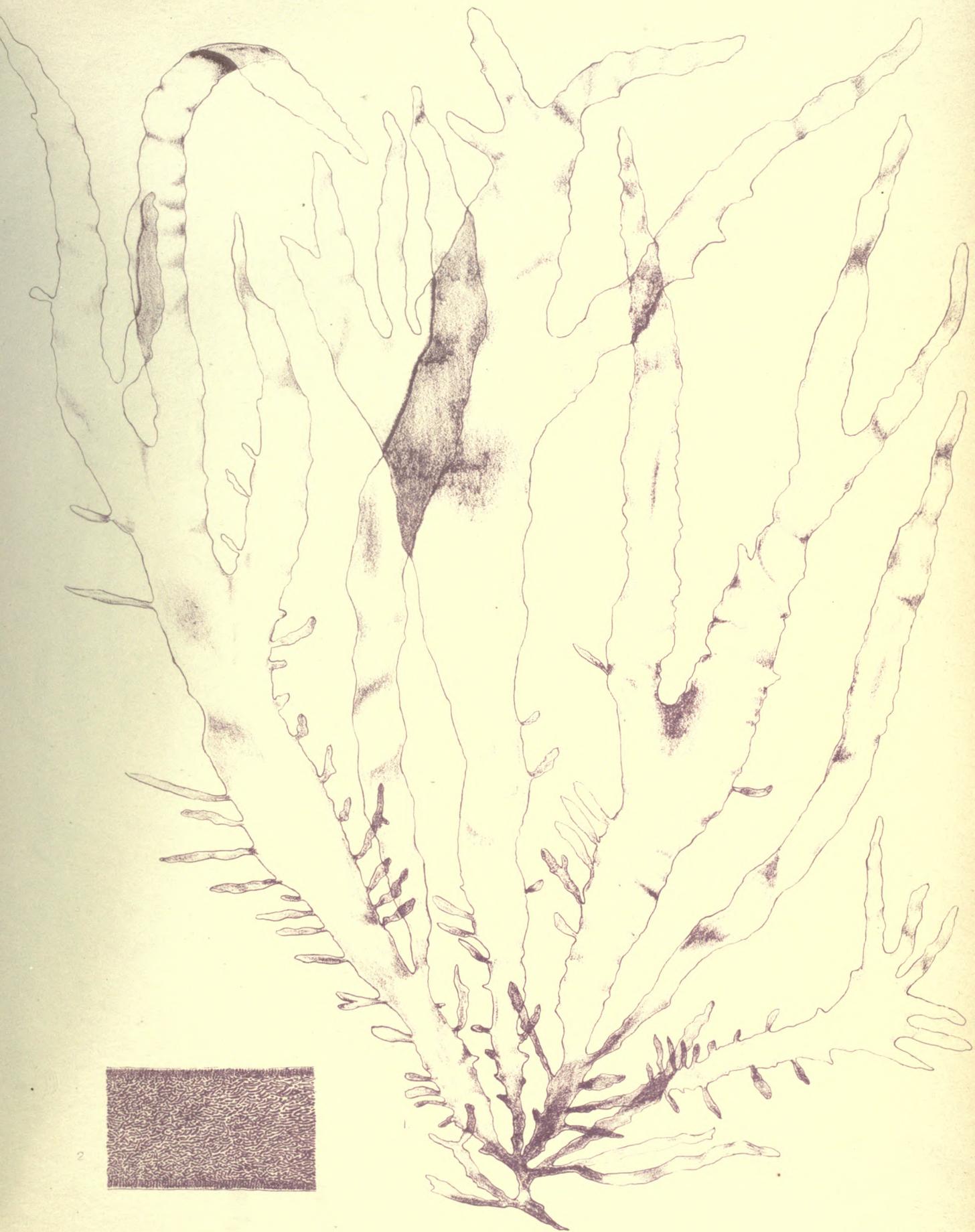




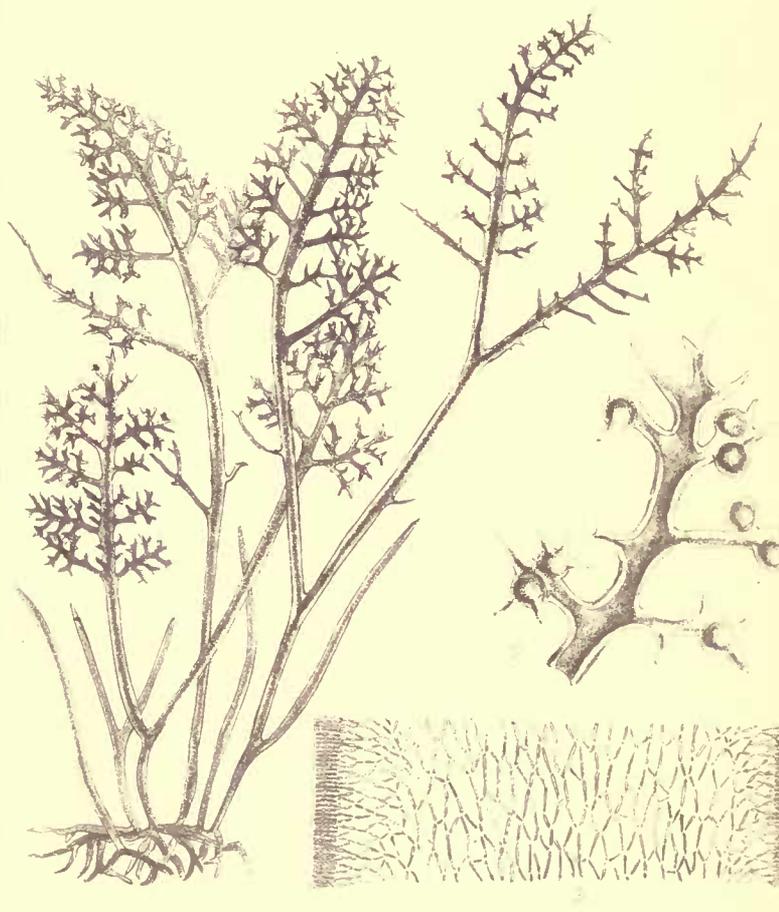
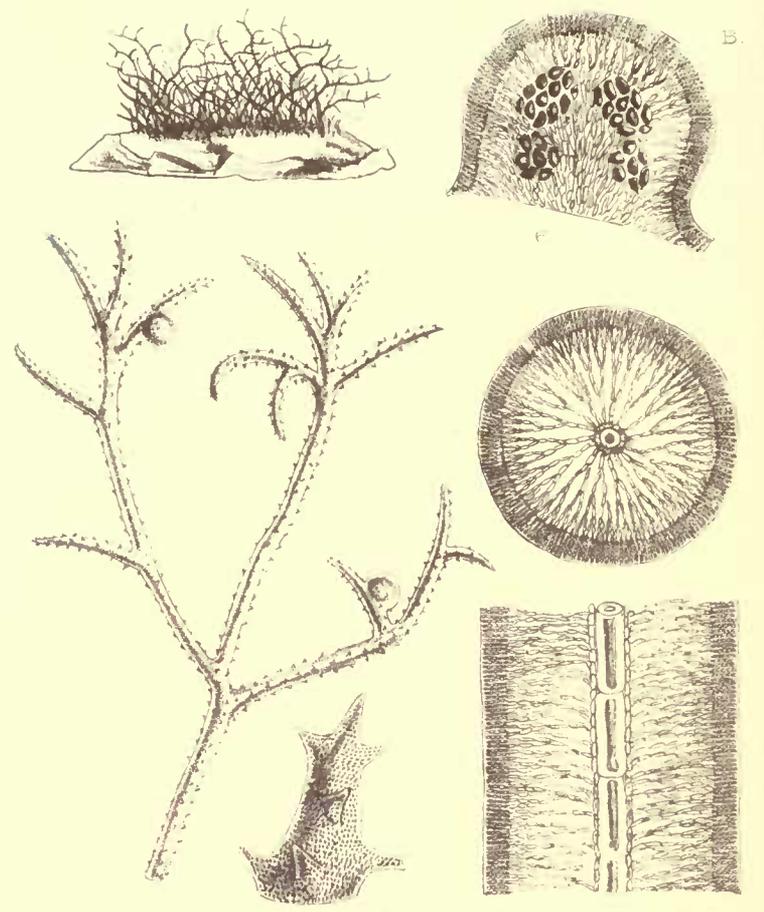
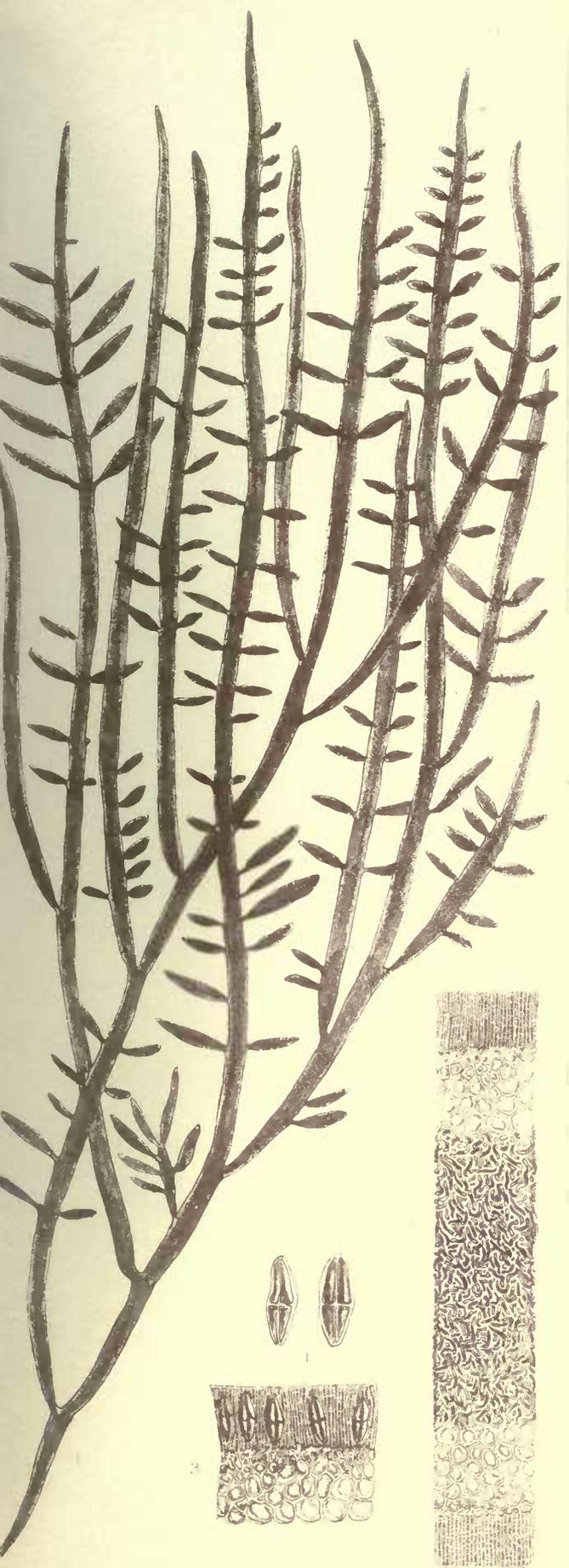




