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THE OEDOGONIACEAE

A MONOGRAPH

Including all the Known Species of the Genera
Bulbochaete, Oedocladium and Oedogonium

By

LEWIS HANFORD TIFFANY, M. Sc., Ph. D.

Associate Professor of Botany
The Ohio State University

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FOREWORD.

For many years the only available keys to the Freshwater Algæ of North America were those published by Francis Wolle about 1887. These were in larger part transcriptions of European descriptions often based on a single collection. Moreover, at that time it was a common practice to name specimens on the basis of vegetative characters or of immature reproductive structures. Consequently many of the records are erroneous and many others are questionable.

In 1909 Frank S. Collins published a monograph of the Green Algæ of North America. He not only added many species and records to the North American algal flora, but also corrected many of the previous errors in nomenclature and in the locality records, and brought the taxonomy of the green algæ in America into harmony with the best usage in Europe. Collins' keys stimulated a wide interest in the green algæ in this country, and led to the publication of many local lists and papers describing new species.

In the determination of algæ, however, descriptions without plates are frequently difficult to interpret, and the greatest need of American students today is a series of illustrated monographs of the various families and orders.

The world wide distribution of many of the freshwater algæ, and the possibility that a species described from Australia may be found in Ohio has made it desirable that the monographs should attempt to cover all the described species. Too often the literature of a group is widely scattered and many of the papers are in obscure journals quite inaccessible to the average student.

In 1900 Karl E. Hirn of Helsingfors, Finland, published in Latin and German a monograph of the Oedogoniaceæ that has been a model and inspiration for all algologists, but this volume and its supplement are now difficult to secure. Moreover many new species have been described and the descriptions by Hirn in many cases have been emended. It has seemed therefore very desirable to publish descriptions and keys to all

the known species of Oedogoniaceæ in English. Dr. Tiffany's extensive acquaintance with American collections, and the species found in European exsiccati over a period of fifteen years have given him an excellent foundation for a critical view of the group.

It is the hope of the Department of Botany at The Ohio State University that this monograph will be followed in the near future by a monograph of the Zygnemales, and subsequently of other groups of the filamentous algæ.

EDGAR N. TRANSEAU.

TABLE OF CONTENTS

34776

ACKNOWLEDGMENTS.

In attempting a complete report of a group as large as the Oedogoniaceæ, one encounters numerous difficulties. The literature is bulky and in many languages. Type specimens are unavailable in some cases. Thanks, however, to the very careful work of Hirn (1900), many forms are perpetuated by extremely accurate and representative drawings. Some of the difficulties are matched, on the other hand, by the relative constancy of the characteristics of the species as they occur in aquatic habitats the world over. Many species appear in the writer's own collections.

It is almost impossible to give full acknowledgment to all who have assisted in making this monographic report possible. The writer has examined the material distributed in the Phycotheca Borealis-Americana and important collections generously supplied by the following: Prof. E. N. Transeau, Ohio State University; the late Prof. O. Nordstedt; Prof. R. B. Wylie, Iowa State University; Prof. G. E. Nichols, Yale University; Prof. F. E. Lambert, Tufts College; Prof. W. R. Taylor, University of Pennsylvania; Prof. C. J. Chamberlain, University of Chicago; Prof. I. F. Lewis, University of Virginia; Mr. G. H. Wailes, British Columbia; Prof. Alma B. Ackley, College of the City of Detroit; Prof. B. B. McInteer, University of Kentucky.

Data on distribution of the genus outside of the United States other than that secured from the literature have been supplied by Mr. G. H. Wailes, British Columbia; Prof. O. Borge, Stockholm; Prof. K. M. Strom, Oslo; Prof. H. Skuja, Riga; Prof. N. N. Woronichin, Leningrad.

The section on Bulbochaete in this report has previously appeared, in substance, in the TRANSACTIONS OF THE AMERICAN MICROSCOPICAL SOCIETY (Tiffany 1928). The text and plates dealing with that genus are incorporated herewith with the permission of the Society, kindly extended through its Secretary, Professor H. J. Van Cleave. My thanks are due Professor I. F. Lewis, University of Virginia, for the loan of his unpublished manuscript on the genus Oedocladium. Professor Lewis is

responsible for the emended description of the genus and for three of the four species now known (two are previously undescribed).

I am particularly indebted to my colleague, Professor E. N. Transeau, who has very graciously placed at my disposal all his notes on Oedogoniaceæ recorded during his long study of freshwater algæ in the United States. He has offered many valuable suggestions during the fifteen years this study has been in progress.

L. H. T.

Department of Botany, The Ohio State University,
Columbus, Ohio, January 2, 1930.

THE OEDOGONIACEÆ

INTRODUCTION.

Perhaps the most sharply circumscribed and clearly delimited group among the green algæ is the family Oedogoniaceæ. The members of its three genera—Bulbochaete, Oedocladium, and Oedogonium—are not only easily separable from other filamentous algæ but also readily distinguishable from each other. The rather rigid vegetative cells, the prominent reproductive organs, the large zoospores each with a crown of cilia at the anterior end, the reticulate chloroplasts, and the attached habit are characteristics of the family.

The filaments of Bulbochaete are branched and composed of cells each bearing at its enlarged upper extremity a laterally placed hair or seta. The setæ are bulbous at the base, hollow, and frequently greatly attentuated, sometimes reaching a millimeter in length. Oedocladium is also branched but is devoid of hairs. Species of Oedogonium are unbranched and in common with Bulbochaete possess holdfast cells that provide attachment for the plants. *Oedocladium hazenii** and species of both Oedogonium and Bulbochaete are aquatic. The remaining three species of Oedocladium are terrestrial.

The family Oedogoniaceæ was established by De Bary in 1854; the genus Bulbochaete by C. A. Agardh in 1817; Oedocladium by Stahl in 1891; and Oedogonium by Link in 1820. The most noteworthy contributors to the taxonomy of the group, other than those above, have been Pringsheim, Wittrock, Nordstedt, and Hirn. Since 1900 a number of algologists have added to our knowledge of the family by descriptions of new species, further notes on life histories, and data on geographic distribution. A list of such workers includes Hirn and Hallas from Finland; William West, G. S. West, Fritsch, Carter, and Hodgetts from England; Borge from Sweden; Wille and Strom from Norway; Pascher and Heering from Germany; Skuja from Latvia; Collins, Transeau, Lewis, and Tiffany from the United States. There have been many other

*In the Index the name of each new species, variety, or form is preceded by an asterisk.

students of this algal family, and some of their names are found in the bibliography near the end of this monographic report.

Some idea of the relative sizes of the three genera of the Oedogoniaceæ may be gained by a numerical recital of the composition of each. The genus Bulbochaete is composed of 48 species, 15 varieties, and 7 forms, with 3 additional species having incomplete descriptions. In Oedogonium there are 195 species, 76 varieties, and 38 forms; in addition there are 41 species and 3 varieties incompletely known. Oedocladium, by far the smallest, has only 4 species recorded to date.

Although an Oedogonium, a Bulbochaete, or even an Oedocladium can be recognized on vegetative characters alone the identification to species is impossible, except in a very few cases, without reproductive organs. Such unusual forms as *Oe.** *undulatum*, *B. horrida*, *Oe. nodulosum*, or *Oe. reinschii* are perhaps always recognizable in vegetative states, but such species are few in number.

The comprehensive reports of Pringsheim (1858), Wittrock (1874), Hirn (1900, 1906), and Heering (1914) are not readily available to many students of the algæ, and their points of emphasis have been necessarily European. The early American accounts of the Oedogoniaceæ by Wood (1872) and by Wolle (1887) are quite unreliable. The work of Collins (1909, *et seq.*) made available much European literature and was the first American publication on the green algæ that was really trustworthy. Perhaps to Collins should go the credit for the initiation of real interest in freshwater algæ in North America. Unfortunately his papers were inadequately illustrated. It is hoped that furnishing a complete English treatise of the family Oedogoniaceæ, including in addition to the taxonomic consideration, a discussion of the more important features of structure, reproduction, and distribution, will not only aid the student in the study of these common algæ but will stimulate added interest in algology generally.

CELL STRUCTURE AND REPRODUCTION.

The cell wall of the Oedogoniaceæ exhibits a rigidity not common to other filamentous Chlorophyceæ. The heavy cellulose layer is covered peripherally with pectose, and upon

*The abbreviation *Oe.* as used in this paper refers to the genus Oedogonium, and not to Oedocladium. When the latter is meant, the abbreviation is *O.*

this is found in varying amounts another compound, resembling chitin. In Bulbochaete and Oedogonium the latter substance does not appear on the holdfast cell or dwarf male at the points of attachment. The cell may frequently be so heavily incrusted with lime that identification is not possible in that condition. The addition of warm lactic acid removes the calcium carbonate without undue change to the filament. Epiphytic small algæ, including species of Oedogonium and Bulbochaete, are commonly found attached to the rigid filaments. Fungal parasites, particularly certain Chytridiales, attack the plants both internally and externally.

The vegetative cells are uninucleate with an elaborate parietal, reticulate chloroplast having one to many scattered pyrenoids. The chloroplast is quite variable in form, the network being considerably attenuated or hardly visible in the compact cylindrical mass (Carter, as reported by Fritsch and West, 1927).

A rather peculiar characteristic of the family is the method of division of the vegetative cell which results in the so-called "apical caps." Previous to the actual division there appears a ring-like thickening of the inner wall of the cell near its upper extremity. The growth of this ring ruptures the old wall circularly, and the outer layer of the ring becomes the new piece of cell wall. In the meantime nuclear division is followed by the formation of a cross wall at the middle of the cell, not connected at first with the cylinder. Later the septum assumes a permanent position near the lower part of the ruptured wall. The upper cell thus formed has a wall made up chiefly of the stretched ring, while the wall of the lower cell consists almost wholly of the lower part of the old cell membrane. The upper cell, however, has at its upper extremity a part of the old cell wall which projects slightly, forming the cap. This apical cap is an excellent diagnostic character of the genus Oedogonium, although in some of the smaller species it is difficultly visible; and the number of caps in each cell denotes the number of divisions it has undergone. (Cf. Pl. LXI, figs. 598–600).

In Bulbochaete there is rarely more than one apical cap to each cell, indicating, as will be explained later, that vegetative division in that genus occurs usually but once in a cell. (Cf. Pl. X, fig. 99).

In Oedocladium usually only the terminal cell undergoes division as outlined above for Oedogonium. Intercalary growth

is apparently uncommon. The cap (or successive caps) may remain at the top of the terminal cell (Pl. LXIII, figs. 616 and 617 and 621; Pl. LXI, fig. 602) or be pushed aside, adhering to the side of the filament (Pl. LXII, fig. 611; Pl. LXIII, fig. 622).

The nuclear phenomena accompanying cell division were early investigated by Strasburger (1880) and Klebahn (1892). More recently Tuttle (1910) has compared mitosis in Oedogonium with that seen in higher plants.

A single multiciliate zoospore is formed from the entire contents of a vegetative cell. Rarely a small amount of protoplasm is visible in the old cell after the emergence of the zoospore. The formation and liberation of the zoospore can readily be followed if the plants are brought into a warm room and observed under the microscope. The protoplast of the cell contracts slightly, and near one side appears a colorless area. A circular rent soon appears near the upper extremity of the cell in the vicinity of the apical cap. The mass then passes with a slow steady movement through the opening in the wall, being considerably constricted at the place of exit. Zoospores are formed from any cell of the filament except the holdfast.

Upon release from the cell, the zoospore assumes a spherical or ovoid shape. It is at first surrounded by a thin gelatinous envelope which rather rapidly increases in volume and transparency and finally disappears. At the anterior end of the forming zoospore appears a colorless area, around the base of which occurs the crown of cilia. The zoospore is active for a short time, its movements becoming progressively less and less until it comes to rest. The cilia are absorbed and the clear anterior end becomes the attached part of the holdfast cell (Cf. Pl. X, figs. 84–92). Sometimes growth of the zoospore begins before movement has ceased. Upon germination, repeated cell division occurs in the manner described above, except in those species where the first division does not result in the formation of a ring. In Oedogonium the sporeling thus formed develops into a filament by intercalary growth.

The development of the germinated zoospore in Bulbochaete involves variations that deserve separate mention. The basal cell formed from the germinated zoospore is usually the only one capable of division, as far as the main axis is concerned. In some of the forms with ellipsoid oospores, however, inter-

calary growth has been noted. The first division is of simple type, without a ring formation. The upper part of the cell is separated from the lower by a circular rent, but no new membrane develops between the two parts. As the new wall grows upward, the separated part is pushed to one side as a lid. The upper new cell grows out into a long tubular bristle with a swollen bulbous base. Subsequent divisions occur with the regular ring formation, and each new cell is intercalated between the basal cell and the next one above. The upper cell of each filament is therefore the oldest one. A lateral protrusion of each cell at its apex is cut off, developing into a hair. It is thus seen that the terminal cell bears two hairs, the other cells one each. Nearly every cell of Bulbochaete has two apical faces, one bearing a hair (or a cell of a side branch), the other the next upper cell of the main axis. Every cell of the principal axis of the filament, except the basal one, may cut off by an oblique division a lateral cell which becomes the basal cell for a side branch. By repeated divisions, first of the simple type and subsequent ones with ring formation, as noted above, this secondary basal cell (which of course is the primary basal cell of the side branch) forms the branch. Tertiary branches are formed similarly from the secondary ones, and so on through further branching. The mode of growth of the main axis is thus repeated by the side branches (See Plate X, figs. 93–99).

The germination of a zoospore of Oedocladium is in many respects unlike that of either Oedogonium or Bulbochaete. The first cell formed upon germination develops into (1) the green filament with the rhizoidal cell forming as a branch; or (2) the rhizoidal filament with the chlorophyllose cell as a side branch; or (3) the green filament with the branch cell also green; or (4) a green filament without early branching. (Cf. Pl. LXII, fig. 612; Pl. LXIII, fig. 623). The formation of a branch in Oedocladium occurs by the development of a circular rent in the upper extremity of a vegetative cell, forming an upper short "lid" and a lower, much longer cylindrical piece. Through this rent the protoplasm of the forthcoming daughter branch cell with its initially thin wall protrudes. A new wall separating the branch cell from the cell of the main filament is then developed. This wall is attached to the juncture of the upper extremity of the cylindrical piece of the primary cell and the lower end of the branch cell, on the one hand, and to the

original upper transverse wall of the primary cell, on the other. (Cf. Pl. LXII, figs. 606 and 612; Pl. LXIII, figs. 616 and 623).

Sexual reproduction of a rather advanced order has been observed in most species of the family. The position and relation of the oogonia and antheridia are used as classificatory items in all three genera. If oogonia and antheridia occur on the same filament the plant is *monoecious* (Pl. IX, fig. 69; Pl. XV, fig. 145); if on separate filaments, *dioecious* (Pl. XXXIII, figs. 291 and 292). *Oe. varians*, *Oe. trioicum*, and perhaps a few others are both dioecious and monoecious. If dioecious, the male filaments may be about equal in size to the female, and the species is *macrandrous* (Pl. XXX, figs. 262 and 263). If the male plants are few-celled, much smaller ("dwarf males" resulting from germinating androspores) and epiphytic on the female plant, the species is *nannandrous* (Pl. II, fig. 17; Pl. LII, fig. 494). If the dwarf males have arisen from the germination of androspores liberated from androsporangia occurring on the same filament with the oogonia, the alga is *gynandrosporous* (Pl. V, fig. 37; Pl. LIV, fig. 509; Pl. LXII, fig. 606); if the androsporangia are formed on separate filaments from the oogonia, the alga is *idioandrosporous* (Pl. VII, fig. 53; Pl. XLV, figs. 434 and 435). A few species among the nannandrous sections are both gynandrosporous and idioandrosporous. The dwarf males form on the suffultory cell (Pl. VII, fig. 52; Pl. L, fig. 482), or on the oogonium (Pl. V, fig. 37; Pl. LIV, fig. 508), or rarely scattered on vegetative cells (Pl. XLVII, fig. 458).

In Oedogonium and Oedocladium a single division of a vegetative cell results in an *oogonium* and a *suffultory* ("supporting") cell (Pl. LXIV, figs. 638–640). The latter (in Oedogonium) may by subsequent divisions form a series of oogonia (Pl. LIX, fig. 577). Flat discoid cells resulting from repeated transverse divisions of a vegetative cell are *antheridia* (in the monoecious and macrandrous species) and *androsporangia* (in the nannandrous species). No seriate oogonia are recorded for the species of Oedocladium.

In Bulbochaete oogonia are developed singly, never in series. An oogonium arises by a double division of a vegetative cell which thus results in two suffultory cells. After the first division the septum becomes fixed near the middle of the old sheath-like wall "so that the membrane of the upper segment is formed by a short cylindrical piece of the latter and above

that by the stretching thickening ring which is becoming bulged out, forming the oogonium. A second thickening ring then develops in the median region of the young oogonium followed by a transverse rupture of the wall at this point; the septum formed in connection with this second division lies on a level with the top of the first-formed sheath, so that the supporting-cells are included in the latter. This curious development is responsible for the fact that the wall of the mature Bulbochaete oogonium can nearly always be seen to consist of three pieces." (West and Fritch 1927, p. 219). (Cf. Pl. LXIV, figs. 641–645.)

If the lower of the two suffultory cells is the longer we speak of the division as supreme, superior, or supramedian, depending upon the relative lengths; if the upper is the longer of the two, the division becomes inframedian, inferior, or basal; if the two are equal in length, the division is median. In some species of Bulbochaete the position of the division is variable and cannot always be depended on as a distinctive diagnostic characteristic. If the two divisions are at right angles to the long axis of the vegetative cell, the oogonium is said to be *erect;* if one division is oblique, giving one suffultory cell a five-sided, or five-angled, appearance (viewed in optical section), the oogonium is *patent.* In members of the genus with globose (or nearly so) oogonia, the upper and not the lower suffultory cell is five-angled, while in those with more ellipsoid oogonia the reverse is true. In the latter case the upper cell is quite small, or may not be visible. A patent oogonium is always formed by a division of the basal cell of a side branch, with which may be associated a bulbous hair, an androsporangium, an antheridium, or rarely a vegetative cell. An erect oogonium on the other hand forms from a division of some vegetative cell other than the basal one. In the globose forms of the genus, patent oogonia are common while erect oogonia occur only in a few species. Among the ellipsoid forms both kinds are found. (Pl. LXIV, figs. 641–645).

The oogonium contains a single egg and varies considerably in shape, being largely ellipsoid, ovoid, globose, or some variation of these shapes. It is usually of noticeably larger diameter than the vegetative cell, although in *Oe. capillare* and in a few others the difference is not great. The oogonium wall is rarely internally ribbed (as in *Oe. acrosporum*), punctate (as in *Oe. minus*), plicate (as in *Oe. megaporum, Oe. platygynum*) or provided with a transversely disposed ring of conical warts (as in *Oe. itzigsohnii*); in most species it is smooth. The


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suffultory cell may be noticeably larger than the other vegetative cells, or of the same diameter (Pl. LXIV, figs. 639–640). The opening in the wall of the oogonium may be a pore, either round and mouth-like, or rimiform, in which case the plant is designated as *poriferous*. An upper part of the oogonium may separate from a lower part, forming a lid; such species are *operculate*. The position of the pore as well as that of the operculum is quite constant for the species and is of considerable diagnostic value. The pore may be superior, supramedian, median, inframedian, or inferior. The division of the operculum

TABLE I.

Ready reference to illustrations of the kinds of ornamentations of oospore walls found in the Oedogoniaceae. It will readily be seen, upon examination of the figure, whether it is the middle or outer layer of the oospore wall with ornamentations.

OOSPORE WALL	SPECIES	PLATE	FIGURE
Angulate	*O. albemarlensis*	LXIII	614
Areolate	*Oe. areolatum*	XXVIII	248
Dentate	*Oe. cleveanum*	XLVI	443
Echinate	*Oe. hystricinum*	XLIII	414
Echinate	*Oe. hystrix* v. *canadense*	XLIII	418
Pitted	*Oe. giganteum*	XXIX	260
Reticulate	*Oe. dictyosporum*	XXVIII	246
Ribbed	*B. imperialis*	VIII	64
Ribbed	*B. bullardi*	VII	52
Ribbed	*Oe. paucocostatum*	XXXII	277
Ribbed	*Oe. crenulatocostatum*	XXVIII	240
Ribbed	*Oe. exospirale*	XLIV	426
Smooth	*B. angulosa*	II	14
Smooth	*Oe. supremum*	LIX	573
Scrobiculate	*B. alabamensis*	V	38
Scrobiculate	*Oe. tiffanii*	XXX	261

may in addition to these positions be supreme or basal (infimus). (Pl. LXIV, figs. 624–635).