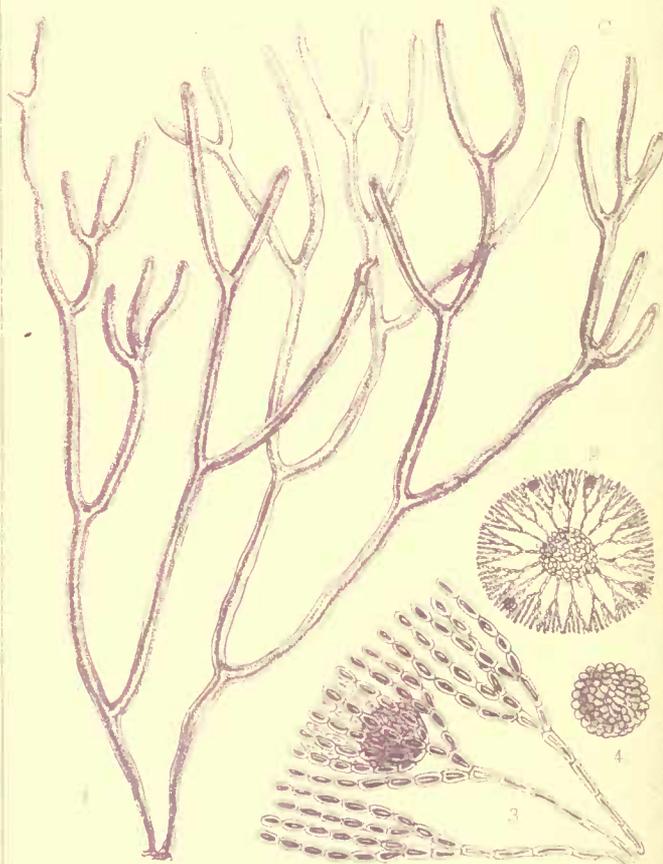
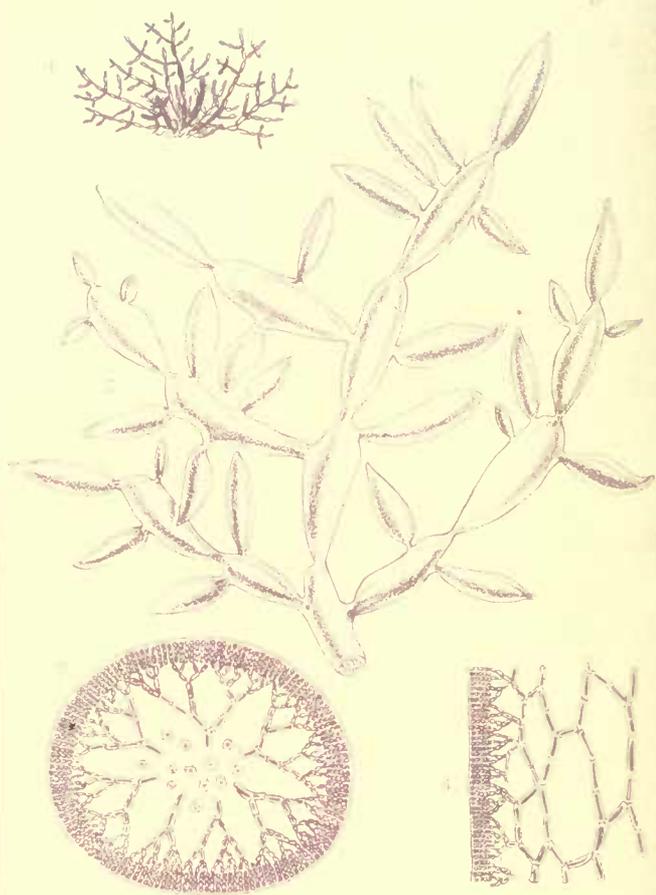
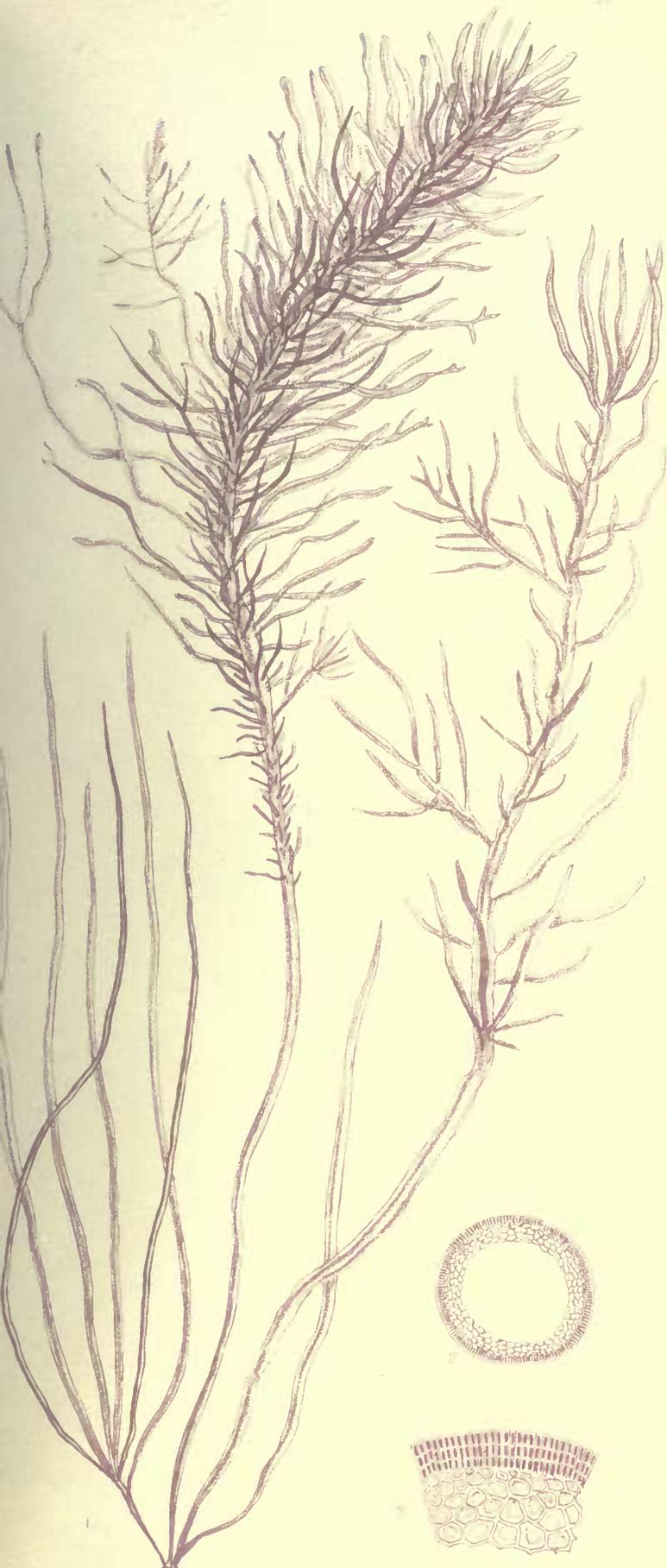
2