The oospore results from the development of the fertilized egg and is considered mature upon the formation of a distinct wall. It may or may not fill the oogonium and may be unlike it in shape. The oospore wall is usually three-layered, although occasionally of two layers. The middle or outer layer (it is invariably the latter in Bulbochaete) may be smooth or variously ornamented (See Table I). The kind of ornamentation is widely varied for the different species: pitted, scrobiculate, reticulate, angulate, dentate, areolate, echinate, or longitudinally or spirally ribbed. The ribs may be entire, crenulate, toothed,

and variously anastomosate. The color of the oospore changes with age from green to brown (or yellowish-brown) or red.

The oospore upon liberation from the rest of the filament by disintegration of the vegetative and oogonial cells sinks to the bottom of the pond or other body of water, or lodges on perennial aquatic macrophytes, or as in the terrestrial species of Oedocladium lies in the damp earth. After a period of rather prolonged dormancy, which apparently may vary from a few months to a few years, it begins to grow. Although the data have been secured for a few species only, it is the usual occurrence for the contents of the oospore to divide and form four zoospores at germination (Pl. X, figs. 78–83; Pl. LXIV, figs. 646–647). Upon their liberation from the old oospore wall, the zoospores swim about for a time, come to rest, and germinate into new filaments, precisely in the same manner as those produced directly from the vegetative cell. The reserve food in the oospore is a fatty oil dissolved in a reddish-brown pigment. The oospore is considered the diploid structure in the life history, the remainder of the plant being haploid.

The antheridium of the monoecious and dioecious-macrandrous species is derived from the division of a vegetative cell, the cross wall arising near the upper part of the cell. If no more divisions occur, we have a single antheridium, often designated as unicellular (Pl. XIV, fig. 136). Subsequent divisions result in a series of antheridia (2 to 45), termed multicellular (Pl. XIII, fig. 125). In the monoecious species the antheridia may be near the oogonium (epigynous, subepignous, hypogynous, etc.) or scattered at some distance from the oogonium (Pl. XV). In the dioecious-macrandrous species the occurrence of seriate antheridia often results in considerable distortion of the filament, particularly if apically located (Pl. XVI, fig. 153). In Bulbochaete the antheridium may arise (as in the development of the oogonium) by a horizontal division of the vegetative cell, resulting in an *erect* antheridium (Pl. IX); if the division is oblique, the antheridium is part of a side branch terminated by a bristle: a *patent* antheridium (Pl. IX). Antheridia of Oedocladium usually occur on special branches, formed as in Oedogonium.

The contents of each antheridium produces one sperm, or as in most species, two sperms. The division of the antheridium when two sperms are formed is either *horizontal*, one lying superimposed on the other (Pl. XV, fig. 145); or *vertical*, the

sperms lying side by side (Pl. XX, fig. 182). In the dwarf males the division is always horizontal. The sperms look like small zoospores and are liberated in the same manner from the filament. After swimming actively for some time, the sperm enters the opening of the oogonium with subsequent fertilization of the egg and production of the oospore.

The formation of the antheridia in the dioecious-nannandrous species involves the production of *androsporangia*, the development of which is practically identical with that of the antheridia. The androsporangia may be developed singly or seriately (Pl. V, fig. 37; Pl. LV, fig. 528; Pl. XLV, fig. 434). The entire contents of the androsporangium produces a single androspore (Pl. LXII, fig. 606), a spore that superficially resembles a sperm or zoospore in form, in manner of liberation from its sporangium (*androsporangium*), and in activity. Upon coming to rest, however, it germinates and produces a short filament known as the *dwarf male*, or *nannandrium* (Pl. LXIV, fig. 645D). This germination of the androspore occurs on the oogonium or suffultory cell, or rarely on scattered vegetative cells.

Division of the germinated androspore results in a lower non-reproductive *stipe* (holdfast cell) and an upper small cell, the *antheridium* (Pl. XLVI, fig. 443 A and S). Subsequent divisions of either stipe or antheridium produce additional antheridia (2 to 4) (Pl. XLVI, fig. 448). If merely an inner partition is formed, the antheridium is *internal* and single (Pl. LI, fig. 486); if the customary ring-formation takes place, the antheridium is termed *external* (Pl. LX, fig. 584). The dwarf males are rarely unicellular (Pl. LIII, fig. 505), and the stipe, though usually one-celled, may be few-celled (Pl. XLVII, fig. 459). Two sperms are normally formed in each antheridium by a transverse division of its contents. The basal cell of the dwarf male, formed as noted above, is usually an elongated, either simple or slightly lobed holdfast.

The basal cell of the filament, resulting as noted previously from the germinating zoospore, is most frequently elongated (Pl. LXIV, fig. 637). The attached lower end may be simple or much lobed. In some species the developing basal cell may be flattened into a subhemispherical cell or rarely appear nearly spherical (Pl. LXIV, fig. 636). The smaller species remain attached throughout almost their entire life history. The larger ones usually become detached and sometimes are

found in considerable mats on the surface of the water. There is no holdfast cell in Oedocladium.

In many of the larger species of the genus Oedogonium, in particular, and rarely in Bulbochaete the protoplast of the cell may form ovoid, ellipsoid, or irregularly shaped aplanospores. In the terrestrial species of Oedocladium resting cells or "akinetes" occur on the rhizoidal filaments. They are in reality few-celled side branches with swollen cells containing reserve foods. Similar reserves sometimes accumulate in the vegetative cells and can thus endure prolonged desiccation (Stahl 1891). Such cells upon subsequent growth ("germination") may produce new plants.

There has been considerable speculation regarding the relationship between the macrandrous and nannandrous species of the Oedogoniaceæ. Hirn (1900) and West (1912a) are of the opinion that dwarf males of the nannandrous species (at least of Oedogonium) arose by the reduction and greater specialization of the zoospores normally producing the antheridial filaments of the macrandrous forms. They would assume as a beginning that the monoecious filaments as well as the zoospores are hermaphroditic. Differentiation of zoospores, some producing antheridial filaments only and others producing oogonial filaments only, gave rise to the dioecious, macrandrous species. Small male filaments of such plants as *Oe. fonticola* or *Oe. verrucosum* perhaps represent intermediate steps in further reduction and specialization leading to the dwarf male, epiphytic on or near the oogonium. Schaffner (1927) regards the androspores as having been derived phylogenetically from original sperms and as retaining sexuality to some degree; *i.e.*, they react toward the oogonium or suffultory cell sufficiently to lodge there, but not sufficiently to fuse with the egg. The dwarf male is thus formed parthenogenetically from an androspore. Pascher (1907) on the other hand states that the nannandrous species are not derived from the macrandrous species.

The numerical composition of the three genera of Oedogoniaceæ based on the nature of the sexual reproduction in the species presents an interesting comparison. In the genus Bulbochaete 42 species, 2 varieties, and 1 form are dioecious, nannandrous; 6 species, 2 varieties, and 1 form are monoecious; no dioecious, macrandrous species are now known.

In Oedocladium 3 species are monoecious and 1 dioecious, nannandrous. In the large genus Oedogonium 61 species, 15 varieties, and 8 forms are monoecious; 56 species, 25 varieties, and 11 forms are dioecious, macrandrous; and 77 species, 36 varieties, and 19 forms are dioecious, nannandrous. *Oe. varians* and *Oe. trioicum* are known to be both monoecious and dioecious. The above summary does not take into account any members of the Oedogoniaceæ with incomplete descriptions.

DISTRIBUTION AND PERIODICITY.

Species of Bulbochaete and of Oedogonium are widely distributed in freshwater, the world over. Oedocladium is so far reported only from the eastern United States and from

TABLE II.

Distribution by continents of the total number of species, varieties, and forms (grouped together) of the genera of the Oedogoniaceae.

Genus	North America	South America	Europe	Asia	Africa	Australia
Bulbochaete	38	15	49	11	3	14
Oedocladium	3	0	1	0	0	0
Oedogonium	205	77	189	49	45	35

Germany; three of the species are terrestrial, growing on wet mud, and the fourth is aquatic. Hirn (1900) reports *Oe. capillare*, *Oe. oblongum*, *Oe. pluviale*, and *B. rhadinospora* var. *litoralis* from brackish waters of Europe. In a vegetative state Oedogonium is known as a part of the red and yellow snow of the Orkneys (Fritsch 1912). Species of both Bulbochaete and Oedogonium have been collected at considerable elevations in alpine regions, usually however not in fruiting condition.

Without distinguishing among species, varieties, and forms, the preceding table (Table II) shows the distribution of all members of the Oedogoniaceæ by continents. Purely as a matter of convenience, Australia is used to include not only that continent but also the nearby groups of islands of New Zealand, Melanesia, and Malaysia.

Data from the North Central States of the United States (Tiffany and Transeau 1927) indicate that most species of

Oedogonium and Bulbochaete grow in small permanent bodies of water rather than in lakes. The order of importance of algal habitats in this region of the United States for these two genera is: permanent ponds, lakes, temporary ponds, streams, and stream oxbows. Nearly 80% of the fruiting records for Oedogonium come from forms collected in the permanent ponds and the lakes. Streams are relatively poor habitats for fruiting species in spite of the prominent holdfast cells of the filaments. (See Table III).

TABLE III.

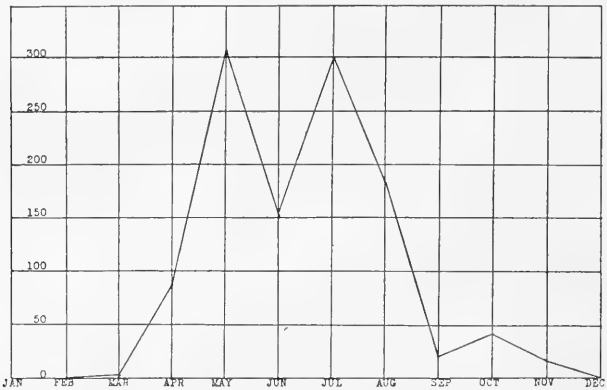
Data showing relative importance of Oedogonium habitats in the North Central States.

HABITAT	NUMBER OF RECORDS	PERCENTAGE
Permanent Ponds	603	54%
Lakes	254	23%
Temporary Ponds	172	15%
Streams	65	6%
Stream Oxbows	20	2%
Total	1114	100%

The above table gives the relative importance of Oedogonium habitats in the North Central States for the 1114 records. Nearly 100 records for the genus Bulbochaete show a very similar distribution among habitats in the same region.

Periodicity as applied to Oedogonium and Bulbochaete has been studied by Fritsch and Rich (1913), Hodgetts (1921), and Tiffany and Transeau (1927). It has been shown that the species of these genera produce reproductive structures at rather definite seasons of the year. The particular months of maximal sexual reproduction vary with the species, the geographical location, and the length of the growing season. The smaller forms as a rule have a short vegetative phase and fruit early in the growing season; the larger forms have usually a longer vegetative period and fruit later in the growing season. In north central United States maximal sexual reproduction is reached in May and in July (see text fig. 1) both in the annuals and perennials. Many species reach a second maximum in October, which is doubtless the development of a second generation.

An explanation of such periodicity in this algal group is not satisfactorily complete. It seems quite evident that a certain time—longer in some species than in others—must elapse, during which vegetative development occurs, before sexual reproduction takes place. When this vegetative phase is completed, it is almost impossible to prevent fruiting, except in extremes of temperature, very inadequate light, or toxic water. Hodgetts (1921) finds in observations on a small pond of Britain that there is some correlation between abundance of Oedogonium and (1) higher temperature and (2) competition with other algæ. We need data indicating the degree of



TEXT FIG. 1. Number of fruiting records each month for the genus Oedogonium, showing periods of maximum sexual reproduction.

relationship between algal growth and reproduction, on the one hand, and intensity and quality of light, mineral composition of the water, and hydrogen ion concentration, on the other.

Zoospore production may occur at practically any time before the formation of oospores. The germination of the zoospores produced directly from the vegetative cells accounts in large measure for the number of individual filaments of a given species found occupying a particular habitat.

TAXONOMIC CONSIDERATION.

In working through a group as large as the Oedogoniaceæ one finds it quite difficult to pass on the validity of some species. Such decisions, while always influenced to some extent by

personal interpretations, must rest upon one's knowledge of all species and their variations.

The ultimate criterion must be the constancy of such characteristics as methods of reproduction, size (within limits), shape of cells, opening of oogonia. How much are all these altered by ecological conditions of the body of water in which the algæ are growing? Unfortunately our data here are far from complete. When one finds a combination of the same characteristics in a given alga year after year in various habitats, one can be reasonably sure of the constancy of the species.

If an alga occurs year after year in the same habitat with a known species, differing in one or more morphological characteristics but evidently closely related to the type, it should be classed as a "variety." As an example, the robust variety (*majus*) of *Oe. grande* has been collected with the type in nearly all collections from the United States. Such differences can hardly be accounted for on the basis of environmental influences.

The category "form" should be regarded as a temporary disposition only. If an alga varies from the description of a given species and has been seen only once or twice, it is hardly possible to know whether the variation is constant or merely an ecological variation. If the form occurs with the type and is found on several occasions to maintain its morphological variation, it should be raised to varietal rank. A "form" then should be retained only when the data are insufficient to pass on the constancy of the variations noted in the description.

In the identification of members of the three genera—Bulbochaete, Oedogonium, and Oedocladium—and in the use of the keys to the species certain terminology is necessary to be able to differentiate among the species. The preceding pages have been written with the hope of elucidating such terminology and at the same time giving a brief introduction to the life history of species of the genera of the Oedogoniaceæ.

Keys to plant genera and species have not always been distinguished from synopses. It seems to the author that a key is merely an arrangement of characteristics, by which through proper manouvering, an "unknown" becomes a "known." A key has sometimes been defined as a scientific puzzle made by one expert to disturb another expert. Such keys may be interesting contributions if one already knows the field covered by them, but it is needless to say that the student, or any beginner for that matter, will find scant encouragement in them

to proceed further with the group concerned. On the other hand, of course, no key to plant forms can be so simple as to preclude the necessity of having a modicum of intelligence regarding scientific terms. Some species are more closely related than are others, and one must exercise judgment in the evaluation of characteristics. One measurement will not suffice, a single oogonium may be a monstrosity, one oospore may be parasitized, and a single vegetative cell may be far from typical. The keys of the following pages have been constructed in as simple a fashion as possible with the particular aim of enabling the student of the group to name his collection.

It is very convenient to use the group name *Stephanokontæ* proposed by Blackman and Tansley (1902) as a division of the class *Chlorophyceæ* and including those forms whose motile reproductive cells have a crown of cilia round the clear anterior end. Quite recently Fritsch (1927) has elevated the *Isokontæ* to be synonymous with and to replace *Chlorophyceæ* (*i.e.*, the *Chlorophyceæ* exclusive of the *Heterokontæ*). *Oedogoniales* with its single family *Oedogoniaceæ* is further considered by Fritsch as a group division of *Isokontæ*.

There is no question but that the Oedogoniales have characteristics of cell wall, cell division, and reproductive structures that separate them as a quite readily distinguishable group. Even Fritsch remarks that they are a "sharply circumscribed group affording but few points of affinity with the other *Isokontæ*" (*loc. cit.*, p. 212). It appears to the writer to be to the best interests of taxonomic nomenclature to retain the group name *Stephanokontæ* as a division of the *Chlorophyceæ*, as noted above.

There is but one order, OEDOGONIALES. The simple or branched filaments are almost invariably attached, at least during a part of their life history, except in Oedocladium.

The single family, OEDOGONIACEÆ, may be characterized as follows:

OEDOGONIACEAE De Bary

1854, p. 94; Pringsheim 1858, p. 68; Wittrock 1874, p. 6; Hirn 1900, p. 71; Collins 1909, p. 222.

Plants aquatic or terrestrial; filaments simple or branching; cells uninucleate; chloroplast parietal, generally in the form of a reticulum, with one or more pyrenoids; cell division by the rupture of a ring-like thickening on the inner wall of each cell near the apex. Reproduction asexually by multiciliate zoospores, formed singly by the vegetative cells, germinating almost immediately. Reproduction sexually by eggs and sperms in oogonia and antheridia; oogonia single or in groups, arising as a result of division of a vegetative cell, opening by a pore or a lid, through which the sperm may pass; the egg when fertilized becomes the oospore, with a wall of one to three layers, which after a period of rest produces four zoospores. Antheridia either in the same filament as the oogonia or in separate filaments; male filaments approximately the same size as the female, or much smaller ("dwarf males"); dwarf males, arising from the germination of androspores, are epiphytic usually on or near the oogonia, sometimes scattered; sperms one or two in each antheridium.

KEY TO THE GENERA.

1. Filaments unbranched..... III. **Oedogonium** (p. 53)
1. Filaments branched..... 2
   2. Vegetative cells with laterally placed setae.... I. **Bulbochaete** (p. 27)
   2. Vegetative cells devoid of setae..... II. **Oedocladium** (p. 51)

Genus I. **Bulbochaete** Agardh

1817, p. XXIX; Pringsheim 1858, p. 71; Wittrock 1874, p. 43; Hirn 1900, p. 321; Collins 1909, p. 266; Tiffany 1928, p. 129.

Filaments usually attached, branched, the branches unilateral; vegetative cells normally widening upwards; basal cell ordinarily the only one capable of division in formation of main axis, first new cell forming a long tubular bristle with swollen bulb-like base, subsequent cells intercalated between basal cell and next one above; rarely division is intercalary; other vegetative cells potential origin for side branches; terminal cell of each branch always furnished with a bristle; oogonium arising by a double division of a vegetative cell.

KEY TO THE SPECIES, VARIETIES, AND FORMS OF BULBOCHAETE.

1. Oogonium 24–27μ in length.....8. *B. minuta*
1. Oogonium 27–40μ in length..... 2
1. Oogonium 40–65 (–68)μ in length.....21
1. Oogonium 65–95μ in length.....52
1. Oogonium 104–108μ in length.....47. *B. imperialis*
1. Oogonium not, or imperfectly, known.....59
2. Monoecious..... 3
2. Dioecious, nannandrous..... 4
3. Vegetative cells longer than broad.....1. *B. nana*
3. Vegetative cells not longer than broad.....2. *B. monile*
4. Suffultory cells without division..... 5
4. Suffultory cells with division..... 6
5. Oospore wall smooth.....33. *B. doliiformis*
5. Oospore wall ribbed.....34. *B. pygmaea*
6. Division of suffultory cell basal..... 7
6. Division of suffultory cell inferior.....10. *B. furberae*
6. Division of suffultory cell inframedian, median, or supramedian†.....11
6. Division of suffultory cell superior.....16
6. Division of suffultory cell supreme.....17a. *B. polyandria* f. *notabilis*
7. Oospore wall smooth..... 8
7. Oospore wall scrobiculate..... 9
8. Oogonium 34–44×31–38μ.....7. *B. elatior*
8. Oogonium 31–37×28–37μ.....7a. *B. elatior* f. *pumila*
9. Vegetative cells 13–17μ.....10
9. Vegetative cells 17–20μ.....9. *B. brebissonii*
10. Antheridia exterior.....7b. *B. elatior* var. *scrobiculata*
10. Antheridia interior.....9a. *B. brebissonii* var. *minor*
11. Oospore wall smooth.....12
11. Oospore wall scrobiculate.....13
12. Diameter of oogonium 33–38μ.....14a. *B. angulosa* f. *picta*
12. Diameter of oogonium 37–42μ.....14. *B. angulosa*
13. Vegetative cells 10–15μ in diameter.....10. *B. furberae*
13. Vegetative cells 15–20μ in diameter.....14
14. Oospore wall nearly smooth to scrobiculate.....15
14. Oospore wall scrobiculate to nearly crenulate.....11. *B. crenulata*
15. Vegetative cells 2–3 diameters long.....12. *B. intermedia*
15. Vegetative cells 3–5 diameters long.....12a. *B. intermedia* var. *depressa*
16. Diameter of vegetative cells 10–12μ.....16b. *B. nordstedtii* var. *minor*
16. Diameter of vegetative cells 14–22μ.....17
17. Vegetative cells $1\frac{1}{4}$–2 diameters long.....15. *B. borealis*
17. Vegetative cells 2–5 diameters long.....18
18. Gynandrosporous.....19
18. Idioandrosporous.....20
19. Diameter of oogonium 28–32μ.....16a. *B. nordstedtii* f. *suberecta*
19. Diameter of oogonium 36–43μ.....16. *B. nordstedtii*
20. Vegetative cells 15–20×45–100μ.....17. *B. polyandria*
20. Vegetative cells 17–22×54–88μ.....17a. *B. polyandria* f. *notabilis*
21. Vegetative cells less than 12μ in diameter.....48. *B. spirogranulata*
21. Vegetative cells more than 12μ in diameter.....22
22. Monoecious.....23
22. Dioecious, nannandrous.....29
22. Reproductive structures imperfectly known.....49. *B. brevifulta*
23. Pore of oogonium less than 5μ wide.....24
23. Pore of oogonium more than 5μ wide.....3. *B. megastoma*
24. Vegetative cells 1–$1\frac{1}{4}$ diameters long.....25
24. Vegetative cells $1\frac{1}{4}$–2 diameters long.....26
25. Oogonium 24–28μ in diameter.....4. *B. basispora*
25. Oogonium 28–34μ in diameter.....2a. *B. monile* var. *robusta*

† Some variations of *B. nordstedtii* and *B. polyandria* may be sought here.