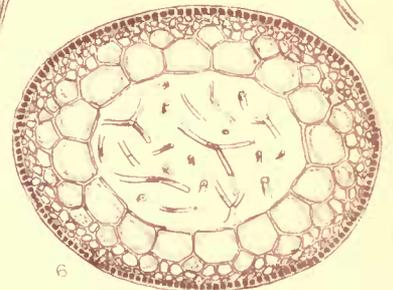
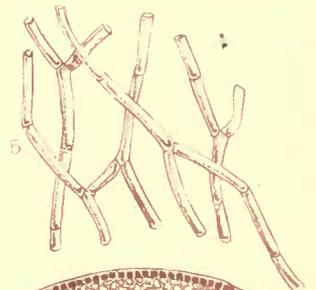
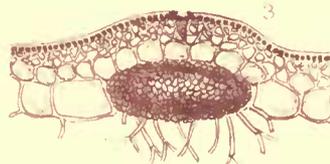
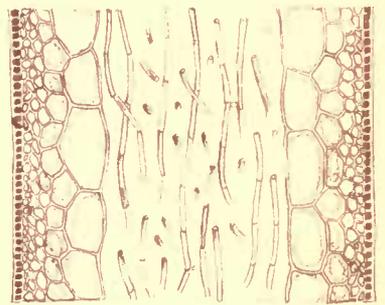
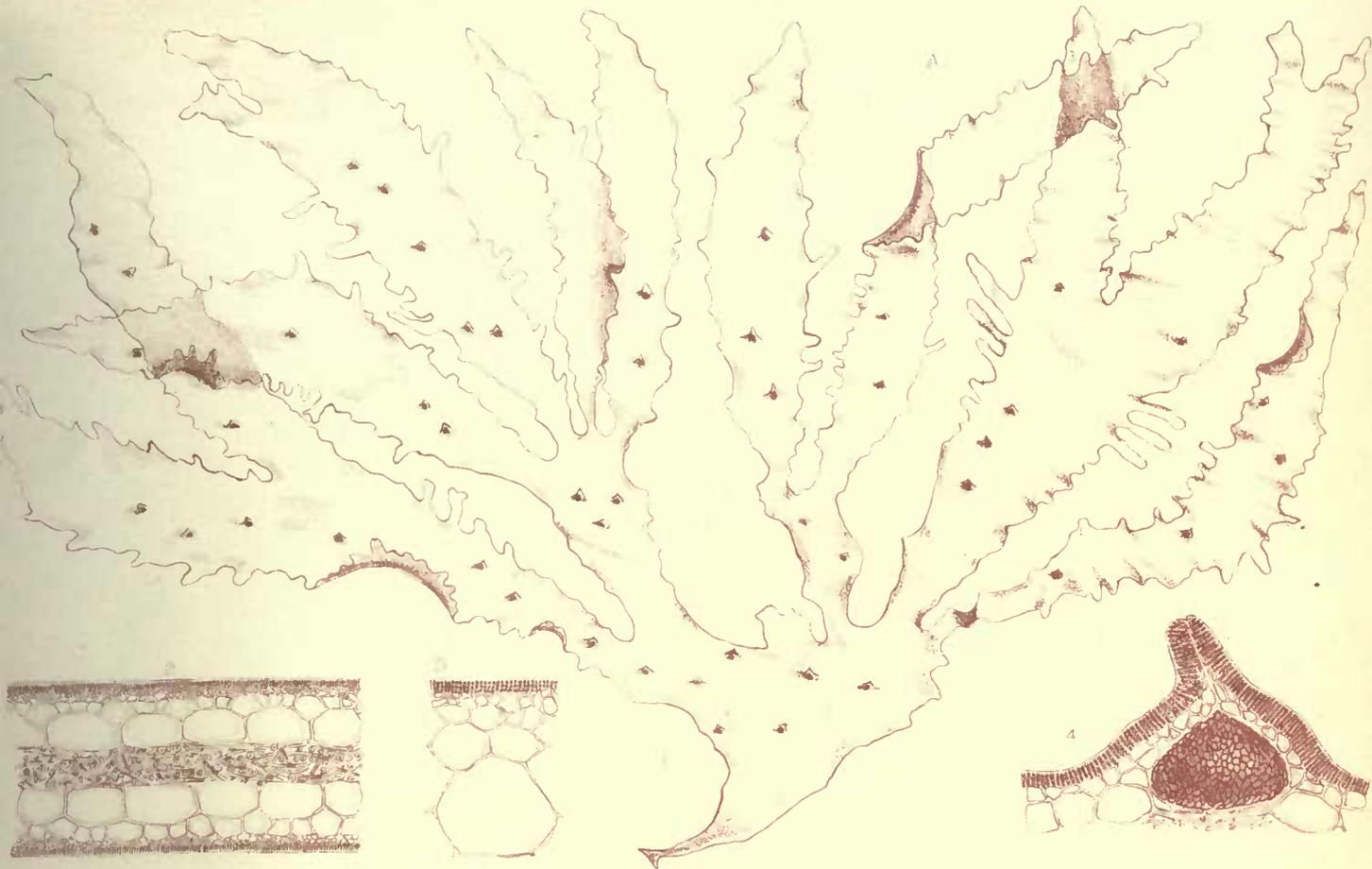