26. Oogonium regularly ellipsoid....5. *B. debaryana*
26. Oogonium cylindric to oblong-ellipsoid....27
27. Length of oogonium 40–48μ....6a. *B. mirabilis* f. *immersa*
27. Length of oogonium 47–58μ....28
28. Diameter of vegetative cells 13–16μ....6b. *B. mirabilis* var. *gracilis*
28. Diameter of vegetative cells 15–20μ....6. *B. mirabilis*
29. Oospore wall smooth....30
29. Oospore wall scrobiculate....32
29. Oospore wall reticulate-scrobiculate....18. *B. gigantea*
29. Oospore wall ribbed....41
30. Division of suffultory cell basal....19. *B. diamesandria*
30. Division of suffultory cell median or nearly so....31
30. Division of suffultory cell superior....22a. *B. sessilis* f. *glabra*
31. Oogonium about 46×44μ....20. *B. elachistandria*
31. Oogonium 55–64×43–51μ....21. *B. obliqua*
32. Diameter of oogonium 40–60μ....33
32. Diameter of oogonium 60–80μ....38
33. Division of suffultory cell supreme....25a. *B. dispar* var. *ripartiana*
33. Division of suffultory cell superior....34
33. Division of suffultory cell supramedian, median, or inframedian....35
33. Division of suffultory cell basal....9. *B. brebissonii*
34. Oogonium subquadrangular-globose....22. *B. sessilis*
34. Oogonium subdepressed-globose....25. *B. dispar*
35. Gynandrosporous....36
35. Idioandrosporous....31. *B. congener*
36. Diameter of oogonium 40–51μ....37
36. Diameter of oogonium 52–60μ....28. *B. crassa*
37. Vegetative cells 1–2 diameters long....30. *B. quadrata*
37. Vegetative cells 2–5 diameters long....13. *B. subintermedia*
38. Gynandrosporous....39
38. Idioandrosporous....27. *B. crassiuscula*
39. Diameter of oogonium 59–70μ....40
39. Diameter of oogonium 70–80μ....23. *B. setigera*
40. Length of oogonium 48–56μ....29. *B. valida*
40. Length of oogonium 57–60μ....26. *B. punctulata*
41. Oogonium 22–27μ in diameter....35. *B. tenuis*
41. Oogonium 27–41μ in diameter....42
42. Vegetative cells rectangular....43
42. Vegetative cells repand....36. *B. repanda*
42. Vegetative cells neither rectangular nor repand....44
43. Diameter of oogonium 28–32μ....37a. *B. rectangularis* var. *hiloensis*
43. Diameter of oogonium 32–39μ....37. *B. rectangularis*
44. Oogonium 39–56μ in length....45
44. Oogonium 58–80μ in length....48
45. Vegetative cells 13–18μ in diameter....46
45. Vegetative cells 17–22μ in diameter....38. *B. varians*
46. Dwarf male stipes 11–14×15–24μ....47
46. Dwarf male stipes 17–18×28–31μ....38b. *B. varians* var. *hawaiensis*
47. Length of oogonium 39–46μ....38a. *B. varians* var. *subsimplex*
47. Length of oogonium 47–53μ....35a. *B. tenuis* var. *norvegica*
48. Oogonium fusiformly ellipsoid....49
48. Oogonium broadly ellipsoid to ovoid....50
49. Ribs of oospore smooth....40. *B. rhadinospora*
49. Ribs of oospore crenulate....40a. *B. rhadinospora* f. *antiqua*
50. Ribs of oospore coarsely serrate or crenulate....39. *B. lagoensis*
50. Ribs of oospore finely serrate or smooth....51
51. Vegetative cells 18–25×27–50μ....41. *B. minor*
51. Vegetative cells 15–22×22–66μ....41a. *B. minor* var. *germanica*
52. Oogonium 29–37μ in diameter....53
52. Oogonium 38–45μ in diameter....40b. *B. rhadinospora* var. *litoralis*
52. Oogonium 41–56μ in diameter....54
52. Oogonium 56–66μ in diameter....42. *B. bullardi*
52. Oogonium 68–92μ in diameter....58

53. Ribs of oospore smooth.....40. *B. rhadinospora*
53. Ribs of oospore crenulate.....40a. *B. rhadinospora* f. *antiqua*
54. Vegetative cells 19–27μ in diameter.....55
54. Vegetative cells 27–30μ in diameter.....43. *B. denticulata*
55. Oogonium 41–46μ in diameter.....44. *B. affinis*
55. Oogonium 46–56μ in diameter.....56
56. Vegetative cells 19–25×40–100μ.....57
56. Vegetative cells about 27×54μ.....45. *B. anomala*
57. Ribs of oospores broadly denticulate.....46. *B. insignis*
57. Ribs of oospores reticulate-denticulate.....46a. *B. insignis* var. *reticulata*
58. Oogonium globose.....24. *B. alabamensis*
58. Oogonium pyriform.....32. *B. pyrulum*
58. Oogonium ellipsoid.....47a. *B. imperialis* var. *regalis*
59. Vegetative cells blood-red in color.....50. *B. sanguinea**
59. Vegetative cells medianly plicate.....51. *B. horrida**

1. **B. nana** Wittrock.

(Pl. IX, fig. 75.)

1872, p. 7, Pl. 1, fig. 9; 1874, p. 50; *B. nana* Wittr. var. *subbasispora* Wittr. 1874, p. 50; Hirn 1900, p. 349, Pl. LVII, fig. 362; Collins 1909, p. 272; Heering 1914, p. 229, fig. 349; West 1916, p. 396, fig. 251c; Tiffany 1928, p. 132, Pl. XXII, fig. 75.

Monoecious; oogonia ellipsoid, patent, below terminal setae or vegetative cells; outer wall of oospore longitudinally ribbed; antheridia 1–2†, erect (rarely patent) subepigynous or scattered; vegetative cells 10–16×10–22μ; oogonia 20–25×33–40μ; oospores 18–23×30–38μ; antheridia 7–9×5–9μ.

Greenland, Alaska, Ceylon, India, Austria, England, Finland, Germany, Latvia, Sweden, Norway, Turkestan.

2. **B. monile** Wittrock and Lundell.

(Pl. IX, fig. 72.)

In Wittrock 1874, p. 50; (?) *B. nana* Wittr. *in* Wolle 1887, p. 100; Hirn 1900, p. 348, Pl. LVII, fig. 360; Collins 1909, p. 272; Heering 1914, p. 229, fig. 348; Tiffany 1928, p. 132, Pl. XXII, fig. 72; P. B. A. No. 1432.

Monoecious; usually few celled; vegetative cells short and sometimes globose; oogonia ellipsoid, patent (rarely erect), below terminal setae or vegetative cells; outer wall of oospore longitudinally ribbed; antheridia 1–2, erect or patent, subepigynous or scattered; vegetative cells 11–16×10–16μ; oogonia 22–25×30–38μ; oospores 20–23×28–35μ; antheridia 8–10×6–8μ.

United States: Massachusetts, New Jersey; Sweden, Finland, Latvia; British Columbia.

2a. Var. **robusta** Hirn.

(Pl. IX, fig. 73.)

1900, p. 349, Pl. LVII, fig. 361; Heering 1914, p. 229; Tiffany 1928, p. 133, Pl. XXII, fig. 73.

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*Species of incomplete descriptions and included in the key with such characters as are available.

†See foot note, page 65.

Oogonia considerably larger and broadly ellipsoid; vegetative cells 14–19×14–19μ; oogonia 28–34×39–45μ; oospores 26–32×37–42μ; antheridia 8–10×5–8μ.

Germany.

B. nana and *B. monile*, as far as specific dimensions are concerned, are quite similar plants. If one has a mature plant of the former, however, he will find vegetative cells longer than their width, and this is almost never the case in the latter. The variety *robusta* is easily separated by its longer oogonia.

3. **B. megastoma** Wittrock and Lundell.
(**Pl. IX, fig. 76.**)

In Wittrock 1874, p. 51, Pl. 1, fig. 21; Hirn 1900, p. 354, Pl. LIX, fig. 370; Heering 1914, p. 231, fig. 353; Tiffany 1928, p. 133, Pl. XXII, fig. 76.

Monoecious; oogonia ellipsoid to subcylindric ellipsoid, patent (rarely erect), below terminal setae or vegetative cells, with large mouth-like pore; outer oospore wall longitudinally ribbed; antheridia 1–2, erect (rarely patent), scattered or subepigynous; vegetative cells 18–24×18–35μ; oogonia 32–36×48–54μ; oospores 30–34×46–52μ; antheridial cells 10–13×7–9μ.

Sweden, Denmark.

The large mouth-like pore of the oogonium rather readily separates mature plants from any others of the genus.

4. **B. basispora** Wittrock and Lundell.
(**Pl. IX, fig. 74.**)

In Wittrock 1874, p. 50; Hirn 1900, p. 350, Pl. LVIII, fig. 364; Heering 1914, p. 229, fig. 350; Tiffany 1928, p. 133, Pl. XXII, fig. 74.

Monoecious; oogonia ellipsoid or subcylindric-ellipsoid, patent or erect, below vegetative cells; outer oospore wall longitudinally ribbed; antheridia 1–3, patent or erect, scattered or subepigynous; vegetative cells 15–19×15–23μ; oogonia 24–28×40–45μ; oospores 22–25×38–43μ; antheridia 8–11×6–8μ.

United States: Ohio; Sweden.

Among the monoecious forms *B. basispora* bears some resemblance to *B. debaryana* and *B. mirabilis*, but can usually be distinguished by its relatively shorter vegetative cells and its oogonia.

5. **B. debaryana** Wittrock and Lundell.
(**Pl. IX, fig. 77.**)

In Wittrock 1874, p. 51; Hirn 1900, p. 353, Pl. LIX, fig. 369; Heering 1914, p. 231, fig. 352; Tiffany 1928, p. 133, Pl. XXII, fig. 77.

Monoecious; oogonia ellipsoid, patent, below vegetative cells or terminal setae; outer wall of oospore longitudinally ribbed; antheridia

1–?, patent or seldom erect, subepigynous or scattered; vegetative cells 18–22×23–44μ; oogonia 27–33×43–50μ; oospores 25–30×40–48μ; antheridia 10–12×8–9μ.

Sweden, Latvia, Canada.

6. **B. mirabilis** Wittrock.

(**Pl. IX, fig. 69.**)

1870, p. 137, Pl. 1, figs. 8 and 9; 1874, p. 50; *B. sp.* Reinsch 1875, p. 81; *B. mirabilis* Wittr. var. *lapponica* Wittr. and Lund. *in* Wittrock 1874, p. 51; Hirn 1900, p. 351, Pl. LVIII, fig. 365; Hirn 1906, p. 57; Collins 1909, p. 272; Heering 1914, p. 229, fig. 351; Tiffany 1928, p. 134, Pl. XXII, fig. 69; P. B. A. No. 1431.

Monoecious; oogonia cylindric-ellipsoid to suboblong-ellipsoid, patent (rarely erect), below terminal setae or vegetative cells; outer wall of oospore longitudinally ribbed; antheridia 1–4, erect or patent, subepigynous or scattered; vegetative cells 15–20×20–40μ; oogonia 26–33×46–58μ; oospores 25–31×44–56μ; antheridia 9–12×6–9μ.

United States: New Jersey, Michigan, Illinois, Minnesota; Greenland, Africa, Europe, Australia, Siberia, Mongolia.

6a. Form **immersa** (Wittrock) Hirn.

(**Pl. IX, fig. 70.**)

1900, p. 352, Pl. LVIII, fig. 367; *B. mirabilis* Wittr. var. *immersa* Wittr. 1874, p. 51; Heering 1914, p. 230; Tiffany 1928, p. 134, Pl. XXII, fig. 70.

Vegetative cells 13–17×16–30μ; oogonia 25–33×40–48μ; oospores 23–30×38–46μ; antheridia 7–11×6–8μ.

Norway, Germany.

6b. Var. **gracilis** (Pringsheim) Hirn.

(**Pl. IX, fig. 71.**)

1900, p. 353, Pl. LIX, fig. 368; *B. gracilis* Pringsh. 1858, p. 74; Wittrock 1874, p. 57; Heering 1914, p. 230; Tiffany 1928, p. 134, Pl. XXII, fig. 71.

Vegetative cells 13–16×17–32μ; oogonia 20–28×47–55μ; oospores 18–26×45–53μ; antheridia 8–11×6–8μ.

Germany, Sweden, Denmark.

7. **B. elatior** Pringsheim.

(**Pl. I, fig. 1.**)

1858, p. 73, Pl. 6, fig. 5; Wittrock 1874, p. 49; Hirn 1900, p. 321, Pl. LI, fig. 327; Hirn 1906, p. 56; Heering 1914, p. 231, fig. 355; Tiffany 1928, p. 134, Pl. XIV, fig. 1.

Dioecious, nannandrous, gynandrosporous; oogonia depressed globose to depressed subquadrangular-globose, erect or seldom patent, below androsporangia; division of suffultory cell basal; oospore smooth; androsporangia epigynous or rarely scattered, 1–2; dwarf males usually on suffultory cells, antheridia exterior, unicellular, stipe scarcely longer than the antheridia; vegetative cells 13–18×20–63μ; oogonia 34–44 ×31–38μ; oospores 32–42×29–36μ; androsporangia 10–13×8–11μ; dwarf male stipe 8–10×18–35μ; antheridia 6–8×9–11μ.

United States: Massachusetts; India, Ceylon, Austria, Australia, Germany, Sweden, New Caledonia.

7a. Form **pumila** Hirn.

(Pl. I, fig. 2.)

1900, p. 322, Pl. LI, fig. 328; Tiffany 1928, p. 135, Pl. XIV, fig. 2.

Smaller; vegetative cells 10–15×25–60μ; oogonia 31–37×28–37μ; androsporangia 10–11×9–11μ; dwarf male stipe 8–10×19–24μ; antheridia 7–9×6–8μ.

Brazil.

7b. Var. **scrobiculata** Tiffany.

(Pl. I, fig. 3.)

1928, p. 135, Pl. XIV, fig. 3.

Similar to the type except outer oospore wall is minutely scrobiculate; antheridia 1–2; vegetative cells 13–16×28–40μ; oogonia 28–44×28–36μ; oospores 26–42×26–34μ; androsporangia 10–13×10–16μ; antheridia 6–8×4–7μ; dwarf male stipe 11–13×16–20μ.

United States: Alabama.

This variety clearly belongs with *B. elatior* because of its exterior antheridia, although the oospore markings are similar to those of *B. brebissonii*. It is barely possible, of course, that *B. elatior* sometimes has scrobiculate oospores, although there is no evidence for it. Until such time as more is known about the variations, if any, in the oospore of the species, it seems best to catalogue the separate variety, as above.

8. **B. minuta** West and West.

(Pl. I, fig. 9.)

1902, p. 126, Pl. 17, fig. 10; Hirn 1906, p. 25, Pl. IV, fig. 28; West 1916, p. 388, fig. 242; Tiffany 1928, p. 135, Pl. XIV, fig. 9.

Dioecious, nannandrous, gynandrosporous; oogonia depressed-globose, patent or erect, below the androsporangia; division of oogonium median or nearly so; suffultory cells without division, or with division basal; oospore wall smooth; androsporangia unicellular, epigynous; dwarf males on suffultory cells, antheridia exterior, unicellular, stipe twice as long as antheridia, curved; vegetative cells 9–12×18–35μ; oogonia 29–35×24–27μ; oospores 27–33×22–25μ; androsporangia 9–11×6–9μ; dwarf males 6–7×18–20μ.

Heneratgodha, Ceylon.

B. minuta is among the smallest of the genus, the length of its oogonium being less than that of any other known species.

9. **B. brebissonii** Kuetzing.

(Pl. I, fig. 7.)

1854, p. 19, Pl. 86, figs. B and f; *B. tumida* Wittr. 1870, p. 139; 1874, p. 46; Hirn 1900, p. 323, Pl. LI, fig. 330; Collins 1909, p. 268; Heering 1914, p. 231, fig. 356; Tiffany 1928, p. 135, Pl. XIV, fig. 7.

Dioecious, nannandrous gynandrosporous; oogonia depressed-subquadrangular-globose, erect, below terminal setae or androsporangia;

division of the suffultory cell basal; outer oospore wall scrobiculate; androsporangia scattered or epigynous, 1–3; dwarf males on oogonia (rarely on adjacent cells), antheridia interior, stipe slightly curved, shorter than antheridia; vegetative cells 17–20×50–90μ; oogonia 42–50×37–45μ; oospores 40–48×35–43μ; androsporangia 11–15×12–18μ; dwarf males 10–12×28–33μ.

United States: Massachusetts, Illinois, Alaska; Europe.

This species is rather readily distinguished by its usually basal division of the suffultory cells, its interior antheridium, and its erect oogonia. It is distinguished from the variety *minor* by its larger size.

9a. Var. **minor** Woronichin.

1923, p. 99; (?) *B. brebissonii* Kuetz. f. *in* Borge 1923, p. 30; Tiffany 1928, p. 136.

Smaller than the type; vegetative cells 13–17×20–100μ; oogonia 35–38×31–38μ; oospores 33–36×29–36μ; dwarf males 8–9×26–27μ.

Tiflis, Caucasus.

10. **B. furberae** Collins.
(**Pl. I, fig. 8.**)

1918a, p. 142, Pl. 124, figs. 1–5; Tiffany 1928, p. 136, Pl. XIV, fig. 8.

Dioecious, nannandrous, gynandrosporous; oogonia depressed globose, below terminal setae, patent (rarely erect); division of suffultory cell inframedian; outer wall of oospore scrobiculate; androsporangia scattered, 1–9; dwarf males on oogonia, stipe strongly curved; antheridia interior; vegetative cells 10–15×30–75μ; oogonia 36–43×27–34μ; oospores 34–41×25–32μ; androsporangia 9–10×8–9μ; dwarf males 7–8×20–25μ.

United States: Massachusetts (Woods Hole).

This species differs from *B. elatior* in its scrobiculate spore wall and its division of suffultory cell. It is smaller than *B. brebissonii*.

11. **B. crenulata** Pringsheim.
(**Pl. I, fig. 4.**)

1858, p. 72, Pl. 6, fig. 4; *B. crenulata* Pringsh. var. *plena* Wittr. 1872, p. 19; Wittrock 1874, p. 45; Hirn 1900, p. 331, Pl. LIII, fig. 337; Collins 1909, p. 269; Heering 1914, p. 233, fig. 359; Tiffany 1928, p. 136, Pl. XIV, fig. 4.

Dioecious, nannandrous, gynandrosporous; oogonia subdepressed-globose, patent, below terminal setae or androsporangia, or rarely vegetative cells; division of suffultory cells median or slightly below; spore wall scrobiculate to crenulate; androsporangia epigynous or scattered, 1–5; dwarf males on or near oogonia, antheridia interior, stipe slightly curved, shorter than antheridium; vegetative cells 16–20×32–70μ; oogonia 43–48×35–43μ; oospores 40–46×33–40μ; antheridia 10–15×7–10μ; dwarf males 9–10×24–26μ.

United States: Michigan, Illinois; Australia, Finland, Germany, Norway, Sweden, Denmark, Patagonia.

B. crenulata has often been confused with forms of *B. intermedia*, since the "crenulations" of the oospore walls are not always distinctly "crenulate." It seems best, however, to retain the two as distinct species because (1) the latter normally has longer cells in proportion to diameter and (2) the two species normally represent extremes of a series of gradations in oospore wall ornamentation: *B. intermedia* may have nearly smooth to scrobiculate oospores, while those of *B. crenulata* vary from distinctly scrobiculate to crenulate.

12. **B. intermedia** De Bary.

(Pl. I, fig. 5.)

1854, p. 72, Pl. 4, figs. 1–7; Wittrock 1874, p. 44; *B. crenulata* Pringsh. var. *supremediana* Wittr. 1883 *in* Wittr. and Nordst. Alg. Exs. Fasc. 11, No. 509; (?) *B. elachistandria* Wittr. *in* Borge 1896, p. 3; Hirn 1900, p. 326, Pl. LII, fig. 333; *B. intermedia* De Bary f. *americana* Hirn 1900, p. 328, Pl. LII, fig. 334; *B. intermedia* De Bary f. *supramediana* (Wittr.) Hirn 1900, p. 328, Pl. LII, fig. 335; Hirn 1906, p. 56; Collins 1909, p. 268, fig. 82; Heering 1914, p. 233, fig. 358; Tiffany 1926, p. 109, Pl. X, fig. 107; 1928, p. 137, Pl. XIV, fig. 5; P. B. A. No. 973.

Dioecious, nannandrous, gynandrosporous; oogonia subdepressed-globose, patent, below androsporangia; division of suffultory cells nearly median; outer wall of oospore scrobiculate, rarely apparently smooth; androsporangia 1–2, epigynous or rarely scattered; dwarf males on the oogonium; antheridium interior, stipe slightly curved, shorter than the antheridium; vegetative cells 17–20×35–70μ; oogonia 40–48×31–40μ; oospores 38–46×30–38μ; androsporangial cells 11–13×7–12μ; dwarf males 9–10×21–26μ.

United States: Iowa, Illinois, Ohio, Michigan, Connecticut, Pennsylvania, Massachusetts, Alaska; Canada, Australia, Europe, Greenland, Africa.

12a. Var. **depressa** Wittrock.

(Pl. I, fig. 6.)

1874, p. 44, Pl. 1, fig. 18; Hirn 1900, p. 329, Pl. LII, fig. 336; *B. intermedia* De Bary var. *depressa* Hirn *in* Heering 1914, p. 233; Tiffany 1926, p. 109; 1928, p. 137, Pl. XIV, fig. 6.

Vegetative cells a little longer than in the type; oogonia depressed-globose; outer oospore wall scrobiculate, often nearly smooth; division of suffultory cell a little above the median position (rarely a little below median); vegetative cells 14–19×35–88μ; oogonia 42–46×30–40μ; oospores 40–44×28–38μ; androsporangial cells 11–13×9–12μ; dwarf males 9–11×22–25μ.

United States: Iowa; Finland, Germany, Norway, Sweden; British Columbia.

Hirn recognized with *B. intermedia* its variety *depressa* and two forms, *americana* Hirn and *supramediana* (Wittrock)

Hirn. I have seen a great number of *intermedia* plants from the North Central states, and judging from this American material and from original descriptions, it seems almost impossible to recognize with certainty either of the two forms above; the variety is probably distinct. Occasionally individual plants and more often parts of filaments are found with slight differences and variations in form and shape of vegetative cells and oogonia. Frequently all variations between the type and the two forms can be noted in one plant. The variety *depressa* with relatively longer cells in proportion to diameter is perhaps sufficiently distinct to recognize. It does not appear to be to the best interests of taxonomic nomenclature in this species to do little more than recognize its variability. I have, therefore, included with the species proper the two forms *americana* and *supramediana*. The relationship to *B. crenulata* is noted above, under that species.

13. **B. subintermedia** Elfving.
(Pl. II, fig. 15.)

In Hirn 1895, p. 8; Hirn 1900, p. 332, Pl. LIII, fig. 338; Heering 1914, p. 233, fig. 360; West 1916, p. 396, fig. 251A; Tiffany 1928, p. 138, Pl. XV, fig. 15.

Dioecious, nannandrous, gynandrosporous; oogonia subdepressed-globose, patent, below terminal setae, androsporangia, or rarely vegetative cells; division of suffultory cell submedian; outer spore wall scrobiculate; androsporangia 1–?, epigynous or scattered; dwarf males on oogonia, stipe curved or nearly erect, shorter than the oogonia; vegetative cells 17–22×34–100μ; oogonia 44–51×39–44μ; oospores 42–48×37–41μ; androsporangia 13–16×9–10μ; dwarf males 10–12× 25–30μ.

Finland, Great Britain.

14. **B. angulosa** Wittrock and Lundell.
(Pl. II, fig. 14.)

In Wittrock 1874, p. 45; (?) *B. elachistandria* Wittr. *in* Wolle 1887, p. 97; Hirn 1900, p. 336, Pl. LIV, fig. 346; Heering 1914, p. 235, fig. 364; Tiffany 1928, p. 138, Pl. XV, fig. 14.

Dioecious, nannandrous, gynandrosporous; oogonia biconically and angularly globose, apically truncate, below terminal setae or rarely androsporangia; division of suffultory cells a little above median position; oospore wall smooth; androsporangia scattered or epigynous, 1–3; dwarf males on oogonia, antheridia interior, stipe somewhat curved; vegetative cells 13–18×20–45μ; oogonia 36–42×33–39μ; oospores 34–40×30–36μ; androsporangia 10–11×9–10μ; dwarf males 8–9× 18–21μ.

United States: Pennsylvania; England, Sweden, Finland, Africa.

14a. Form **picta** Hirn.

1900, p. 337.

Of smaller dimensions; vegetative cells 13–16×19–40μ; oogonia 33–38×31–37μ.

Brazil.

15. **B. borealis** Wittrock.

(**Pl. II, fig. 10.**)

1870, p. 138; 1874, p. 46; Hirn 1900, p. 324, Pl. LI, fig. 331; Heering 1914, p. 233, fig. 357; Tiffany 1928, p. 139, Pl. XV, fig. 10.

Dioecious, nannandrous, gynandrosporous; oogonia subdepressed-globose, patent, below vegetative cells, wall thick; division of suffultory cell superior (occasionally nearly supreme); outer oospore wall scrobiculate or sometimes nearly smooth; androsporangia 1–3, subepigynous, patent; dwarf males on oogonia, antheridia interior, stipe a little curved, shorter than antheridia; vegetative cells 16–21×20–42μ; oogonia 40–48×35–40μ; oospores 38–46×33–38μ; androsporangia 12–13×8–9μ; dwarf males 9–10×18–21μ.

Norway, Sweden, Finland.

16. **B. nordstedtii** Wittrock.

(**Pl. II, fig. 17.**)

1874, p. 44; Hirn 1900, p. 332, Pl. LIII, fig. 339; Collins 1909, p. 269; Heering 1914, p. 234, fig. 361; West 1916, p. 396, fig. 251B; Tiffany 1928, p. 139, Pl. XV, fig. 17; P. B. A. No. 717.

Dioecious, nannandrous, gynandrosporous; oogonia depressed-globose or subquadrangularly so, patent, below androsporangia or rarely terminal setae; division of suffultory cell superior (occasionally submedian); oospore wall finely scrobiculate or nearly smooth; androsporangia unicellular, epigynous; dwarf males on oogonia, stipe slightly curved, shorter than antheridia; vegetative cells 14–18×28–85μ; oogonia 36–43×29–36μ; oospores 34–41×27–34μ; androsporangia 10–12×9–12μ; dwarf males 9–19×23–25μ.

United States: Ohio, Illinois, Connecticut, Alaska; Greenland, Australia, Finland, Germany, Spain, Sweden, Austria, Ireland.

16a. Form **suberecta** Collins.

(**Pl. II, fig. 18.**)

1912, p. 88; Tiffany 1928, p. 139, Pl. XV, fig. 18.

Smaller; oogonia 28–32×34–38μ, depressed-globose, often erect.

United States: Massachusetts.

The suberect habit of this form appears to be very inconstant, but the smaller dimensions warrant a separate form.

16b. Var. **minor** Woronichin.

1923, p. 99.

Vegetative cells 10–12×20–25μ; oospores about 36×33μ; dwarf males 8–10×19–20μ.

Tiflis (Caucasus).

17. **B. polyandria** Cleve.

(Pl. II, figs. 11 and 12.)

In Wittrock 1870, p. 140; *B. polyandra* Cleve *in* Wittrock 1874, p. 46; Hirn 1900, p. 334, Pl. LIV, fig. 342; Collins 1909, p. 270; Heering 1914, p. 234, fig. 362; Tiffany 1928, p. 140, Pl. XV, figs. 11 and 12; P. B. A. No. 1682.

Dioecious, nannandrous, idioandrosporous; oogonia subdepressed-globose, patent, below terminal setae or vegetative cells; division of suffultory cell superior (rarely submedian); outer oospore wall scrobiculate or nearly smooth; androsporangia to 10-seriate; dwarf males on oogonia, antheridia interior, stipe slightly curved, shorter than antheridia; vegetative cells 15–20×45–100μ; oogonia 39–46×32–42μ; oospores 37–44×30–40μ; androsporangia 12–14×11–15μ: dwarf males 8–9×23–26μ.

United States: Massachusetts, Florida; Brazil, Europe.

17a. Form **notabilis** Hirn.

(Pl. II, fig. 13.)

1900, p. 334, Pl. LIV, fig. 343; Tiffany 1928, p. 140, Pl. XV, fig. 13.

Division of suffultory cell often supreme; vegetative cells 17–22 ×51–88μ; oogonia 41–46×36–43μ; oospores 39–44×34–41μ; androsporangia 12–14×12–15μ; dwarf males 8–10×23–25μ.

Great Britain.

18. **B. gigantea** Pringsheim.

(Pl. V, figs. 35 and 36.)

1858, p. 71, Pl. 6, fig. 1; Wittrock 1874, p. 48; Hirn 1900, p. 347, Pl. LVII, fig. 359; Collins 1909, p. 271; Heering 1914, p. 239, fig. 373; Tiffany 1926, p. 109, Pl. X, figs. 108–110; Tiffany 1928, p. 140, Pl. XVIII, figs. 35 and 36.

Dioecious, nannandrous, idioandrosporous; oogonia subdepressed globose or rarely depressed oboviform-globose, patent, below terminal setae, rarely below vegetative cells; division of suffultory cell slightly below median; outer wall of oospore reticulate-scrobiculate; androsporangia 1–5; dwarf males slightly longer than the oogonia on which they develop; antheridia interior; stipe about twice as long as antheridium, curved; vegetative cells 24–32×50–112μ; oogonia 60–70×50–58μ; oospores 58–68×48–56μ; androsporangial cells 18–20×10–14μ; dwarf male stipe 10–13×28–45μ; antheridial cell 13–14×20–30μ.

United States: Michigan, Florida, Iowa, Pennsylvania; Australia, Europe.

19. **B. diamesandria** Nordstedt and Hirn.

(Pl. II, fig. 16.)

In Hirn 1900, p. 323, Pl. LI, fig. 329; Tiffany 1928, p. 140, Pl. XV, fig. 16.

Dioecious, nannandrous, gynandrosporous; oogonia subdepressed-globose, erect, below terminal setae or vegetative cells; division of suffultory cell basal; oospore wall smooth; androsporangia scattered or subepigynous, 1–?; dwarf males on suffultory cells (rarely on oogonia), antheridia unicellular; vegetative cells 17–23×42–80μ; oogonia 48–54× 45–52μ; oospores 45–53×43–50μ; androsporangia 14–17×10–15μ; dwarf male stipe 11–13×15–21μ; antheridia 10–12×14–18μ.

Bengal, Asia.

20. **B. elachistandria** Wittrock.

(**Pl. III, fig. 21.**)

1874, p. 43; *B. intermedia* Pringsh. 1858, p. 72, Pl. IV, figs. 15–23; Hirn 1900, p. 342, Pl. LVI, fig. 354; Heering 1914, p. 231, fig. 354; Tiffany 1928, p. 141, Pl. XVI, fig. 21.

Dioecious, nannandrous, gynandrosporous; oogonia globose, patent, below androsporangia; division of suffultory cell nearly median; oospore wall smooth (?); androsporangia epigynous or scattered, 1–2; dwarf males on oogonia, small and unicellular; vegetative cells 20–24×30–60μ; oogonia about 46×44μ; androsporangia 14–16×10–11μ; dwarf males 9×19μ.

Germany.

21. **B. obliqua** Lundell.

(**Pl. III, fig. 26.**)

In Hirn 1900, p. 344, Pl. LVI, fig. 356; Heering 1914, p. 238, fig. 371; Tiffany 1928, p. 141, Pl. XVI, fig. 26.

Dioecious, nannandrous, gynandrosporous and idioandrosporous; oogonia depressed-globose, patent, below terminal setae or (rarely) androsporangia; division of suffultory cell median or nearly so; oospore wall smooth; androsporangia 1–?, epigynous; dwarf males on oogonia, antheridia interior; vegetative cells 21–27×42–108μ; oogonia 55–64×43–51μ; oospores 53–62×40–49μ; androsporangia 16–21×7–10μ; dwarf male stipes 9–10×25–36μ; antheridia 10–12×15–21μ.

United States: Michigan; Austria, Sweden.

22. **B. sessilis** Wittrock.

(**Pl. III, fig. 19.**)

1872, p. 18, Pl. 1, fig. 2; 1874, p. 47; Hirn 1900, p. 338, Pl. LV, fig. 349; Heering 1914, p. 236, fig. 366; Tiffany 1928, p. 141, Pl. XVI, fig. 19.

Dioecious, nannandrous, gynandrosporous; oogonia subquadrangularly globose, patent, below terminal setae or occasionally below vegetative cells; division of suffultory cell superior; outer oospore wall scrobiculate; androsporangia scattered, 1–3; dwarf males on oogonia or rarely suffultory cells, antheridia interior, stipe a little curved, shorter than antheridia; vegetative cells 19–22×38–72μ; oogonia 51–56×44–50μ; oospores 48–54×42–48μ; androsporangia 10–13×10–12μ; dwarf males 9–11×26–29μ.

France, Sweden, Canada.

22a. Form **glabra** Hirn.

(**Pl. III, fig. 20.**)

1900, p. 339, Pl. LV, fig. 350; Heering 1914, p. 236; Tiffany 1928, p. 141, Pl. XVI, fig. 20.

Smaller, with oospore wall smooth; vegetative cells 16–21×32–75μ; oogonia 44–51×40–45μ; oospores 42–48×38–43μ; androsporangia 10–12×10–12μ; dwarf males 9–11×23–27μ.

Sweden.

23. **B. setigera** (Roth) C. A. Agardh.

(Pl. V, fig. 37.)

1817, p. 71; *Conferva setigera* Roth 1806, p. 283; *B. setigera* C. A. Agardh 1817, p. 71; Wittrock 1874, p. 47; (?) *B. setigera* var. *Canbyii* Wood *in* Wolle 1887, p. 99; (?) *B. Canbyii*, Wood 1872, p. 202; Hirn 1900, p. 339, Pl. LV, fig. 351; Collins 1909, p. 271; Heering 1914, p. 236, fig. 367; Tiffany 1928, p. 142, Pl. XVIII, fig. 37.

Dioecious, nannandrous, gynandrosporous; oogonia subdepressed or depressed (quadrangularly) globose, patent, generally below terminal setae, more rarely below androsporangia or vegetative cells; division of suffultory cell slightly above median or rarely superior; outer oospore wall scrobiculate; androsporangia scattered or more rarely epigynous, 1–3; dwarf males on oogonia or near it; antheridia interior, stipe curved, shorter than antheridium; vegetative cells 25–28×62–140μ; oogonia 70–80×56–65μ; oospores 67–77×53–62μ; androsporangia 16–20× 10–18μ; dwarf males 11–14×30–36μ.

United States: Connecticut, New Jersey, Florida, Alabama, South Carolina, Michigan; Europe, South America; Africa.

24. **B. alabamensis** Transeau and Brown.

(Pl. V, fig. 38.)

In Tiffany 1928, p. 142, Pl. XVIII, fig. 38.

Dioecious, nannandrous, gynandrosporous; oogonia globose, depressed globose, or rarely angularly globose, patent; division of suffultory cells superior; outer spore wall scrobiculate; androsporangia hypogynous or epigynous or rarely scattered; dwarf males, a little shorter than oogonia, on vegetative cells, antheridia interior, stipe a little curved; vegetative cells 22–40×62–111μ; oogonia 77–92×70–88μ; oospores 75–90×68–86μ; dwarf male stipes 14–18×35–38μ; antheridia 14–15×15–16μ.

United States: Alabama.

In form and general appearance this species is near *B. setigera*. It is larger, however, in all dimensions and is thus the largest globose species of the genus.

25. **B. dispar** Wittrock.

(Pl. III, fig. 23.)

In Wittrock and Nordstedt Exs. 1882; Hirn 1900, p. 335, Pl. LIV, fig. 344; Collins 1909, p. 270; Heering 1914, p. 234, fig. 363; Tiffany 1928, p. 142, Pl. XVI, fig. 23.

Dioecious, nannandrous, gynandrosporous and idioandrosporous; oogonia subdepressed globose, patent, below terminal setae or rarely vegetative cells; division of suffultory cell superior (rarely submedian); outer spore wall thick, finely scrobiculate; androsporangia scattered, 1–2; dwarf males on oogonia, antheridia interior, stipe a little curved, shorter than antheridia; vegetative cells 16–21×32–95μ; oogonia 44–56×42–51μ; oospores 40–54×38–48μ; androsporangia 12–16× 10–12μ; dwarf males 9–11×23–26μ.

Sweden, Greenland.

25a. Var. **ripartiana** Wittrock.

(Pl. III, figs. 24 and 25.)

In Hirn 1900, p. 335, Pl. LIV, fig. 345; Tiffany 1928, p. 143, Pl. XVI, figs. 24 and 25.

Idioandrosporous; division of suffultory cell supreme; dwarf males on or near oogonia; vegetative cells 15–21×45–105μ; oogonia 48–54×41–50μ; oospores 46–53×39–48μ; androsporangia 12–16×11–14μ; dwarf males 10–12×23–25μ.

France.

26. **B. punctulata** (Nordstedt) Hirn.

(Pl. IV, fig. 31.)

1900, p. 326, Pl. LI, fig. 332; *B. setigera* (Roth) C. A. Agardh var. *punctulata* Nordstedt 1888, p. 9; Tiffany 1928, p. 143, Pl. XVII, fig. 31.

Dioecious, nannandrous, gynandrosporous; oogonia subdepressed globose, patent, below terminal setae or androsporangia, wall thickened, division median, narrow but distinct; division of suffultory cell superior; outer oospore wall scrobiculate; androsporangia epigynous, 1–?; dwarf males on oogonia, antheridia interior, stipe a little curved, shorter than the antheridium; vegetative cells 22–26×66–104μ; oogonia 64–68×57–60μ; oospores 60–66×53–58μ; androsporangia 18×11μ; dwarf males 11–12×30–34μ.

New Zealand.

27. **B. crassiuscula** Nordstedt.

(Pl. IV, figs. 28 and 29.)

1877, p. 30, Pl. 3, figs. 14 and 15; *B. setigera* (Roth) C. A. Agardh *in* Moebius 1894, p. 315; (?) *B. ellipsospora* West 1899, p. 54; Hirn 1900, p. 341, Pl. LV, fig. 352; Collins 1909, p. 271; Heering 1914, p. 236, fig. 368; Tiffany 1928, p. 143, Pl. XVII, figs. 28 and 29.

Dioecious, nannandrous, idioandrosporous; oogonia depressed (subquadrangularly) globose, patent, below terminal setae or occasionally vegetative cells; division of suffultory cells superior (rarely submedian); outer oospore wall scrobiculate; androsporangia 1–4; dwarf males on oogonium or near it; antheridia interior, stipe slightly curved, shorter than antheridium; vegetative cells 22–27×55–148μ; oogonia 60–78×50–62μ; oospores 58–76×48–60μ; antheridia 16–19×10–13μ; dwarf males 12–14×30–34μ.

United States: Illinois, Massachusetts, Michigan; Canada, Greenland, Europe, Australia, Ceylon.

28. **B. crassa** Pringsheim.

(Pl. IV, fig. 32.)

1855, Pl. 1, fig. 29; Wittrock 1874, p. 48; Hirn 1900, p. 343, Pl. LVI, fig. 355; Heering 1914, p. 238, fig. 370; Tiffany 1928, p. 143, Pl. XVII, fig. 32.

Dioecious, nannandrous, gynandrosporous; oogonia subdepressed globose to globose, patent, below terminal setae or rarely vegetative cells; division of suffultory cell median or a little above; outer oospore wall scrobiculate; androsporangia scattered, up to 4-seriate; dwarf males a little longer than oogonia, antheridia exterior, unicellular, stipe about twice as long as antheridium; vegetative cells 22–26×44–60μ;

oogonia 52–60×42–51μ; oospores 50–58×40–48μ; androsporangia 13–15 ×14–16μ; dwarf male stipes 9–11×32–44μ; antheridia 8–9×21–24μ.