2

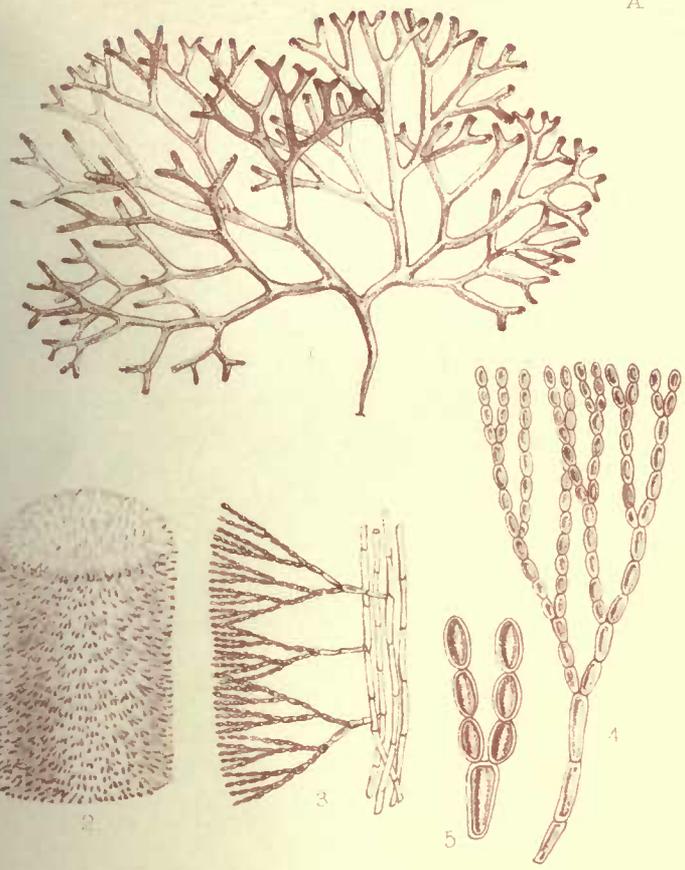








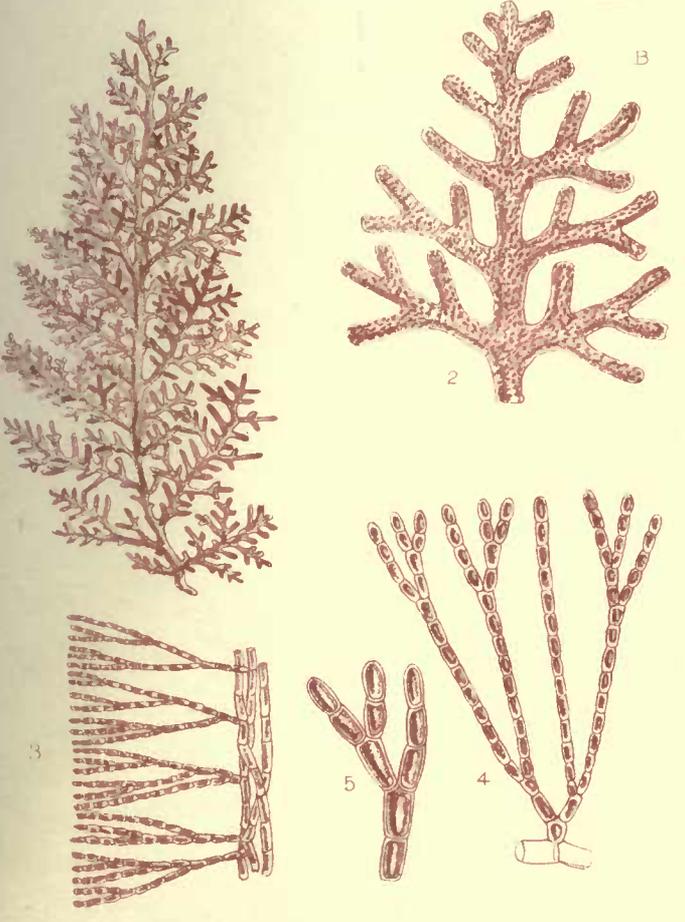
A



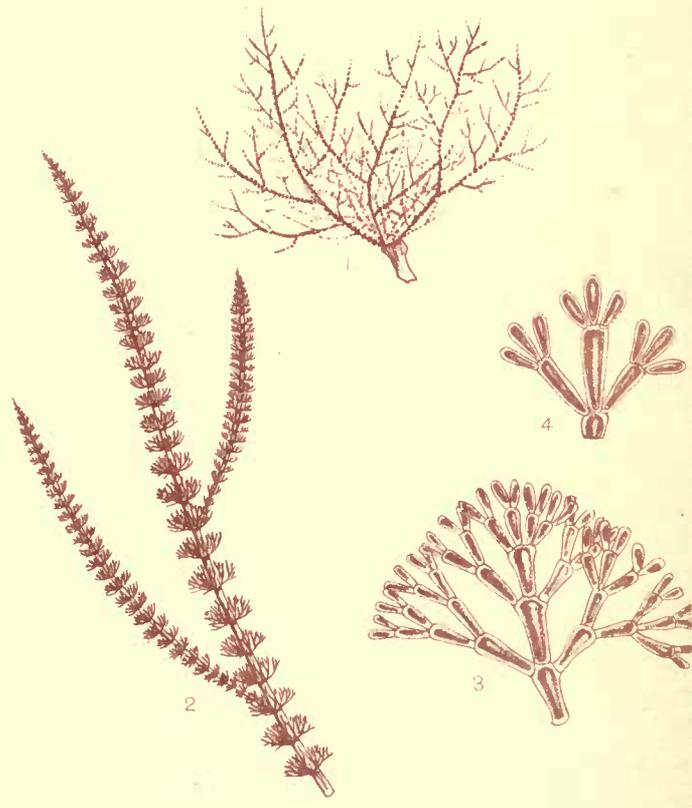
D

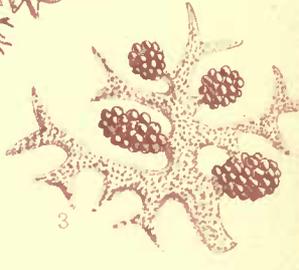
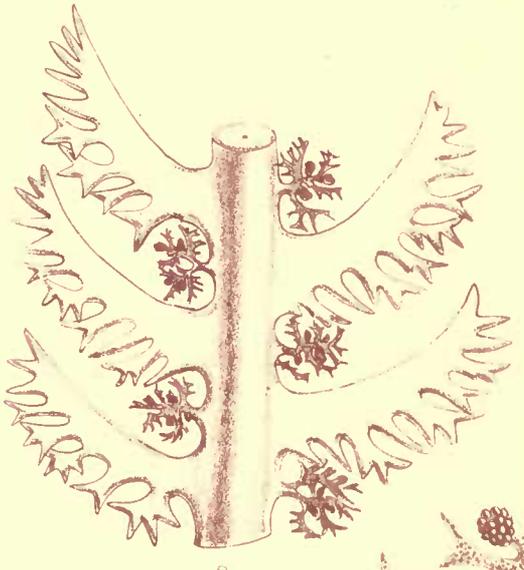
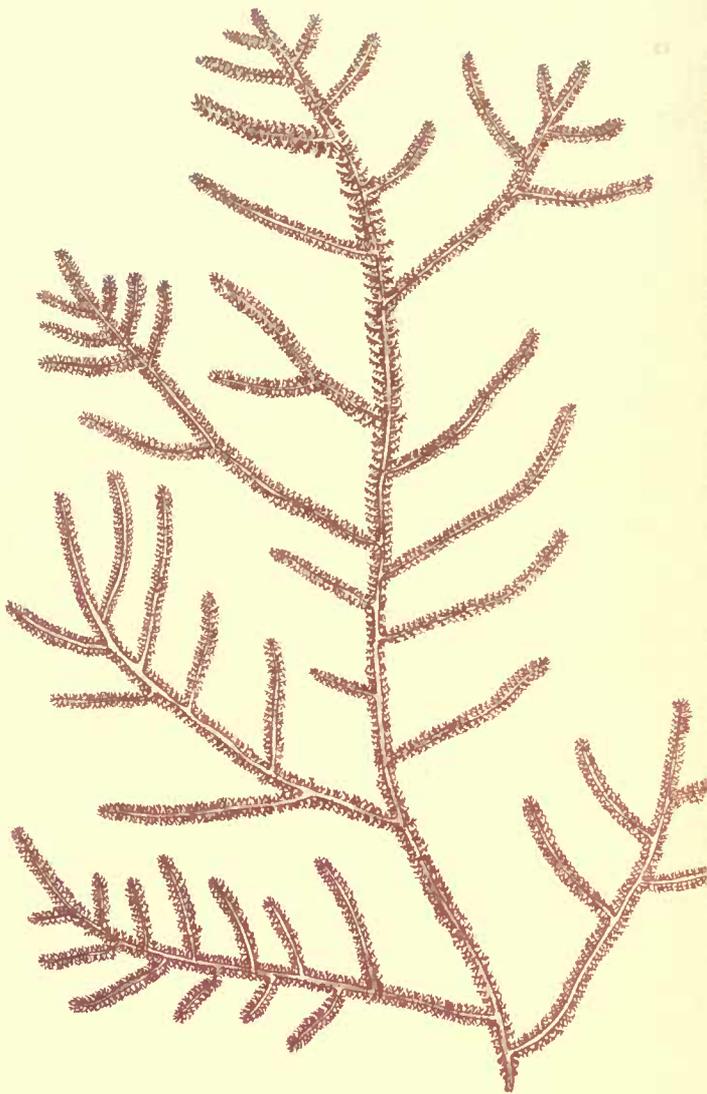
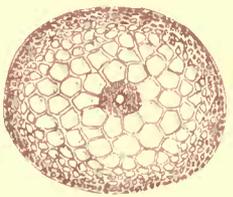
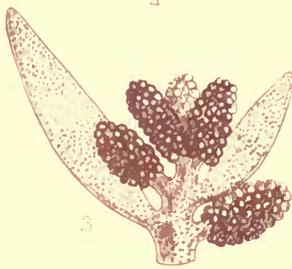