United States: Ohio; Germany, Austria, Switzerland.

The outer oospore wall of this species is recorded by Hirn as doubtfully smooth. Material collected in Ohio in 1920 showed the wall to be scrobiculate, and the description is emended accordingly.

29. **B. valida** Wittrock.

(**Pl. IV, fig. 27.**)

1872, p. 17, Pl. 1, fig. 1; 1874, p. 48; Hirn 1900, p. 346, Pl. LVI, fig. 357; Heering 1914, p. 238, fig. 372; Tiffany 1928, p. 144, Pl. XVII, fig. 27.

Dioecious, nannandrous, gynandrosporous; oogonia depressed globose, patent, below terminal setae; division of suffultory cell about median; outer oospore wall scrobiculate; androsporangia scattered, 1–3; dwarf males on oogonia, antheridia interior, stipe a little longer than antheridium, curved; vegetative cells 23–27×46–95μ; oogonia 59–70×48–56μ; oospores 57–68×46–54μ; androsporangia 18–20× 10–14μ; dwarf male stipes 9–10×23–29 (–40) μ; antheridia 11–12× 20–22μ.

United States: Michigan; Finland, Sweden.

30. **B. quadrata** Wittrock.

(**Pl. III, fig. 22.**)

1872, p. 19, Pl. 1, fig. 3; 1874, p. 45; Hirn 1900, p. 338, Pl. LV, fig. 348; Heering 1914, p. 236, fig. 365; Tiffany 1928, p. 144, Pl. XVI, fig. 22.

Dioecious, nannandrous, gynandrosporous; oogonia subdepressed (subquadrangularly) globose, patent, below androsporangia; division of suffultory cell inframedian (rarely nearly median); outer oospore wall scrobiculate; androsporangia 1–2, epigynous, rarely scattered; dwarf males on oogonia, antheridia interior, stipe a little curved, shorter than antheridium; vegetative cells 19–25×30–50μ; oogonia 40–50×40–45μ; oospores 38–48×38–43μ; androsporangia 15–17×11–12μ; dwarf males 10–12×27–32μ.

United States: Ohio; Finland, Sweden.

31. **B. congener** Hirn.

(**Pl. V, figs. 33 and 34.**)

1900, p. 346, Pl. LVII, fig. 358; Tiffany 1926, p. 108, Pl. X, figs. 111 and 112; Tiffany 1928, p. 144, Pl. XVIII, figs. 33 and 34.

Dioecious, nannandrous, idioandrosporous; oogonia depressed-globose or more rarely oboviform-globose, patent, below terminal setae; division of suffultory cell inframedian; outer oospore wall scrobiculate; androsporangia 1–4; dwarf males a little shorter than the oogonia on which they develop; antheridia interior, stipe about twice as long as the antheridial cell, curved; vegetative cells 21–24×40–75μ; oogonia 44–54×40–48μ; oospores 42–52×38–46μ; androsporangial cells 13–15× 10–13μ; dwarf males 9–10×29–34μ; antheridial cells 10–11×14–17μ.

United States: Iowa; South America.

32. **B. pyrulum** Lundell.

(**Pl. IV, fig. 30.**)

In Hirn 1900, p. 342, Pl. LV and LVI, fig. 353; Heering 1914, p. 238, fig. 369; Tiffany 1928, p. 145, Pl. XVII, fig. 30.

Dioecious, nannandrous, (?) idioandrosporous; oogonium pyriform, patent, below terminal setae, wall thickened; division of suffultory cells submedian; outer oospore wall finely scrobiculate; dwarf males near or on oogonia, antheridia interior, stipe a little curved, shorter than antheridium; vegetative cells 23–29×64–178μ; oogonia (58–) 68–85×64–79μ; oospores 65–83×61–77μ; dwarf males 11–14×29–33μ.

Austria, Sweden, Finland.

33. **B. doliiformis** Borge.

(**Pl. VI, figs. 39 and 40.**)

1925, p. 11, Pl. 1, fig. 41; Tiffany 1928, p. 145, Pl. XIX, figs. 39 and 40.

Dioecious, nannandrous; oogonia ellipsoid, erect, below terminal setae; suffultory cell without division; oospores ellipsoid, not quite filling oogonia, wall smooth; dwarf males on vegetative cells, antheridia exterior, 2; vegetative cells 11–15×11–16μ; oogonia 23–25×26–33μ; oospores 22–23×27–28μ; dwarf male stipe 10–12×10–12μ; antheridia 7–8×7–8μ.

Argentina.

This species is near *B. pygmaea* in size and shape of cells and in having suffultory cells without division. The plant is few celled with the vegetative cells convex, as seen laterally, sometimes with a broad median constriction, and the oospore wall is smooth.

34. **B. pygmaea** Pringsheim; Wittrock.

(**Pl. VI, fig. 41.**)

In Wittrock 1870, p. 141; *B. pygmaea* b. *minor* Pringsh. 1858, p. 74; *B. pygmaea* Wittr. 1870, p. 141; Wittrock 1874, p. 52; Hirn 1900, p. 356, Pl. LIX, fig. 372; Collins 1909, p. 273; Heering 1914, p. 239, fig. 374; Tiffany 1928, p. 145, Pl. XIX, fig. 41.

Dioecious, nannandrous, gynandrosporous; oogonia ellipsoid, patent, below terminal setae or vegetative cells; outer wall of oospore longitudinally ribbed; suffultory cells without division; androsporangia subepigynous or scattered, 1–? celled; dwarf males near oogonia, antheridia exterior, 1–3; vegetative cells 11–15×8–15μ; oogonia 22–25× 32–40μ; oospores 20–23×30–38μ; androsporangia 7–10×6–9μ; dwarf male stipes 11–12×15–19μ; antheridia 7–8×7–8μ.

United States: Massachusetts; Europe, Brazil.

35. **B. tenuis** (Wittrock) Hirn.

(**Pl. VII, fig. 59.**)

1900, p. 368, Pl. LXIII, fig. 388; *B. rectangularis* Wittr. var. *tenuis* Wittr. 1874, p. 56; *B. rectangularis* Wittr. var. *norvegica* Wittr. 1874, p. 56; *B. tenuis* (Wittr.) Hirn var. *norvegica* (Wittr.) Hirn 1900, p. 369 (not 1906, p. 60); Collins 1912, p. 89; Heering 1914, p. 242, fig. 381; Tiffany 1928, p. 146, Pl. XX, fig. 59.

MARINE BIOLOGICAL LABORATORY WOODS HOLE LIBRARY MASS.

Dioecious, nannandrous, gynandrosporous; oogonia suboblong-ellipsoid, erect or patent, below terminal setae or androsporangia; outer oospore wall longitudinally ribbed; androsporangia epigynous or more rarely scattered, 1–?; dwarf males on or near oogonia; antheridia exterior, 1–3; vegetative cells 13–16×20–40μ; oogonia 22–26×42–48μ; oospores 20–24×40–46μ; androsporangia 10–12×13–19μ; dwarf male stipes 12–14×18–24μ; antheridia 7–9×6–7μ.

United States: Massachusetts; Northern Europe.

35a. Var. **norvegica** (Wittrock) Hirn.
(Pl. VII, fig. 60.)

1906, p. 60; Tiffany 1928, p. 146, Pl. XX, fig. 60.

Larger vegetative cells and oogonia; vegetative cells 15–18×22–36μ; oogonia 27–34×47–53μ; oospores 25–32×45–51μ; dwarf male stipes 12–14×19–23μ; antheridia 8–9×8μ.

Finland.

The dimensions of the variety *norvegica* as given by Hirn in his monograph (1900, p. 369) are so nearly the same as those of the species proper as to make its varietal position scarcely tenable. Material collected by Silfvenius in Finland in 1903 is labelled variety *norvegica* by Hirn (1906) having the dimensions given above. It seems best, therefore, to consider the variety as having the dimensions as recorded for the Finnish material, and to regard the former description as included in the species proper.

36. **B. repanda** Wittrock.
(Pl. VI, fig. 47.)

1874, p. 55; *B. rectangularis* Wittr. var. *Lundellii* Wittr. 1874, p. 56; (?) *B. rhadinospora* Wittr. *in* Wolle 1887, p. 103; Hirn 1900, p. 363, Pl. LXI, fig. 380; Collins 1909, p. 274; Heering 1914, p. 240, fig. 378; Tiffany 1928, p. 146, Pl. XIX, fig. 47.

Dioecious, nannandrous, gynandrosporous; oogonia suboblong-ellipsoid, patent or erect, below androsporangia, terminal setae, or vegetative cells; outer oospore wall longitudinally ribbed; androsporangia epigynous or subepigynous, 1–?; dwarf males near or on oogonia; antheridia exterior, 1–3; vegetative cells, frequently repand, 12–17×24–60μ; oogonia 26–36×43–58μ; oospores 21–33×40–50μ; androsporangia 13–15×16–21μ; dwarf male stipes 11–15×21–27μ; antheridia 7–10×5–7μ.

United States: Massachusetts, Maine, New Jersey, Florida; Greenland, Finland, Norway, Sweden, Germany.

The peculiar repand appearance of the vegetative cells usually makes the identification of this species easy. Occasionally a single plant may lack this vegetative character and may thus be confused with *B. rectangularis* or *B. varians*.

37. **B. rectangularis** Wittrock.

(Pl. VI, fig. 43.)

1870, p. 142; 1874, p. 55; (?) *B. ignota* Wood 1872, p. 201; Hirn 1900, p. 359, Pl. LX, fig. 376; Collins 1909, p. 273; Heering 1914, p. 239, fig. 376; Tiffany 1928, p. 147, Pl. XIX, fig. 43; P. B. A. No. 516.

Dioecious, nannandrous, gynandrosporous; oogonia ellipsoid, patent or more rarely erect, below terminal setae or androsporangia or more rarely vegetative cells; outer oospore wall longitudinally ribbed; androsporangia scattered or epigynous, 1–?; dwarf males near or occasionally on oogonia; antheridia exterior, 1–4; vegetative cells, subrectangular in cross section, 16–23×20–46μ; oogonia 32–39×45–63μ; oospores 29–37×43–61μ; androsporangia 13–16×10–27μ; dwarf male stipes 14–18×22–27μ; antheridia 8–10×5–7μ.

United States: Pennsylvania, Ohio, Illinois, Michigan, Massachusetts, Rhode Island, Connecticut; Europe, Patagonia, Mongolia.

This species is usually characterized by its long and few branches and its nearly rectangular cells in cross section.

37a. Var. **hiloensis** Nordstedt.

(Pl. VI, fig. 44.)

1878, p. 22; Hirn 1900, p. 361, Pl. LX, fig. 377; Collins 1909, p. 274; Tiffany 1928, p. 147, Pl. XIX, fig. 44.

Smaller, androsporangia generally epigynous; vegetative cells 14–19×24–48μ; oogonia 28–32×47–51μ; androsporangia 12–14×13–16μ; dwarf male stipes 13–14×22–24μ; antheridia 8–9×5–7μ.

Australia; (?) Pennsylvania (U. S. A.). The only American record is that of Wolle.

38. **B. varians** Wittrock.

(Pl. VI, fig. 48.)

1870, p. 143; 1874, p. 53; Hirn 1900, p. 357, Pl. LIX, fig. 373; Heering 1914, p. 239, fig. 375; Tiffany 1926, p. 109, Pl. X, fig. 113; Tiffany 1928, p. 147, Pl. XIX, fig. 48.

Dioecious, nannandrous, gynandrosporous; oogonia ovoid, patent or erect, below terminal setae or below androsporangial cells; outer oospore wall longitudinally ribbed, ribs serrate; androsporangia scattered, epigynous or hypogynous, 1–2; dwarf males on or near the oogonia, antheridia exterior, 1–3; vegetative cells 17–22×22–33μ; oogonia 30–36×44–54μ; oospores 28–34×42–52μ; androsporangial cells 14–17×14–18μ; dwarf male stipes 14–16×24–27μ; antheridial cells 8–10×6–7μ.

United States: Iowa, Ohio, Illinois, Michigan, Alabama, Mississippi, Indiana; Canada, Europe.

38a. Var. **subsimplex** (Wittrock) Hirn.

(Pl. VI, fig. 49.)

1900, p. 357, Pl. LIX and LX, fig. 374; *B. pygmaea* a. *major* Pringsh. 1858, p. 74; *B. subsimplex* Wittr. 1870, p. 142; 1874, p. 52; *B. varians* Wittr. var. *alpina* Wittr. and Lund. *in* Wittrock 1874, p. 53; *B. dumosa* Wood 1872, p. 202; *B. reticulata* Nordst. var. *minor* Lemmermann 1895, p. 25; Collins 1909, p. 273; Heering 1914, p. 239; Tiffany 1926, p. 110; 1928, p. 147, Pl. XIX, fig. 49.

Smaller in nearly all parts; ribs of oospore serrulate or smooth; vegetative cells 13–18×16–34μ; oogonia 26–30×39–46μ; oospores 24–28×37–44μ; androsporangial cells 10–14×7–16μ; dwarf male stipes 11–14×15–24μ; antheridial cells 7–8×5–7μ.

United States: Iowa, Ohio, Mississippi, Illinois, Pennsylvania; Brazil, India, Europe, Australia; British Columbia.

38b. Var. **hawaiensis** Nordstedt.

(Pl. VI, fig. 50.)

1878, p. 21; Hirn 1900, p. 358, Pl. LX, fig. 375; Tiffany 1928, p. 148, Pl. XIX, fig. 50.

Vegetative cells 13–18×17–36μ; oogonia 27–30×44–54μ; androsporangia 12–16×13–14μ; dwarf male stipes 17–18×28–31μ; antheridia 10–11×6–7μ.

United States: Ohio, Illinois; Australia.

39. **B. lagoensis** Wittrock.

(Pl. VI, fig. 46.)

1874, p. 53; Hirn 1900, p. 361, Pl. LXI, fig. 378; Tiffany 1928, p. 148, Pl. XIX, fig. 46.

Dioecious, nannandrous; oogonia ellipsoid, erect or rarely patent, below vegetative cells; outer oospore wall longitudinally ribbed, the ribs dentate and connected by transverse lines; dwarf males near oogonia; antheridia exterior, 1–2; vegetative cells 18–23×23–35μ; oogonia 37–41×56–63μ; oospores 35–39×54–61μ; dwarf male stipes 15–17×24–25μ; antheridia 9–10×7–8μ.

Brazil.

40. **B. rhadinospora** Wittrock.

(Pl. VIII, fig. 66.)

1874, p. 53; Hirn 1900, p. 372, Pl. LXIII and LXIV, fig. 393; Heering 1914, p. 242, fig. 383; Tiffany 1928, p. 148, Pl. XXI, fig. 66.

Dioecious, nannandrous, gynandrosporous; oogonia fusiformly ellipsoid, patent or rarely erect, below androsporangia or terminal setae or rarely vegetative cells; outer wall of oospore longitudinally ribbed, ribs smooth; androsporangia epigynous or rarely scattered, 1–?; dwarf males on or near oogonia; antheridia exterior, 1–4; vegetative cells 15–22×20–44μ; oogonia 29–37×61–80μ; oospores 27–35×59–78μ; androsporangia 13–17×16–23μ; dwarf male stipes 13–16×23–25μ; antheridia 7–9×6–8μ.

Sweden.

40a. Forma **antiqua** (Nordstedt) Hirn.

(Pl. VIII, fig. 67.)

1900, p. 372, Pl. LXIV, fig. 394; Nordstedt 1883, p. 154; *B. varians* Wittr. var. *antiqua* Nordstedt *in* Borge 1896, p. 4; Tiffany 1928, p. 148, Pl. XXI, fig. 67.

Ribs of oospore crenulate; vegetative cells 15–21×20–42μ; oogonia 32–37×58–78μ; oospores 30–35×56–76μ; androsporangia 15–18×23–26μ; dwarf male stipes 14–17×23–26μ; antheridia 9–11×6–10μ.

Australia.

40b. Var. **litoralis** Hirn.

(Pl. VIII, fig. 68.)

1900, p. 373, Pl. LXIV, fig. 395; Tiffany 1928, p. 149, Pl. XXI, fig. 68.

Larger; vegetative cells 22–28×28–56μ; oogonia 38–45×75–87μ; oospores 36–43×73–85μ; androsporangia 17–20×18–20μ; dwarf male stipes 15–17×28–30μ; antheridia 9–13×6–9μ.

Sweden.

This variety is the only *Bulbochaete* known to inhabit brackish waters.

41. **B. minor** Al. Braun.

(Pl. VII, fig. 54.)

In Kuetzing 1849, p. 422; Wittrock 1874, p. 54; Hirn 1900, p. 369, Pl. LXIII, fig. 390; Collins 1909, p. 275; Heering, p. 242; Tiffany 1926, Pl. X, fig. 114; 1928, p. 149, Pl. XX, fig. 54.

Dioecious, nannandrous, gynandrosporous; oogonia ovoid, erect or rarely patent, below terminal setae, androsporangial cells, or more rarely vegetative cells; outer oospore wall longitudinally ribbed; androsporangia epigynous, subepigynous, or scattered, 1–?; dwarf males on or near oogonia; antheridium exterior, 1–4; vegetative cells 18–25×27–50μ; oogonia 32–42×59–69μ; oospores 30–40×57–67μ; androsporangia 15–16×16–21μ; dwarf male stipes 12–15×22–24μ; antheridia 6–10×6–7μ.

United States: Iowa, Indiana, Illinois, New Jersey; Germany, Sweden, Austria, England.

41a. Var. **germanica** Hirn.

(Pl. VII, fig. 55.)

1900, p. 370, Pl. LXIII, fig. 391; (?) *B. minor* Al. Br. *in* De Bary 1854, p. 72; *B. minor* Al. Br. *in* Pringsheim 1858, p. 74; Heering 1914, p. 242, fig. 382; Tiffany 1928, p. 149, Pl. XX, fig. 55.

Vegetative cells 15–22×23–56μ; oogonia 30–35×56–65μ; oospores 28–33×54–63μ; dwarf male stipes 10–12×21–24μ; antheridia 6–9×6–7μ.

Germany.

This variety on the basis of dimensions and habit seems scarcely tenable. I have not been able to examine the original material, however, and have followed Hirn's disposition of it.

42. **B. bullardi** Transeau and Tiffany.

(Pl. VII, figs. 52 and 53.)

1919, p. 241, Pl. XIV, figs. a–e; Tiffany 1928, p. 149, Pl. XX, figs. 52 and 53.

Dioecious, nannandrous, idioandrosporous; oogonia ovoid-ellipsoid or ellipsoid, erect, terminated by long setae, pore evident and supramedian; oospores filling or nearly filling oogonia, ribs of outer wall of oospore dentate, the teeth connected by transverse lines, longitudinal ribs uniting irregularly; androsporangia 1–6; dwarf males slightly curved, on oogonia or suffultory cells or vegetative cells; antheridia exterior, 1–3; vegetative cells 20–32×60–165μ; oogonia 56–66×70–96μ;

oospores 54–64×67–94μ; androsporangia 18–21×15–33μ; dwarf male stipes 18–21×30–33μ; antheridia 9–14×6–10μ.

United States: Massachusetts.

The combination of dimensions and oospore markings rather readily separates this species from *B. imperialis* and *B. insignis*, its nearest relatives.

43. **B. denticulata** Wittrock.

(Pl. VI, fig. 51.)

1874, p. 54; Hirn 1900, p. 362, Pl. LXI, fig. 379; Heering 1914, p. 240, fig. 377; Tiffany 1928, p. 150, Pl. XIX, fig. 51.

Dioecious, nannandrous; oogonia broadly ellipsoid, patent, below terminal setae or rarely vegetative cells; outer oospore wall longitudinally ribbed, ribs often anastomosing; dwarf males on or near oogonia; antheridia exterior, 1–2; vegetative cells 27–30×34–45μ; oogonia 48–54×69–76μ; oospores 46–52×67–74μ; dwarf male stipes 18–21×30–31μ; antheridia 13–14×8–10μ.

Norway.

44. **B. affinis** Hirn.

(Pl. VII, fig. 61.)

1900, p. 371, Pl. LXIII, fig. 392; *B. minor* Al. Br. *in* Borge 1896, p. 4; Tiffany 1928, p. 150, Pl. XX, fig. 61.