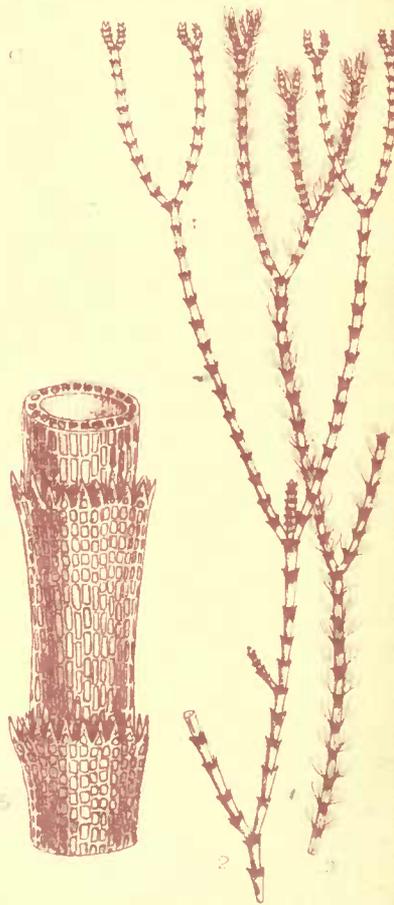
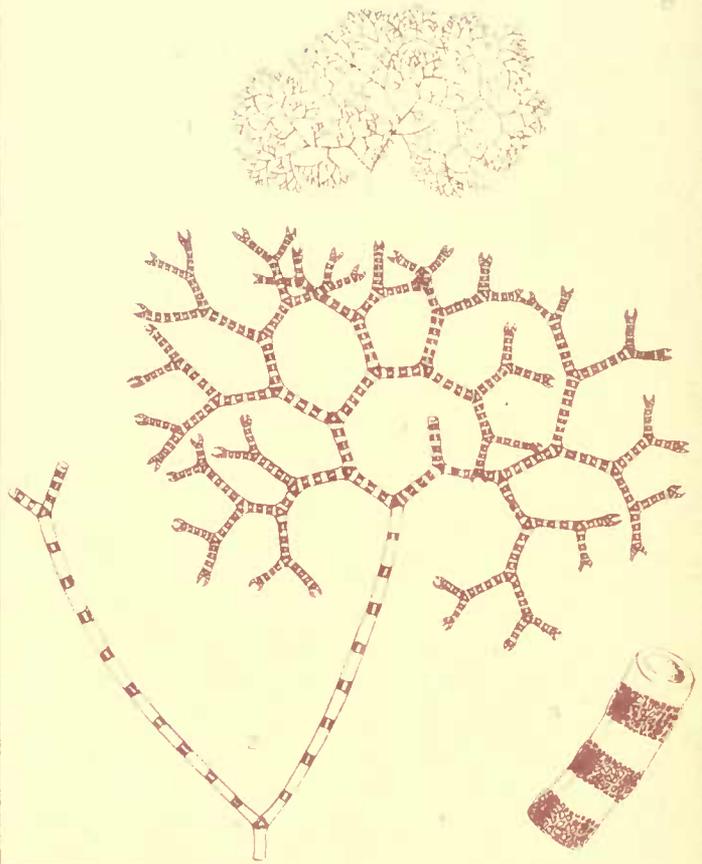
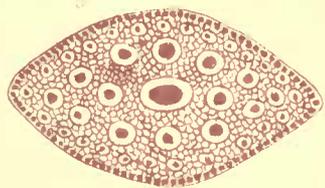
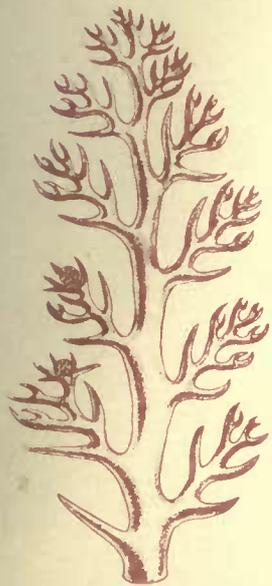
B