Dioecious, nannandrous, gynandrosporous; oogonia suboblong-ellipsoid to ellipsoid, patent or rarely erect, below terminal setae or androsporangia; outer oospore wall longitudinally ribbed, androsporangia epigynous, 1–?; dwarf males near or on oogonia, antheridia exterior, 1–3; vegetative cells 22–27×27–47μ; oogonia 40–46×67–78μ; oospores 38–44×65–76μ; androsporangia 18–19×23–30μ; dwarf male stipes 17–19×22–28μ; antheridia 9–12×9–13μ.

Australia.

45. **B. anomala** Pringsheim.

(Pl. VI, fig. 45.)

1858, p. 73, Pl. 6, fig. 6; Wittrock 1874, p. 56; Hirn 1900, p. 366, Pl. LXII, fig. 385; Heering 1914, p. 240, fig. 380; Tiffany 1928, p. 150, Pl. XIX, fig. 45.

Dioecious, nannandrous; oogonia ellipsoid, erect, below vegetative cells; dwarf males near oogonia; antheridia exterior, 1–2; vegetative cells 26–27×52–54μ; oogonia 49–51×75–80μ; oospores 47–48×73–78μ; dwarf male stipes 18×37μ; antheridia 13×13μ.

Germany.

46. **B. insignis** Pringsheim.

(Pl. VIII, fig. 62.)

1858, p. 73, Pl. 6, fig. 7; (?) *B. pringsheimiana* Archer 1866, p. 121; *B. speciosa* Wittr. 1870, p. 143; Wittrock 1874, p. 55; (?) *B. pachyderma* Reinsch 1875, p. 82; (?) *B. anomala* Pringsheim *in* Nordstedt 1888, p. 8; Hirn 1900, p. 364, Pl. LXII, fig. 383; Collins 1909, p. 274; Heering 1914, p. 240, fig. 379; Tiffany 1928, p. 150, Pl. XXI, fig. 62; P. B. A. Nos. 1332 and 1430.

Dioecious, nannandrous, gynandrosporous; oogonia ellipsoid, erect or patent, below androsporangia or terminal setae or vegetative cells; oospores ellipsoid with broadly denticulate longitudinal ribs on the

outer oospore wall; androsporangia epigynous or scattered, 1–?; dwarf males near or on oogonia; antheridia exterior, 1–3; vegetative cells 19–25×48–88μ; oogonia 46–56×70–90μ; oospores 44–54×68–88μ; androsporangia 16–20×9–25μ; dwarf male stipes 16–19×29–33μ; antheridia 10–13×7–10μ.

United States: Massachusetts, Michigan, Illinois, New York, New Jersey, Alaska; Europe, Australia.

46a. Var. **reticulata** (Nordstedt) Hirn.

(Pl. VIII, fig. 63.)

1900, p. 365, Pl. LXII, fig. 384; *B. reticulata* Nördst. 1877, p. 32; Collins 1909, p. 275; Tiffany 1928, p. 151, Pl. XXI, fig. 63.

Outer wall of oospore reticulate-dentate, with doubly dentate, occasionally anastomosing, longitudinal ridges, the teeth united to each other by transverse ridges; vegetative cells 20–25×40–87μ; oogonia 44–52×66–85μ; oospores 42–50×64–83μ; androsporangia 16–19×13–23μ; dwarf male stipes 17–20×30–33μ; antheridia 11–13×6–9μ.

United States: Massachusetts, Illinois; Sweden, Denmark.

47. **B. imperialis** Wittrock.

(Pl. VIII, fig. 64.)

1874, p. 54; Hirn 1900, p. 367, Pl. LXII, fig. 386; Tiffany 1928, p. 151, Pl. XXI, fig. 64.

Dioecious, nannandrous, gynandrosporous; oogonia broadly ellipsoid, erect, terminated by setae; outer oospore wall longitudinally ribbed, the ribs irregularly anastomosing or connected by transverse ribs; androsporangia scattered, 1–?; dwarf males on or near oogonia; antheridia exterior, 1–2 celled; vegetative cells 26–31×32–106μ; oogonia 81–83×104–108μ; oospores 79–81×102–106μ; androsporangia 18–20×25–26μ; dwarf male stipes 19–21×30–35μ; antheridia 13–16×7–9μ.

Brazil.

47a. Var. **regalis** Wittrock.

(Pl. VIII, fig. 65.)

1874, p. 55; Hirn 1900, p. 367, Pl. LXII, fig. 387; Tiffany 1928, p. 151, Pl. XXI, fig. 65.

Smaller than the type; vegetative cells 24–26×72–117μ; oogonia 68–70×88–90μ; dwarf male stipe 20×39μ; antheridia 15–16×6–7μ.

Brazil.

48. **B. spirogranulata** West and West.

(Pl. VII, figs. 57 and 58.)

1902, p. 126, Pl. 17, figs. 8 and 9; Hirn 1906, p. 27, Pl. IV, fig. 29.

Oogonia oblong-ellipsoid, subpatent; outer wall of oospore thick with longitudinal, crenulate ribs; androsporangia scattered; suffultory cells without division; setae long; vegetative cells, spirally granulate, 9–12×31–57μ; oogonia 20–24×48–49μ; androsporangia 7–8×9–10μ.

Heneratgodha, Ceylon.

The vegetative cells of this species are minutely granulate, with the markings spirally arranged. This character is rather unique among the ellipsoid members of the genus.

49. **B. brevifulta** Wittrock.

(Pl. VII, fig. 56.)

1874, p. 57; Hirn 1900, p. 373, Pl. LXI, fig. 382; Tiffany 1928, p. 152, Pl XX, fig. 56.

Oogonia broadly ellipsoid, erect, terminated by setae; oospores with outer wall longitudinally and irregularly ribbed; vegetative cells 19–24 $\times$38–72μ; oogonia 34–42$\times$50–56μ; oospores 32–40$\times$48–54μ.

Brazil.

This description is quite incomplete and the position of the species must be considered temporary until more data can be secured.

50. **B. sanguinea** Hansgirg.

1905, p. 437; Hirn 1906, p. 26; Heering 1914, p. 242; Tiffany 1928, p. 152.

Few celled and little branched; cell walls 2–3μ thick; vegetative cells 26–35$\times$24–50μ, with contents blood-red in color; reproductive cells unknown.

Austria.

Hansgirg gives no figures for this interesting form, but compares it in habit with *B. minor*. A somewhat similar species, *B. purpurea* Corda (Hansgirg *loc. cit.*) with purple-red vegetative cells alternating with colorless empty cells, was described from Bohemia. Cleve (1895) also observed a red Bulbochaete, collected in October, 1894. Until more is known of the reproductive structures of these forms, their specific position must be merely a provisional record.

51. **B. horrida** Nordstedt.

(Pl. VI, fig. 42.)

In Hirn 1900, p. 355, Pl. LIX, fig. 371; Tiffany 1928, p. 152, Pl. XIX, fig. 42.

Dioecious, nannandrous; vegetative cells medianly plicate; oogonia ellipsoid; antheridia of dwarf males 1–?; vegetative cells 16–25$\times$12–25μ; basal cells 17–20$\times$10–20μ.

South America.

Little is known of the reproduction of this interesting species, and figures are available only for the vegetative cells. The median plications of the latter, however, readily separate it from any other species of the genus known at the present time. Hirn's record of Lagerheim's collections in the Guianas in which dwarf males and ellipsoid oogonia were seen is our only information regarding the fructification of the species.

Genus II. **Oedocladium** Stahl.

1891, p. 339; Hirn 1900, p. 374; Collins 1918, p. 71; Lewis 1930.

Terrestrial or aquatic, branching, rhizoidal; if terrestrial, partly subterranean and subhyaline, partly above ground and green; vegetative cell cylindrical or nearly so, growth chiefly by division of terminal cell of a filament or branch; asexual reproduction by "akinete" and zoospore; oogonium arising by a simple division of a vegetative cell; sexual reproduction both monoecious and dioecious, nannandrous.

KEY TO THE SPECIES OF OEDOCLADIUM.

1. Monoecious, terrestrial 2
1. Dioecious-nannandrous, aquatic ..... 4. *O. hazenii*
2. Oospore smooth 3
2. Oospore angulate 4
3. Vegetative cell 7×20μ ..... 1. *O. protonema*
3. Vegetative cell 12–18×56–78μ ..... 3. *O. media*
4. Oogonium 52×52μ ..... 3. *O. media*
4. Oogonium 90×95μ ..... 2. *O. albemarlensis*

1. **O. protonema** Stahl.

(Pl. LXIII, figs. 619-623.)

1891, p. 347, Pl. XVI, figs. 1–6, Pl. XVII, figs. 1–12; Hirn 1900, p. 374, Pl. LXIV, fig. 396.

Monoecious; oogonium single, subglobose, rarely terminal, pore median; oospore globose, filling oogonium, spore wall smooth; antheridium scattered, 1–6; vegetative cell 7×20μ, rhizoidal 3×(up to)300μ; oogonium 50–76×58–76μ; oospore 45–60×45–60μ.

Germany (Strassburg).

2. **O. albemarlensis** Lewis.

(Pl. LXIII, figs. 613-617.)

In Collins (as *O. albemarlense* Lewis) 1918, p. 71, Pl. III, figs. 22a and 22b.

Monoecious; oogonium single, mostly terminal, subglobose with conical apex (if terminal), pore inferior; oospore globose, not filling oogonium, spore wall of three layers: outer layer smooth, middle layer angulate (in optical section undulate), inner layer smooth; antheridium to 9; vegetative cell subcylindrical; terminal cell with conical apex; vegetative cell 25–40×50–150μ, rhizoidal 4–10×(up to)350μ; oogonium 90×95μ; oospore 69×69μ; antheridium 20–25×8–19μ; zoospore 32–50μ.

United States: Virginia (on sandy loam, bank of the Rivanna, near Charlottesville, Albemarle County) growing with Vaucheria and Riccia. Collected by Professor I. F. Lewis.

3. **O. media** Lewis nov. sp. mss.

(**Pl. LXI, figs. 601-603.**)

Monoecious; oogonium single, mostly terminal, globose to subglobose, with conical apex (if terminal), pore median; oospore globose, not quite filling oogonium, spore wall with middle layer angulate or smooth; antheridium 1–2; terminal cell with conical apex; vegetative cell 12–18×56–78μ, rhizoidal 10×(up to)270μ; oogonium 52×52μ; oospore 44×44μ; antheridium 15×9–15μ.

United States: Massachusetts (Woods Hole). Collected by Professor I. F. Lewis.

4. **O. hazenii** Lewis nov. sp. mss.

(**Pl. LXII, figs. 604-612.**)

Dioecious, nannandrous, gynandrosporous; oogonium globose to subglobose, terminal or intercalary, pore inferior; oospore globose, not or nearly filling oogonium, spore wall with middle layer angulate; androsporangium 1–2, epigynous, subepigynous, or scattered; dwarf male curved or erect, on suffultory cell or more rarely on oogonium; antheridium exterior, single; vegetative cell 15–26×47–132μ, rhizoidal 4×(up to)425μ; oogonium 50–75×50–75μ; oospore 45–55×45–55μ; androsporangium 16×7–12μ; dwarf male stipe 18–22×7–10μ; antheridium 6–8×6–7μ.

United States: New Jersey. Collected by Professor T. E. Hazen.

O. hazenii is the only dioecious, nannandrous species of the genus as well as the only aquatic member, so far recorded.

Data for descriptions and plates of *Oedocladium media* and *O. hazenii* were supplied by Professor I. F. Lewis of the University of Virginia. Lewis' *O. hazenii* makes it necessary to emend Stahl's original description of the genus to include this nannandrous species growing in an aquatic habitat.

Genus III. **Oedogonium** Link.

1820, p. 5; Pringsheim 1858, p. 68; Wittrock 1874, p. 6; Hirn 1900, p. 72; Collins 1909, p. 223; *Prolifera* Vaucher 1803, p. 14; *Vesiculifera* Hassall 1845, p. 195; *Cymatonema* Kuetzing 1849, p. 375; *Androgynia* Wood 1872, p. 196; *Pringsheimia* Wood 1872, p. 195; *Conferva* (early authors).

Filaments single, unbranched; vegetative cells cylindrical, or sometimes capitellate, nodulose or undulate; basal cell with holdfast; terminal cell obtuse, apiculate, or hyaline; all vegetative cells, except the basal one, capable of division; oogonia and antheridia produced by direct division of vegetative cells.

KEY TO THE SPECIES, VARIETIES, AND FORMS OF OEDOGONIUM

1.	Vegetative cell undulate or nodulose		2
1.	Vegetative cell punctate or granulate		6
1.	Vegetative cell distinctly capitellate		7
1.	Vegetative cell cylindrical		35
1.	Vegetative cell subhexagonal or subellipsoid	236.	*Oe. reinschii**
2.	Without dwarf male		3
2.	With dwarf male		4
3.	Diameter of oogonium 18–23μ	105.	*Oe. sphaerandrium*
3.	Diameter of oogonium 48–57μ	96.	*Oe. nodulosum*
3.	Diameter of oogonium 64–74μ	96a.	*Oe. nodulosum* var. *commune*
4.	Diameter of oogonium 44–56μ		5
4.	Diameter of oogonium 58–68μ	119a.	*Oe. undulatum* var. *americanum*
5.	Dwarf male 36–46μ in length	119b.	*Oe. undulatum* f. *senegalense*
5.	Dwarf male 48–70μ in length	119.	*Oe. undulatum*
6.	Diameter of vegetative cell 6–8μ	155.	*Oe. elegans*
6.	Diameter of vegetative cell 9–13μ	84.	*Oe. minus*
6.	Diameter of vegetative cell 16–22μ	85.	*Oe. punctatostriatum*
7.	Without dwarf male		8
7.	With dwarf male		17
7.	Reproductive structures imperfectly known		34
8.	Dioecious		9
8.	Monoecious		11
9.	Division of oogonium basal	78.	*Oe. infimum*
9.	Division of oogonium inferior	77.	*Oe. inversum*
9.	Division of oogonium median		10
9.	Division of oogonium supramedian or superior	89.	*Oe. mitratum*
10.	Oogonium 26–29μ in diameter	79a.	*Oe. howardii* var. *minus*
10.	Oogonium 29–32μ in diameter	79.	*Oe. howardii*
10.	Oogonium 32–36μ in diameter	81.	*Oe. latiusculum*
11.	Oogonium opening by a pore	20a.	*Oe. hirnii* var. *africanum*
11.	Oogonium opening by a lid		12
12.	Diameter of oogonium 15–25μ		13
12.	Diameter of oogonium 34–46μ		16
13.	Division of oogonium median		14
13.	Division of oogonium supramedian		15
14.	Oogonium subdepressed-globose	86.	*Oe. capitellatum*
14.	Oogonium angular-globose	87.	*Oe. quadratum*
15.	Diameter of oogonium 15–20μ	210.	*Oe. virceburgense**
15.	Diameter of oogonium 18–23μ	105.	*Oe. sphaerandrium*
15.	Diameter of oogonium 26–29μ	211.	*Oe. spurium**

*Species so marked have incomplete descriptions and are included in what is perhaps their probable position in the genus, using such characters as are available.

16. Vegetative cell punctate..... 84. *Oe. minus*
16. Vegetative cell not punctate..... 88. *Oe. bohemicum*
17. Poriferous.....120. *Oe. nebraskense*
17. Operculate..... 18
18. Division of oogonium median..... 19
18. Division of oogonium supramedian..... 24
18. Division of oogonium inframedian..... 26
18. Division of oogonium superior.....156. *Oe. rigidum*
18. Division of oogonium supreme..... 29
19. Division of oogonium narrow..... 20
19. Division of oogonium wide..... 21
20. Oogonium 28–35 × 23–38μ.....171a. *Oe. decipiens* f. *dissimile*
20. Oogonium 46–54 × 44–54μ.....157. *Oe. bengalense*
20. Oogonium 57–64 × 48–53μ.....158. *Oe. indicum*
21. Diameter of oospore 22–26μ..... 22
21. Diameter of oospore 30–32μ.....160b. *Oe. areschougii* f. *robustum*
21. Diameter of oospore 42–48μ..... 23
21. Diameter of oospore 48–53μ.....159. *Oe. brasiliense*
22. Gynandrosporous.....160. *Oe. areschougii*
22. Idioandrosporous.....160a. *Oe. areschougii* var. *americanum*
23. Vegetative cell 14–19μ in diameter.....157. *Oe. bengalense*
23. Vegetative cell 19–26μ in diameter.....161. *Oe. confertum*
24. Diameter of oogonium 14–26μ.....163. *Oe. clavatum*
24. Diameter of oogonium 27–42μ..... 25
24. Diameter of oogonium 50–55μ.....173. *Oe. costatum*
24. Diameter of oogonium 58–65μ.....174. *Oe. boreale*
25. Oogonium 19–25μ in length.....164a. *Oe. oelandicum* f. *minus*
25. Oogonium 25–32μ in length.....164. *Oe. oelandicum*
25. Oogonium 40–45μ in length.....165. *Oe. megaporum*
26. Suffultory cell enlarged.....167b. *Oe. platygynum* var. *continuum*
26. Suffultory cell not enlarged..... 27
27. Diameter of vegetative cell 6–10μ..... 28
27. Diameter of vegetative cell 12–15μ.....166. *Oe. bahusiense*
28. Gynandrosporous only.....167c. *Oe. platygynum* var. *novæzelandiæ*
28. Idioandrosporous only.....167a. *Oe. platygynum* f. *obtusum*
28. Gynandrosporous and idioandrosporous.....167. *Oe. platygynum*
29. Oospore wall smooth..... 30
29. Oospore wall longitudinally ribbed.....194. *Oe. michiganense*
30. Idioandrosporous..... 31
30. Gynandrosporous..... 32
31. Oogonium 48–60 × 62–74μ.....190. *Oe. praticolum*
31. Oogonium 66–78 × 72–90μ.....191. *Oe. supremum*
32. Diameter of oogonium 36–42μ.....192. *Oe. wabashense*
32. Diameter of oogonium 42–55μ..... 33
32. Diameter of oogonium 55–58μ...189a. *Oe. obtruncatum* var. *completum*
33. Length of oogonium 56–68μ.....189. *Oe. obtruncatum*
33. Length of oogonium 68–75μ.....189b. *Oe. obtruncatum* var. *ellipsoideum*
34. Vegetative cell 2–3μ in diameter.....203. *Oe. fusus**
34. Vegetative cell 4–6μ in diameter.....210. *Oe. virceburgense**
34. Vegetative cell 6–13μ in diameter.....211. *Oe. spurium**
35. Diameter of vegetative cell not more than 2μ.....197. *Oe. angustissimum**
35. Diameter of vegetative cell 2–60μ..... 36
35. Diameter of vegetative cell (56–) 60–93μ.....268
36. Without dwarf males..... 37
36. With dwarf males.....186
37. Oogonium opening by a pore..... 38
37. Oogonium opening by a lid.....139
38. Pore median..... 39
38. Pore supramedian (rarely varying to superior)..... 51
38. Pore superior†..... 63

*See footnote, page 53.
†Some variations of *Oe. varians* may be sought here.