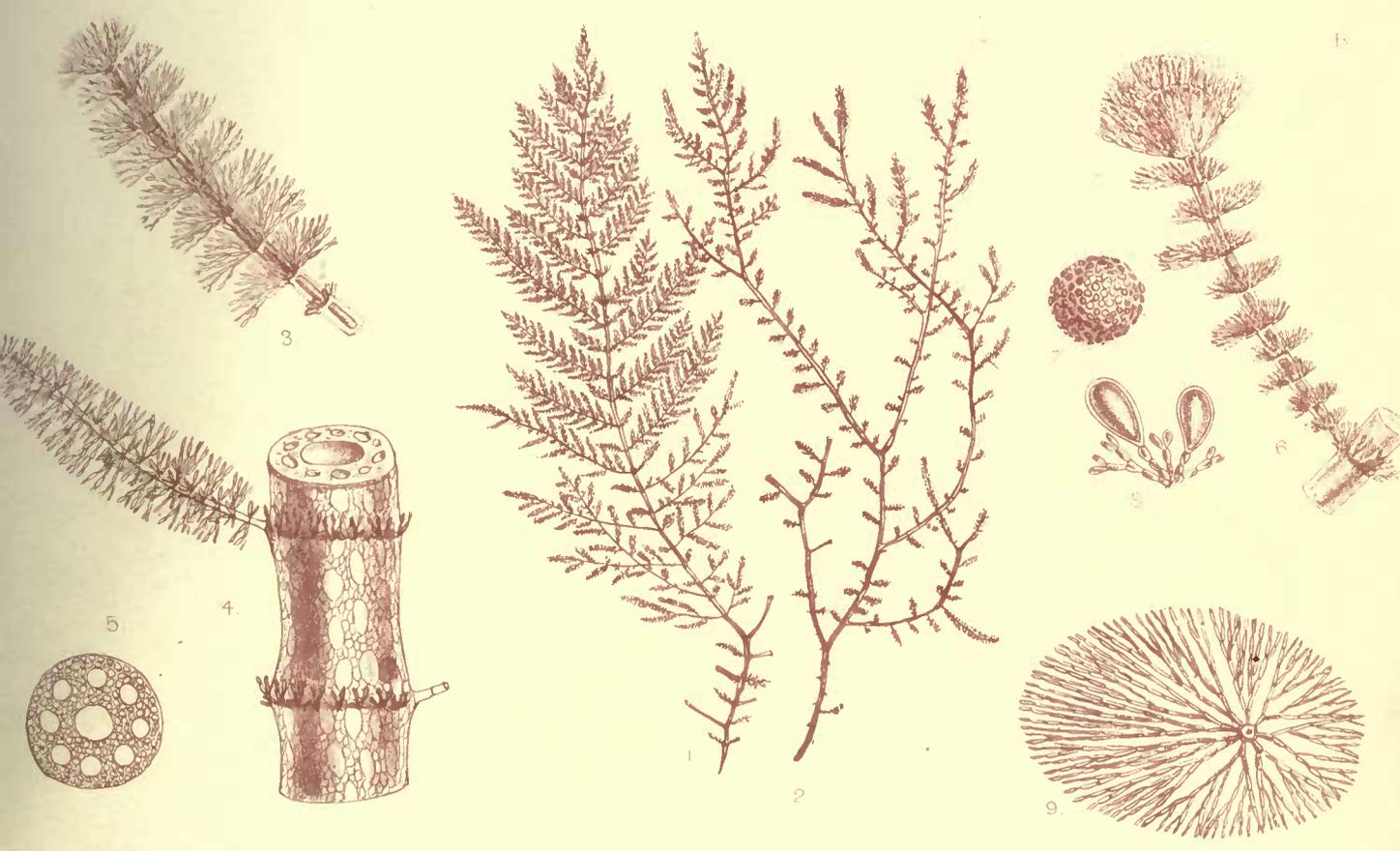
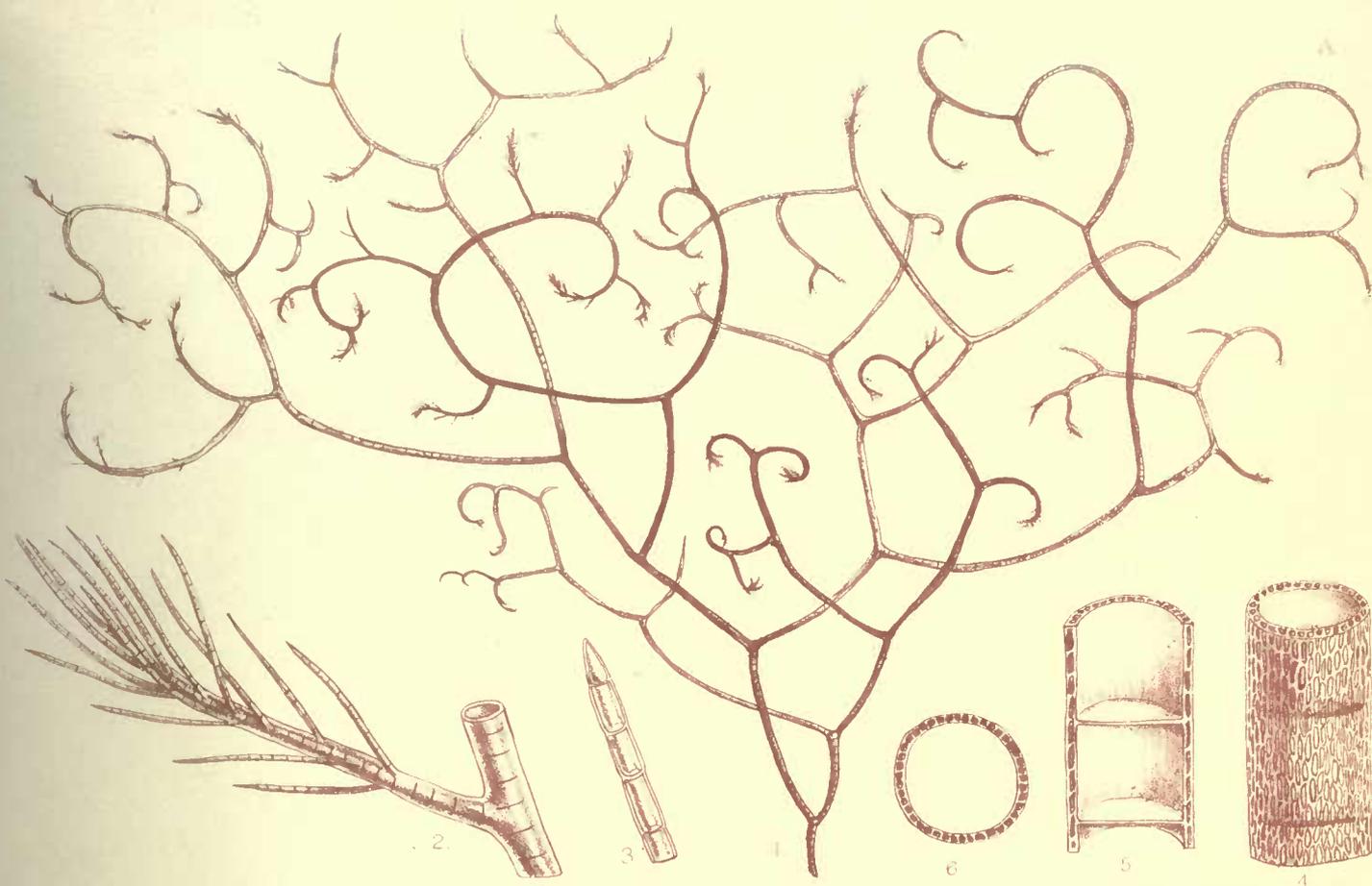
C

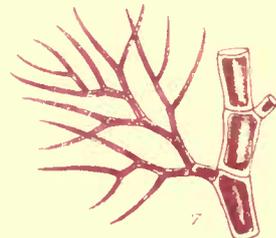
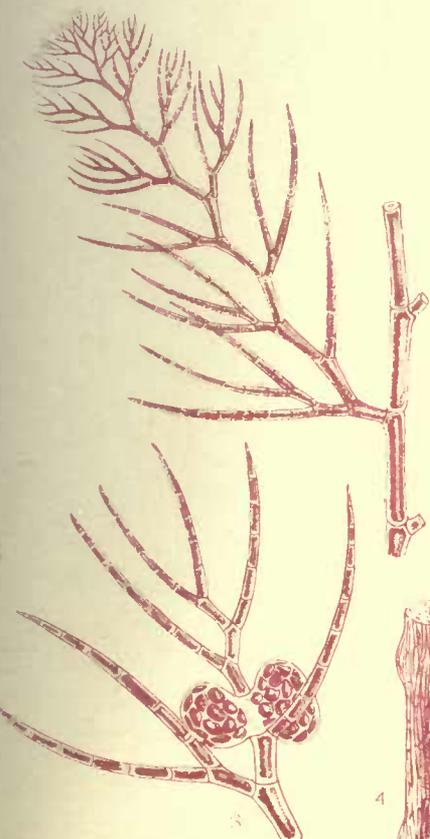
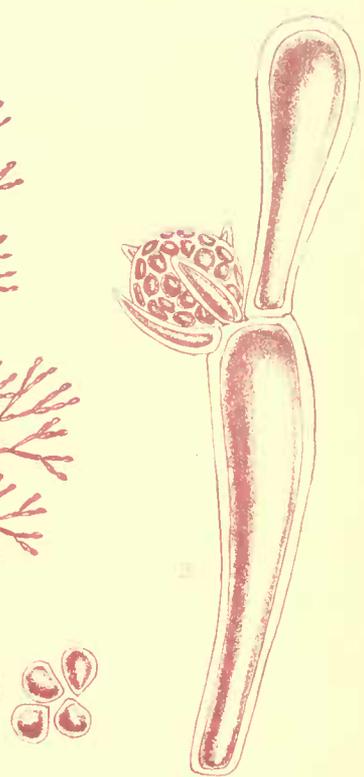
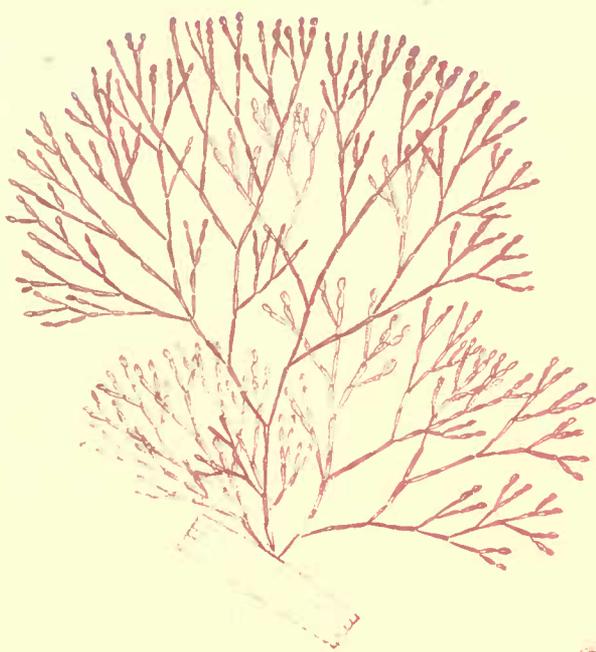