39. Wall of oospore smooth 40
39. Wall of oospore scrobiculate 49
39. Wall of oospore echinate 50
40. Monoecious 41
40. Dioecious 44
41. Diameter of oogonium 18–28μ 42
41. Diameter of oogonium 32–38μ ..... 1. *Oe. laeve*
42. Filament irregularly curved ..... 2. *Oe. curvum*
42. Filament straight 43
43. Oogonium 23–28 × 26–31μ ..... 3. *Oe. cryptoporum*
43. Oogonium 18–25 × 18–26μ ..... 3a. *Oe. cryptoporum* var. *vulgare*
44. Diameter of oogonium 22–27μ 45
44. Diameter of oogonium 27–32μ 47
44. Diameter of oogonium 30–39μ 48
45. Diameter of vegetative cell 5–10μ 46
45. Diameter of vegetative cell 8–13μ ..... 4b. *Oe. rufescens* var. *lundellii*
46. Diameter of vegetative cell 5–9μ 4a. *Oe. rufescens* var. *exiguum*
46. Diameter of vegetative cell 8–10μ ..... 4. *Oe. rufescens*
47. Diameter of vegetative cell 9–11μ .....218a. *Oe. inerme* var. *mentiens**
47. Diameter of vegetative cell 11–14μ ..... 5. *Oe. calcareum*
48. Oospore 28–35 × 28–35μ ..... 6. *Oe. sociale*
48. Oospore 33–38 × 28–32μ .....218. *Oe. inerme**
49. Monoecious ..... 7. *Oe. cymatosporum*
49. Dioecious (very rarely monoecious) ..... 8. *Oe. magnusii*
50. Diameter of vegetative cell 9–14μ ..... 9. *Oe. suecicum*
50. Diameter of vegetative cell 14–16μ, 9a. *Oe. suecicum* f. *australe*
51. Oospore scrobiculate, 22–27μ in diameter .....217. *Oe. moniliforme**
51. Oospore scrobiculate, 43–48μ in diameter, 66a. *Oe. argenteum* f. *michiganense*
51. Oospore smooth 52
52. Monoecious 53
52. Dioecious 58
52. Both monoecious and dioecious ..... 10. *Oe. varians*
53. Pore a little above median 54
53. Pore nearly superior 56
53. Pore variable between these two positions 57
54. Diameter of oogonium 34–45μ 55
54. Diameter of oogonium 46–55μ ..... 11. *Oe. urbicum*
55. Oospore depressed-globose, 30–34 × 28–32μ ..... 12. *Oe. obsoletum*
55. Oospore regularly globose, 30–39 × 30–39μ ..... 13. *Oe. plusiosporum*
56. Oospore 31–41 × 30–41μ ..... 10. *Oe. varians*
56. Oospore 40–48 × 40–48μ ..... 14. *Oe. tyrolicum*
57. Terminal cell narrowed and often setiferous .....225. *Oe. inflatum**
57. Terminal cell neither narrowed nor setiferous ..... 11. *Oe. urbicum*
58. Pore a little above median 59
58. Pore nearly superior 60
58. Pore variable between these two positions 62
59. Vegetative cell 1–3 diameters long .... 15b. *Oe. cardiacum* f. *pulchellum*
59. Vegetative cell 3–7 diameters long ..... 15. *Oe. cardiacum*
60. Diameter of vegetative cell 8–12μ ..... 16. *Oe. franklinianum*
60. Diameter of vegetative cell 12–16μ ..... 10. *Oe. varians*
60. Diameter of vegetative cell 14–30μ 61
61. Oospore depressed-globose, 31–42μ in diameter, 15d. *Oe. cardiacum* var. *minus*
61. Oospore subglobose, 42–49μ in diameter ..... 17. *Oe. glabrum*
61. Oospore globose, 43–58μ in diameter .. 15a. *Oe. cardiacum* f. *interjectum*
61. Oospore ellipsoid-globose, 40–52μ in diameter, 15c. *Oe. cardiacum* var. *carbonicum*
62. Oospore not filling oogonium .....225. *Oe. inflatum**
62. Oospore completely filling oogonium ..... 18. *Oe. lautumniarum*

*See footnote, page 53.

63. Wall of oospore smooth 64
63. Wall of oospore longitudinally ribbed 116
63. Wall of oospore areolate 129
63. Wall of oospore reticulate 131
63. Wall of oospore pitted 132
63. Wall of oospore scrobiculate 133
64. Monoecious 65
64. Dioecious 83
64. Reproductive structures imperfectly known 113
65. Diameter of vegetative cell 8–34μ 66
65. Diameter of vegetative cell 33–54μ 80
66. Diameter of oogonium 32–36 (–40)μ 67
66. Diameter of oogonium 36–63μ 70
66. Diameter of oogonium 63–68μ ... 29a. *Oe. upsaliense* var. *fennicum*
67. Vegetative cell 8–14μ in diameter 68
67. Vegetative cell 15–18μ in diameter ..... 19. *Oe. intermedium*
68. Length of oogonium 32–46μ 69
68. Length of oogonium about 53μ ..... 226. *Oe. warmingianum**
69. Oospore 28–31μ in diameter ..... 20. *Oe. hirnii*
69. Oospore 30–37 (–40)μ in diameter ..... 21. *Oe. globosum*
70. Plant few celled when mature 71
70. Plant many celled when mature 72
71. Antheridium single, alternating with vegetative cell. 22. *Oe. zigzag*
71. Antheridium 1–4, in series ..... 23. *Oe. curtum*
72. Oospore globose to subglobose 73
72. Oospore obovoid to ellipsoid 77
73. Diameter of vegetative cell 12–19μ 74
73. Diameter of vegetative cell 19–34μ 76
74. Oospore completely filling oogonium 75
74. Oospore not filling oogonium .... 19a. *Oe. intermedium* var. *fennicum*
75. Antheridium 1–3 ..... 24. *Oe. fragile*
75. Antheridium 3–6 ..... 24a. *Oe. fragile* var. *abyssinicum*
76. Oogonium usually globose ..... 24b. *Oe. fragile* var. *robustum*
76. Oogonium usually ovoid ..... 25. *Oe. vaucherii*
77. Division of antheridium horizontal ..... 26. *Oe. richterianum*
77. Division of antheridium vertical 78
78. Vegetative cell 8–14μ in diameter ..... 27. *Oe. pseudoboscii*
78. Vegetative cell 14–24μ in diameter 79
79. Oogonium 40–44 × 70–80μ ..... 28. *Oe. sodiroanum*
79. Oogonium 45–50 × 66–100μ ..... 29. *Oe. upsaliense*
79. Oogonium 48–55 × 65–80μ ..... 30. *Oe. oviforme*
80. Diameter of oogonium 53–67μ 81
80. Diameter of oogonium 68–95μ 82
81. Diameter of vegetative cell 37–48μ ..... 31. *Oe. geniculatum*
81. Diameter of vegetative cell 50–54μ ..... 32. *Oe. suboctangulare*
82. Diameter of vegetative cell 33–37μ ..... 33. *Oe. martinicense*
82. Diameter of vegetative cell 44–52μ ..... 34. *Oe. kurzii*
83. Diameter of vegetative cell 11–13μ ..... 223. *Oe. lageniforme**
83. Diameter of vegetative cell 14–56μ 84
84. Oogonium scarcely exceeding vegetative cell in diameter 85
84. Oogonium noticeably exceeding vegetative cell in diameter 86
85. Oospore globose to cylindric-globose ..... 35. *Oe. capillare*
85. Oospore cylindric-globose to subcylindrical, 35a. *Oe. capillare* f. *stagnale*
85. Oospore subrectangular-ellipsoid ..... 32. *Oe. suboctangulare*
86. Oospore globose, subglobose, or cylindric-globose 87
86. Oospore ellipsoid, obovoid, subcylindrical, or subellipsoid 95
87. Male filament of same diameter as female 88
87. Male filament smaller than female 90
88. Oogonium 36–42μ in diameter ... 36a. *Oe. plagiostomum* var. *gracilius*
88. Oogonium 42–49μ in diameter ..... 36. *Oe. plagiostomum*
88. Oogonium 54–63μ in diameter 89

*See footnote, page 53.

89. Vegetative cell 16–26 × 112–250μ ..... 17. *Oe. glabrum*
89. Vegetative cell 33–42 × 42–130μ ..... 38. *Oe. princeps*
90. Diameter of male vegetative cell 18–33μ 91
90. Diameter of male vegetative cell 34–50μ 94
91. Oospore usually ellipsoid to cylindric-globose ..... 37. *Oe. capilliforme*
91. Oospore usually globose to subglobose 92
92. Division of antheridium horizontal 93
92. Division of antheridium vertical ..... 39. *Oe. biforme*
93. Oogonium 40–53 × 40–65μ ..... 37b. *Oe. capilliforme* f. *lorentzii*
93. Oogonium 46–57 × 52–64 (–80)μ ..... 37a. *Oe. capilliforme* f. *debaryanum*
93. Oogonium 36–53 × 43–60μ ..... 37c. *Oe. capilliforme* var. *australe*
94. Oogonium 46–56μ in diameter ..... 37d. *Oe. capilliforme* var. *diversum*
94. Oogonium 54–65μ in diameter ..... 40. *Oe. anomalum*
94. Oogonium 70–85μ in diameter ..... 42. *Oe. rivulare*
95. Diameter of oogonium 35–63 (–68)μ 96
95. Diameter of oogonium (60–) 63–90μ 106
96. Male filament larger than female ..... 43. *Oe. pachyandrium*
96. Male filament not larger than female 97
97. Vegetative cell 1–3 diameters long 98
97. Vegetative cell 2–6 diameters long 100
97. Vegetative cell 3–11 diameters long 102
98. Oospore 40–60μ long ..... 35a. *Oe. capillare* f. *stagnale*
98. Oospore 60–80μ long 99
99. Diameter of oospore 41–51μ ..... 209. *Oe. oryzæ**
99. Diameter of oospore 40–56μ ..... 209a. *Oe. oryzæ* var. *seriosporum**
99. Diameter of oospore 51–60μ ..... 44. *Oe. mexicanum*
100. Cell diameter of male filament 18–28μ 101
100. Cell diameter of male filament 28–33μ ..... 45. *Oe. grande*
100. Cell diameter of male filament 32–42μ, 45d. *Oe. grande* var. *majus*
101. Oogonium usually obovoid ..... 45b. *Oe. grande* var. *aequatoriale*
101. Oogonium usually subobovoid ..... 39. *Oe. biforme*
102. Division of antheridium horizontal, 15c. *Oe. cardiacum* var. *carbonicum*
102. Division of antheridium vertical 103
103. Oogonium usually obovoid ..... 46. *Oe. oboviforme*
103. Oogonium usually cylindric-obovoid ..... 39. *Oe. biforme*
103. Oogonium usually subovoid or ellipsoid-ovoid 104
104. Diameter of oogonium 42–52μ ..... 45c. *Oe. grande* var. *angustum*
104. Diameter of oogonium 49–68μ 105
105. Diameter of vegetative cell 20–27μ ..... 45a. *Oe. grande* f. *gemelliparum*
105. Diameter of vegetative cell 28–37μ ..... 45. *Oe. grande*
105. Diameter of vegetative cell 36–46μ ..... 45d. *Oe. grande* var. *majus*
106. Oospore conspicuously not filling oogonium ..... 42. *Oe. rivulare*
106. Oospore nearly or quite filling oogonium 107
107. Vegetative cell 1–6 diameters long 108
107. Vegetative cell 6–10 diameters long ..... 47. *Oe. subrectum*
108. Cell diameter of male filament 30–37μ 109
108. Cell diameter of male filament 36–50μ 110
109. Oospore obovoid to ellipsoid ..... 48. *Oe. landsboroughi*
109. Oospore ellipsoid to globose-ellipsoid ..... 49. *Oe. crassum*
110. Length of oospore 77–100μ 111
110. Length of oospore 100–125μ ..... 49b. *Oe. crassum* var. *longum*
111. Diameter of oogonium 64–73μ ..... 48a. *Oe. landsboroughi* var. *norvegicum*
111. Diameter of oogonium 75–90μ 112
112. Vegetative cell 1–3 diameters long, 49a. *Oe. crassum* f. *amplum*
112. Vegetative cell 3–5 diameters long, 49c. *Oe. crassum* var. *subtumidum*
113. Diameter of vegetative cell 6–24 (–27)μ 114
113. Diameter of vegetative cell 24–42μ 115

*See footnote, page 53.

114. Oogonium about 35 × 53μ.....226. *Oe. warmingianum**
114. Oogonium 33–36 × 48–63μ.....223. *Oe. lageniforme**
114. Oogonium 37–49 × 54–76μ.....225. *Oe. inflatum**
115. Oogonium 43–55 × 45–95μ.....209. *Oe. oryzæ**
115. Oogonium 42–60 × 43–99μ.....209a. *Oe. oryzæ* var. *seriosporum**
116. Outer oospore wall ribbed externally..... 50. *Oe. exocostatum*
116. Middle oospore wall ribbed externally.....117
117. Ribs continuous and entire.....118
117. Ribs granulate, crenate, crenulate, or pitted.....126
117. Ribs dentate..... 57b. *Oe. crenulatocostatum* var. *aureum*
118. Ribs 15–22 in number.....119
118. Ribs 26–35 in number.....120
118. Ribs 35–45 in number..... 51. *Oe. kjellmanii*
119. Vegetative cell 10–15μ in diameter..... 52. *Oe. paulense*
119. Vegetative cell 24–30μ in diameter.....220. *Oe. urceolatum**
120. Monoecious.....121
120. Dioecious.....123
121. Oospore completely filling oogonium.....122
121. Oospore not filling oogonium..... 53b. *Oe. paludosum* var. *parvisporum*
122. Oogonium 39–48μ in diameter..... 53. *Oe. paludosum*
122. Oogonium 54–63μ in diameter... 53a. *Oe. paludosum* var. *americanum*
123. Oospore usually completely filling oogonium..... 54. *Oe. leiopleurum*
123. Oospore usually not filling oogonium.....124
124. Oospore ellipsoid.....125
124. Oospore ellipsoid-globose, rarely subglobose, 55a. *Oe. boscii* f. *dispar*
124. Oospore ellipsoid-obovoid or obovoid, 55b. *Oe. boscii* var. *notabile*
125. Diameter of oogonium 33–38μ..... 55c. *Oe. boscii* var. *occidentale*
125. Diameter of oogonium 39–51μ..... 55. *Oe. boscii*
126. Ribs 14–20 in number.....127
126. Ribs 30–35 in number..... 56. *Oe. margaritiferum*
126. Ribs 35–45 in number..... 51. *Oe. kjellmanii*
127. Ribs crenulate.....128
127. Ribs crenate..... 57c. *Oe. crenulatocostatum* var. *longiarticulatum*
128. Ribs distinctly crenulate..... 57. *Oe. crenulatocostatum*
128. Ribs scarcely crenulate.. 57a. *Oe. crenulatocostatum* f. *cylindricum*
129. Dioecious.....130
129. Monoecious..... 58. *Oe. arcyosporum*
130. Diameter of oogonium 30–35μ. 57b. *Oe. crenulatocostatum* var. *aureum*
130. Diameter of oogonium 48–60μ..... 59. *Oe. areolatum*
130. Diameter of oogonium 66–72μ.....214. *Oe. hoehnei**
131. Oogonium 33–40 × 38–46μ..... 60. *Oe. dictyosporum*
131. Oogonium about 42 × 52μ..... 60a. *Oe. dictyosporum* f. *westii*
132. Oogonium 35–38 × 53–58μ.....216. *Oe. capense**
132. Oogonium 53–69 × 67–106μ.....215. *Oe. giganteum**
133. Monoecious..... 61. *Oe. foveolatum*
133. Dioecious.....134
134. Diameter of vegetative cell 11–25μ.....135
134. Diameter of vegetative cell 25–48μ.....138
135. Suffultory cell enlarged.....136
135. Suffultory cell not enlarged.....137
136. Diameter of oogonium 40–48μ..... 62. *Oe. scrobiculatum*
136. Diameter of oogonium 56–58μ..... 63. *Oe. verrucosum*
136. Diameter of oogonium 64–76μ..... 64. *Oe. tiffanii*
137. Diameter of oogonium 38–45μ..... 65. *Oe. punctatum*
137. Diameter of oogonium 45–53μ..... 66. *Oe. argenteum*
137. Diameter of oogonium 51–64μ..... 67. *Oe. wylici*
138. Length of oogonium 48–70μ..... 68. *Oe. americanum*
138. Length of oogonium 78–113μ..... 69. *Oe. taphrosporum*

*See footnote, page 53.

WITHOUT DWARF MALES; OPERCULATE OOGONIUM, CYLINDRICAL VEGETATIVE CELLS.

139. Wall of oospore echinate....212. *Oe. velatum**
139. Wall of oospore punctate-granulate....109a. *Oe. crispum* f. *granulosum*
139. Wall of oospore longitudinally ribbed....140
139. Wall of oospore smooth....145
140. Division of oogonium superior....141
140. Division of oogonium supreme....70. *Oe. pseudacrosporum*
141. Ribs 15–23 in number....142
141. Ribs 30–50 in number....143
142. Diameter of oogonium 48–52μ....71a. *Oe. paucocostatum* var. *gracilis*
142. Diameter of oogonium 54–60μ....71. *Oe. paucocostatum*
142. Diameter of oogonium 59–74μ....72. *Oe. australianum*
143. Dioecious....73. *Oe. tumidulum*
143. Monoecious....144
143. Reproductive structures imperfectly known....219. *Oe. sol**
144. Oospore 48–55 × 50–58μ....74. *Oe. nobile*
144. Oospore 58–59 × 72–80μ....74a. *Oe. nobile* var. *minus*
144. Oospore 65–75 × 88–104μ....75. *Oe. insigne*
145. Oogonium without projections....146
145. Oogonium with projections....184
146. Oospore with a median constriction....147
146. Oospore without a median constriction....148
147. Oogonium medianly plicate....76. *Oe. excisum*
147. Oogonium not medianly plicate....200. *Oe. pusillum**
148. Division of oogonium median....149
148. Division of oogonium supramedian....155
148. Division of oogonium superior....157
148. Division of oogonium inferior....77. *Oe. inversum*
148. Division of oogonium basal....78. *Oe. infimum*
149. Diameter of oogonium 13–20μ....150
149. Diameter of oogonium 20–30μ....151
149. Diameter of oogonium 30–40μ....152
150. Oogonium 13–15 × 18–23μ....198. *Oe. inconspicuum**
150. Oogonium 14–15 × 31–35μ....203. *Oe. fusus**
150. Oogonium 15–19 × 18–23μ....196. *Oe. tapeinosporum**
151. Division of oogonium narrow....101. *Oe. gunnii*
151. Division of oogonium wide....224. *Oe. poecilosporum**
152. Dioecious....153
152. Monoecious....154
153. Diameter of oogonium 29–33μ....79. *Oe. howardii*
153. Diameter of oogonium 33–40μ....80. *Oe. pratense*
154. Oogonium subglobose....82. *Oe. acmandrium*
154. Oogonium pyriform-globose....83. *Oe. psaegmatosporum*
155. Dioecious....89. *Oe. mitratum*
155. Monoecious....90. *Oe. petri*
155. Antheridium not known....156
156. Oogonium 15–20 × 15–23μ....210. *Oe. virceburgense**
156. Oogonium 27–28 × 26–28μ....222. *Oe. consociatum**
157. Dioecious....158
157. Monoecious....165
157. Both dioecious and monoecious....91. *Oe. trioicum*
157. Reproductive structures imperfectly known....183
158. Diameter of oogonium 13–16μ....91. *Oe. trioicum*
158. Diameter of oogonium 16–43μ....159
158. Diameter of oogonium 43–50μ....92. *Oe. welwitschii*
158. Diameter of oogonium 52–60μ....93. *Oe. iowense*
158. Diameter of oogonium about 82μ....94. *Oe. dioicum*
159. Oospore globose to subglobose....160
159. Oospore ellipsoid, ovoid, or oblong....162

*See footnote, page 53.