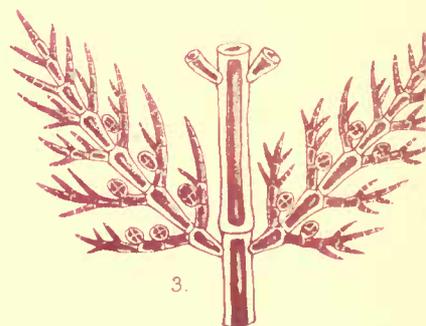
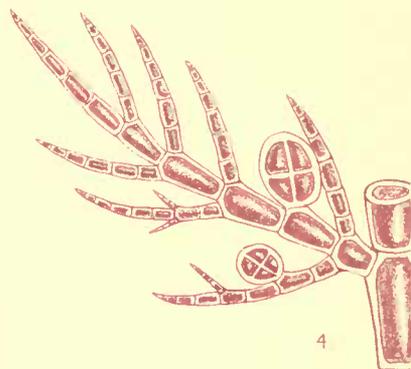
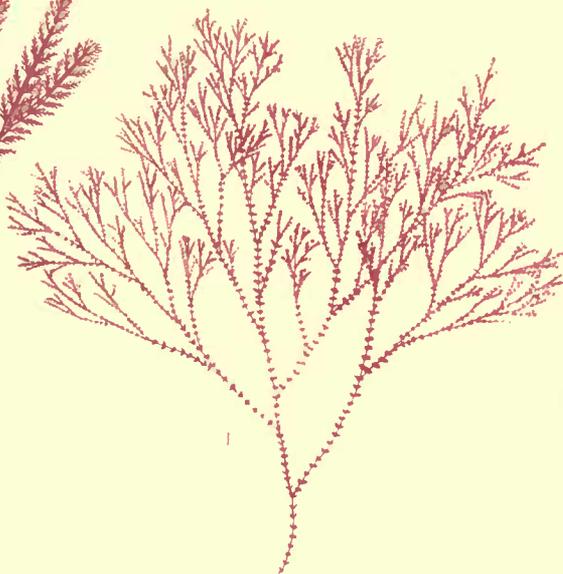
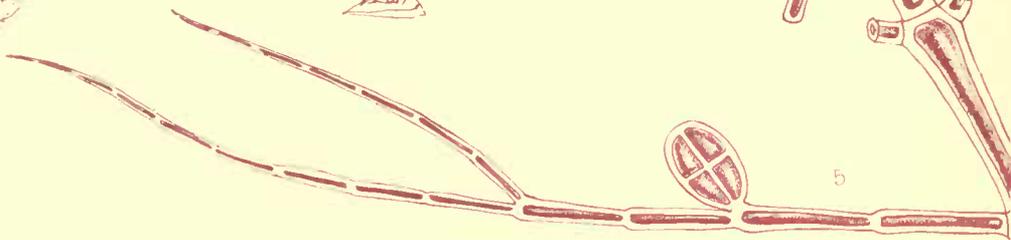
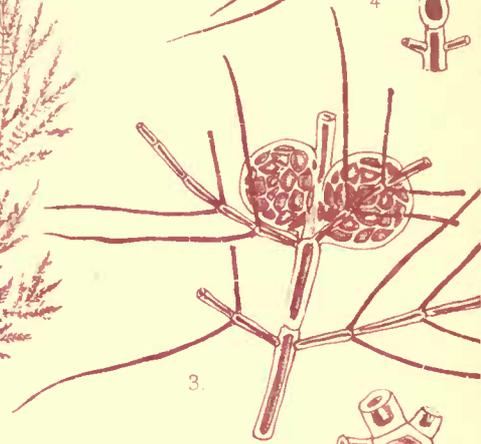
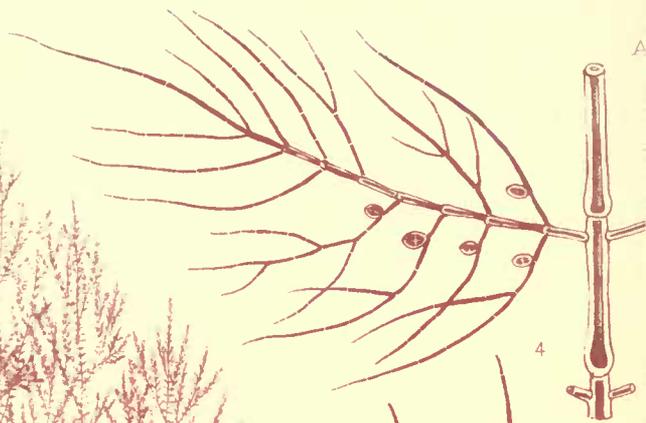
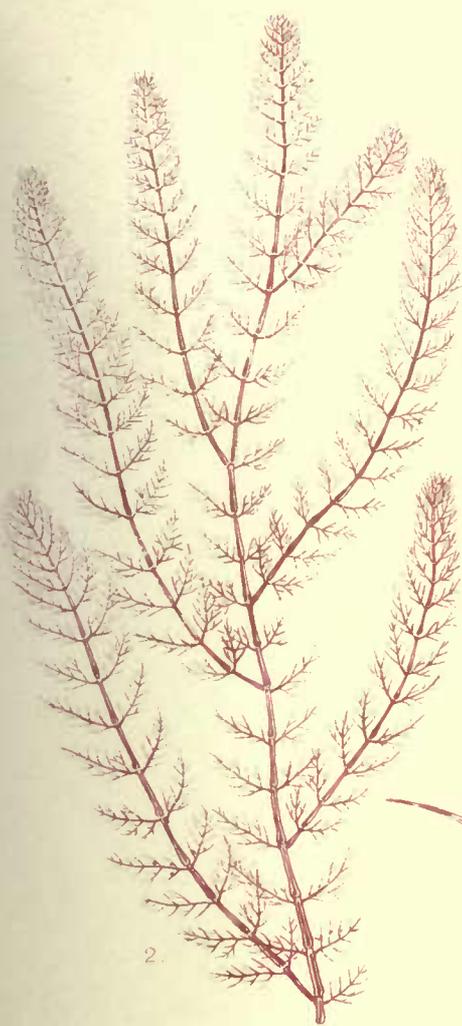












B

U.C. BERKELEY LIBRARIES



C021036627

1304

Q 11

S 68

V. 5

THE UNIVERSITY OF CALIFORNIA LIBRARY