160. Vegetative cell 1–3 diameters long, 95a. *Oe. pringsheimii* var. *abbreviatum*
160. Vegetative cell 2–5 diameters long 161
161. Female vegetative cell 10–15μ in diameter, 95b. *Oe. pringsheimii* var. *nordstedtii*
161. Female vegetative cell 14–20μ in diameter ..... 95. *Oe. pringsheimii*
162. Diameter of oogonium 16–20μ ... 99a. *Oe. pisanum* var. *gracilis*
162. Diameter of oogonium 23–29μ 163
162. Diameter of oogonium 28–33μ ..... 202. *Oe. sancti thomæ**
163. Oospore filling oogonium longitudinally 164
163. Oospore not filling oogonium longitudinally ..... 97. *Oe. porrectum*
164. Basal cell elongate ..... 99. *Oe. pisanum*
164. Basal cell subhemispherical ..... 98. *Oe. nanum*
165. Oogonium pyriform to subpyriform 166
165. Oogonium obovoid-globose to subglobose 169
165. Oogonium ellipsoid to oblong 177
166. Diameter of vegetative cell 8–11μ 167
166. Diameter of vegetative cell 11–13μ ..... 102. *Oe. simplex*
166. Diameter of vegetative cell 13–16μ ..... 100. *Oe. pyriforme*
167. Diameter of oogonium 23–30μ 168
167. Diameter of oogonium 30–33μ ..... 103. *Oe. pyrulum*
167. Diameter of oogonium 34–40μ ..... 103a. *Oe. pyrulum* var. *amplius*
168. Oospore subglobose, 22–26 $\times$ 21–24μ ..... 104. *Oe. loricatum*
168. Oospore globose, 25–29μ in diameter ..... 106. *Oe. pithophoræ*
169. Diameter of vegetative cell 8–16μ 170
169. Diameter of vegetative cell 16–20μ ..... 107. *Oe. autumnale*
169. Diameter of vegetative cell 20–27μ 176
170. Oospore not filling oogonium 171
170. Oospore filling oogonium 172
171. Diameter of oogonium 30–38μ ..... 109d. *Oe. crispum* var. *hawaiense*
171. Diameter of oogonium 40–43μ ..... 108. *Oe. obesum*
172. Diameter of oogonium 23–28μ ..... 104. *Oe. loricatum*
172. Diameter of oogonium 30–38μ 173
172. Diameter of oogonium 38–50μ 174
173. Vegetative cell 1–3 diameters long ... 109e. *Oe. crispum* var. *uruguayense*
173. Vegetative cell 3–5 diameters long ... 109c. *Oe. crispum* var. *gracilescens*
174. Oogonium obovoid-globose 175
174. Oogonium subglobose ..... 109a. *Oe. crispum* f. *granulosum*
175. Diameter of oogonium 38–45μ ..... 109. *Oe. crispum*
175. Diameter of oogonium 40–50μ ..... 109b. *Oe. crispum* f. *inflatum*
176. Diameter of oogonium 44–49μ ... 110a. *Oe. rupestre* f. *pseudautumnale*
176. Diameter of oogonium 48–58μ ..... 110. *Oe. rupestre*
177. Diameter of oogonium 9–14μ ..... 201. *Oe. selandiæ**
177. Diameter of oogonium 13–19μ 178
177. Diameter of oogonium 20–28μ 179
177. Diameter of oogonium 35–42μ ..... 111. *Oe. ahlstrandii*
177. Diameter of oogonium 50–70μ ..... 112. *Oe. pachydermum*
178. Length of oogonium 25–28μ ..... 91. *Oe. trioicum*
178. Length of oogonium 34–40μ ..... 114. *Oe. gracillimum*
179. Oospore nearly or quite filling oogonium 180
179. Oospore not filling oogonium longitudinally 181
180. Vegetative cell 7–9 $\times$ 11–36μ ..... 115. *Oe. oblongellum*
180. Vegetative cell 8–15 $\times$ 16–60μ ..... 113. *Oe. kirchneri*
181. Oospore oblong-ellipsoid ..... 114a. *Oe. gracillimum* f. *majus*
181. Oospore globose ..... 116b. *Oe. oblongum* f. *sphaericum*
181. Oospore ellipsoid 182
182. Diameter of oogonium 20–26μ ..... 116. *Oe. oblongum*
182. Diameter of oogonium 26–28μ ... 116a. *Oe. oblongum* f. *majus*
183. Diameter of oogonium 9–14μ ..... 201. *Oe. selandiæ**
183. Diameter of oogonium 28–33μ ..... 202. *Oe. sancti thomæ**
183. Diameter of oogonium 35–44μ ..... 204. *Oe. rhodosporum**
183. Diameter of oogonium 40–45μ ..... 205. *Oe. vesicatum**
183. Diameter of oogonium 40–50μ ..... 206. *Oe. montagnei**

184. Oogonium with mammiform projections....118. *Oe. mammiferum*
184. Oogonium with conically obtuse projections....185
184. Oogonium with projections intermediate between the two above, 117a. *Oe. itzigsohnii* f. *heteromorphum*
185. Diameter of vegetative cell 5–7μ....117b. *Oe. itzigsohnii* var. minus
185. Diameter of vegetative cell 8–10μ....117. *Oe. itzigsohnii*

DIOECIOUS, NANNANDROUS, WITH CYLINDRICAL VEGETATIVE CELLS.

186. Oogonium opening by a pore....187
186. Oogonium opening by a lid....228
187. Pore median, or a little above median....188
187. Pore inframedian....123a. *Oe. hystrix* var. *canadense*
187. Pore supramedian....201
187. Pore superior....202
187. Pore inferior....226
188. Wall of oospore echinate....189
188. Wall of oospore punctate....120. *Oe. nebraskense*
188. Wall of oospore spirally ribbed....194
188. Wall of oospore smooth....197
189. Spines more than 5μ in length....124a. *Oe. echinospermum* var. *horridum*
189. Spines less than 5μ in length....190
190. Suffultory cell enlarged....122. *Oe. hystricinum*
190. Suffultory cell not or very slightly enlarged....191
191. Diameter of vegetative cell 7–13μ....121. *Oe. aster*
191. Diameter of vegetative cell 12–16μ....125. *Oe. pungens*
191. Diameter of vegetative cell 17–30μ....192
192. Diameter of oogonium 36–38μ....123b. *Oe. hystrix* var. *subglobosum*
192. Diameter of oogonium 38–50μ....193
193. Oospore globose....124. *Oe. echinospermum*
193. Oospore ellipsoid....123. *Oe. hystrix*
194. Suffultory cell enlarged....195
194. Suffultory cell not enlarged....196
195. Oogonium 40–44μ in diameter....126. *Oe. exospirale*
195. Oogonium 51–60μ in diameter....127. *Oe. illinoisense*
196. Diameter of oospore 37–45μ....128a. *Oe. spirale* var. *acutum*
196. Diameter of oospore 46–56μ....128. *Oe. spirale*
197. Oospore globose to subglobose....198
197. Oospore sexangular-ellipsoid....200
197. Oospore ovoid....132b. *Oe. braunii* var. *zehneri*
198. Vegetative cell 8–9μ in diameter....129. *Oe. depressum*
198. Vegetative cell 9–12μ in diameter....130. *Oe. semiapertum*
198. Vegetative cell 12–23μ in diameter....199
199. Diameter of oogonium 23–30μ....132a. *Oe. braunii* var. *hafniense*
199. Diameter of oogonium 30–37μ....132. *Oe. braunii*
199. Diameter of oogonium 43–48μ....131. *Oe. gallicum*
199. Diameter of oogonium 49–52μ....133. *Oe. flavescens*
200. Diameter of oogonium 19–30μ....135a. *Oe. sexangulare* var. *angulosum*
200. Diameter of oogonium 29–33μ....135. *Oe. sexangulare*
200. Diameter of oogonium 36–42μ....135b. *Oe. sexangulare* var. *majus*
201. Oospore wall punctate....120. *Oe. nebraskense*
201. Oospore wall spirally ribbed....128b. *Oe. spirale* var. *latviense*
201. Oospore wall smooth....143a. *Oe. multisporum* var. *magnum*
201. Oospore wall echinate....134. *Oe. manschuricum*
202. Oospore wall smooth....203
202. Oospore wall dentate....136. *Oe. stellatum*
202. Oospore wall spirally ribbed....128b. *Oe. spirale* var. *latviense*
202. Oospore wall echinate....215
202. Oospore wall longitudinally ribbed....218
202. Oospore wall pitted....225

*See footnote, page 53.

203. Suffultory cell enlarged....204
203. Suffultory cell not enlarged....207
204. Diameter of oogonium 35–50μ....205
204. Diameter of oogonium 53–60μ...138a. *Oe. borisianum* var. *westii*
204. Diameter of oogonium 65–80μ....206
205. Vegetative cell 12–15 × 60–120μ....137. *Oe. silvaticum*
205. Vegetative cell 15–23 × 45–150μ....138. *Oe. borisianum*
206. Suffultory cell 26–40μ in diameter....139. *Oe. alternans*
206. Suffultory cell about 44μ in diameter....140. *Oe. kitutæ*
207. Diameter of vegetative cell 10–20μ....208
207. Diameter of vegetative cell 21–40μ....210
208. Oogonium 24–35μ in diameter....143. *Oe. multisporum*
208. Oogonium 35–45μ in diameter....209
209. Oospore globose....144. *Oe. irregulare*
209. Oospore depressed-globose....144a. *Oe. irregulare* var. *condensatum*
210. Diameter of oogonium 39–60μ....211
210. Diameter of oogonium 65–80μ....139. *Oe. alternans*
211. Vegetative cell 1–3 diameters long....212
211. Vegetative cell 3–6 diameters long....214
212. Oospore not filling oogonium....141. *Oe. victoriense*
212. Oospore nearly or quite filling oogonium....213
213. Oogonium 39–54 × 42–65μ....142a. *Oe. crassiusculum* var. *arechavaletæ*
213. Oogonium 55–60 × 60–75μ....142c. *Oe. crassiusculum* var. *cataractum*
214. Gynandrosporous....142. *Oe. crassiusculum*
214. Idioandrosporous....142b. *Oe. crassiusculum* var. *idioandrosporum*
215. Spines arranged spirally....216
215. Spines not arranged spirally....217
216. Diameter of antheridium 6–9μ....136. *Oe. stellatum*
216. Diameter of antheridium 9–10μ.145a. *Oe. donnellii* var. *wittrockiana*
216. Diameter of antheridium 14–15μ....145. *Oe. donnellii*
217. Diameter of oogonium 29–33μ....146. *Oe. armigerum*
217. Diameter of oogonium 35–36μ....147. *Oe. echinatum*
217. Diameter of oogonium 46–57μ....148. *Oe. lindmanianum*
218. Ribs 16–25 in number....219
218. Ribs 25–40 in number....223
219. Oogonium 45–50μ in diameter....149a. *Oe. cyathigerum* f. *americanum*
219. Oogonium 48–65μ in diameter....220
219. Oogonium 65–81μ in diameter....149c. *Oe. cyathigerum* f. *perfectum*
220. Oospore usually completely filling oogonium....221
220. Oospore incompletely filling oogonium, 149d. *Oe. cyathigerum* var. *ellipticum*
221. Dwarf male 47–58μ in length....222
221. Dwarf male 60–75μ in length....149b. *Oe. cyathigerum* f. *ornatum*
222. Diameter of oogonium 48–57μ.149e. *Oe. cyathigerum* var. *hormosporum*
222. Diameter of oogonium 57–66μ....149. *Oe. cyathigerum*
223. Ribs crenulate....150a. *Oe. wolleanum* var. *concinnum*
223. Ribs entire....224
224. Ribs 25–35 in number....150. *Oe. wolleanum*
224. Ribs 35–40 in number....150b. *Oe. wolleanum* f. *insigne*
225. Pits more or less in longitudinal rows....151. *Oe. concatenatum*
225. Pits not in longitudinal rows....151a. *Oe. concatenatum* f. *hutchinsiæ*
225. Pits in vertical and transverse rows.151b. *Oe. concatenatum* var. *rectangulare*
226. Oospore ribbed....152. *Oe. huntii*
226. Oospore echinate....153. *Oe. hispidum*
226. Oospore dentate....227
227. Oogonium 47–60 × 48–63μ....154. *Oe. cleveanum*
227. Oogonium 39–46μ × 40–47μ....154a. *Oe. cleveanum* f. *exoticum*
228. Division of oogonium median....229
228. Division of oogonium supramedian....233
228. Division of oogonium inframedian....236
228. Division of oogonium superior....240
228. Division of oogonium supreme‡....261

‡Some forms of *Oe. ciliatum* may be sought here.

229. Oogonium longitudinally plicate....230
229. Oogonium not longitudinally plicate....231
230. Diameter of oogonium 16–18μ...233a. *Oe. crenulatum* var. *gracilius**
230. Diameter of oogonium 25–27μ....233. *Oe. crenulatum**
231. Diameter of oogonium 13–16μ....168. *Oe. longicolle*
231. Diameter of oogonium 16–20μ....168a. *Oe. longicolle* var. *senegalense*
231. Diameter of oogonium 21–26μ....169. *Oe. rothii*
231. Diameter of oogonium 25–31μ....232
231. Diameter of oogonium 30–38μ....171. *Oe. decipiens*
231. Diameter of oogonium 39–46μ....172. *Oe. macrospermum*
231. Diameter of oogonium 89–100μ....162. *Oe. perspicuum*
232. Gynandrosporous....171c. *Oe. decipiens* var. *bernardense*
232. Idioandrosporous....171b. *Oe. decipiens* var. *africanum*
233. Oogonium with verticillate folds....234
233. Oogonium without verticillate folds....235
234. Diameter of oogonium 23–28μ....229. *Oe. plicatulum**
234. Diameter of oogonium 50–55μ....173. *Oe. costatum*
234. Diameter of oogonium 58–65μ....174. *Oe. boreale*
235. Vegetative cell 4–7μ in diameter....170. *Oe. danicum*
235. Vegetative cell 13–24μ in diameter....175. *Oe. mirandrium*
236. Oogonium plicate....237
236. Oogonium not plicate....176. *Oe. contortum*
237. Suffultory cell enlarged....238
237. Suffultory cell not enlarged....239
238. Diameter of oogonium 23–26μ....232. *Oe. pulchrum**
238. Diameter of oogonium 28–32μ...167b. *Oe. platygynum* var. *continuum*
239. Oogonium 16–23μ in diameter....230. *Oe. lagerstedtii**
239. Oogonium 23–29μ in diameter....231. *Oe. uleanum**
240. Oospore wall smooth....241
240. Oospore wall pitted....177. *Oe. schmidlei*
240. Oospore wall echinate....212. *Oe. velatum**
240. Oospore wall scrobiculate....258
241. Vegetative cell 3–8μ in diameter....242
241. Vegetative cell 8–32μ in diameter....245
242. Diameter of oogonium 14–20μ....243
242. Diameter of oogonium 19–23μ...179b. *Oe. rugulosum* f. *rotundatum*
243. Oospore 15–20μ in length....244
243. Oospore 19–25μ in length....179. *Oe. rugulosum*
244. Oogonium ovoid to ellipsoid....178. *Oe. longatum*
244. Oogonium obovoid to ovoid-ellipsoid, 179a. *Oe. rugulosum* f. *minutum*
245. Oospore globose or subglobose....246
245. Oospore ellipsoid or subellipsoid....253
246. Suffultory cell enlarged....247
246. Suffultory cell not enlarged....248
247. Diameter of vegetative cell 9–15μ....180. *Oe. hians*
247. Diameter of vegetative cell 13–20μ....175. *Oe. mirandrium*
248. Vegetative cell ¾ to 2½ diameters long....249
248. Vegetative cell 2 to 3 diameters long, 184e. *Oe. macrandrium* var. *hohenackerii*
248. Vegetative cell 2½ to 6 diameters long....250
248. Vegetative cell 6 to 14 diameters long....181. *Oe. hoersholmiense*
249. Diameter of vegetative cell 12–14μ....182. *Oe. laetevirens*
249. Diameter of vegetative cell 13–21μ....184c. *Oe. macrandrium* f. *lundense*
249. Diameter of vegetative cell 21–29μ....183. *Oe. pluviale*
250. Length of oogonium 28–44μ....251
250. Length of oogonium 44–55μ....252
251. Oogonium usually single or in two's...184d. *Oe. macrandrium* var. *propinquum*
251. Oogonium usually in groups of 2 to 6..184b. *Oe. macrandrium* f. *aemulans*
252. Oospore 31–37 × 33–39μ....184. *Oe. macrandrium*
252. Oospore 35–40 × 36–45μ....184a. *Oe. macrandrium* f. *acuminatum*

*See footnote, page 53.

253. Diameter of vegetative cell 7–12μ.....181. *Oe. hoersholmiense*
253. Diameter of vegetative cell 14–32μ.....254
254. Terminal cell setiform.....185. *Oe. ciliatum*
254. Terminal cell not setiform.....255
255. Diameter of oospore 27–32μ.....207. *Oe. flexuosum**
255. Diameter of oospore 32–42μ.....256
255. Diameter of oospore 41–48μ.....186. *Oe. spectabile*
256. Vegetative cell ¾ to 3 diameters long.....257
256. Vegetative cell 3 to 5 diameters long.....187. *Oe. implexum*
257. Oogonium globose-obovoid.....208. *Oe. fonticola**
257. Oogonium subglobose.....183. *Oe. pluviale*
258. Diameter of oogonium 30–39μ.....259
258. Diameter of oogonium 40–50μ.....260
258. Diameter of oogonium 56–68μ...188b. *Oe. monile* var. *eminens*
259. Suffultory cell tumid.....188. *Oe. monile*
259. Suffultory cell not tumid.....184f. *Oe. macrandrium* var. *scrobiculatum*
260. Suffultory cell 27–28μ in diameter.188c. *Oe. monile* f. *victoriense*
260. Suffultory cell 35–38μ in diameter.188a. *Oe. monile* f. *borgei*
261. Oospore wall smooth.....262
261. Oospore wall longitudinally ribbed.....264
262. Diameter of oogonium 30–36μ.....181. *Oe. hoersholmiense*
262. Diameter of oogonium 42–55μ.....263
262. Diameter of oogonium 55–58μ...189a. *Oe. obtruncatum* var. *completum*
263. Length of oogonium 56–68μ.....189. *Oe. obtruncatum*
263. Length of oogonium 68–75μ.....189b. *Oe. obtruncatum* var. *ellipsoideum*
264. Ribs 11–17 in number.....195b. *Oe. acrosporum* var. *bathmidosporum*
264. Ribs 23–30 in number.....265
264. Ribs 40–45 in number.....193. *Oe. tentoriale*
265. Vegetative cell 7–8μ in diameter.....195c. *Oe. acrosporum* var. *floridense*
265. Vegetative cell 12–21μ in diameter.....266
266. Plant usually less than 10-celled.195a. *Oe. acrosporum* f. *boreale*
266. Plant usually more than 15-celled.....267
267. Diameter of oogonium 35–48μ.....195. *Oe. acrosporum*
267. Diameter of oogonium 44–56μ.....195d. *Oe. acrosporum* var. *majusculum*
268. Oospore wall smooth.....269
268. Oospore wall punctate.....41c. *Oe. fabulosum* var. *punctatum*
269. Vegetative cell 56–70μ in diameter....41b. *Oe. fabulosum* var. *columbianum*
269. Vegetative cell 70–93μ in diameter.....270
270. Oospore globose to ellipsoid.....41. *Oe. fabulosum*
270. Oospore subglobose to subcylindrical, 41a. *Oe. fabulosum* var. *maximum*

*See footnote, page 53.

1. **Oe. laeve** Wittrock.

(Pl. XI, fig. 100.)

1874, p. 8; De Toni 1889, p. 35; Hirn 1900, p. 75.

Monoecious; oogonium single,* depressed-globose, pore median; oospore depressed-globose, filling oogonium, spore wall smooth; antheridium in groups of 1–2,* subepigynous, sperm 1; vegetative cell 10–14×20–70μ; oogonium 32–38×24–30μ; oospore 30–35×23–26μ; antheridium 9–10×9–13μ.

United States: Illinois, Michigan; France.

Originally distributed from France, the species was found subsequently in Illinois and Michigan (Transeau), and the above description is made from the American material. The large oogonium in relation to the diameter of the vegetative cell and the depressed-globose oospores are chief characteristics. It is clearly separated from *Oe. curvum*, in addition, by the absence of any marked tendency toward irregularly curved filaments.

2. **Oe. curvum** Pringsheim.

(Pl. XI, figs. 103 and 104.)

1858, p. 69, Pl. 5, fig. 3; Hirn 1900, p. 74, Pl. I, fig. 3; Tiffany 1926, p. 99, Pl. III, figs. 25–27.

Monoecious; oogonium 1–6, depressed globose, pore median; oospore depressed-globose, filling or not filling oogonium, spore wall smooth; antheridium 1–7, sperm 1; basal cell elongate; filament usually irregularly curved; vegetative cells 5–10×10–40μ; oogonium 21–25×18–24μ; oospore 19–23×14–19μ; antheridium 6–9×6–9μ.

United States: Iowa, Alabama; Germany, Spain, Sweden.

This species is to be compared with *Oe. cryptoporum* below. The irregularly curved filaments, particularly in the region of the antheridia, are usually characteristic. The pore is sometimes a little above the median position.

3. **Oe. cryptoporum** Wittrock.

(Pl. XI, fig. 101.)

1870, p. 119; Hirn 1900, p. 72, Pl. I, fig. 1; P. B. A. No. 1525.

Monoecious; oogonium 1, subdepressed-obovoid-globose or subdepressed-globose, pore median; oospore subdepressed-globose, quite filling oogonium, spore wall smooth; antheridium 1–7, scattered or subhypogynous or subepigynous; sperm 1; vegetative cell 7–10×28–60μ; oogonium 23–28×26–31μ; oospore 22–27×19–21μ; antheridium 6–8×7–11μ.

United States: Utah; Austria, Denmark, Norway, Sweden.

*Hereafter a numeral (or numerals) only will indicate the number of oogonia and antheridia; thus 1=a single oogonium or antheridium and 2–7 means that oogonia (or antheridia) may occur in groups of from two to seven seriate individuals. The same applies to androsporangia.

3a. Var. **vulgare** Wittrock.

(Pl. XI, fig. 102.)

1874, p. 7; Wolle 1887, p. 70, Pl. 74, figs. 1 and 2; *Oe. cryptoporum* Wittr. *in* Hirn 1896, p. 2; Hirn 1900, p. 73, Pl. I, fig. 2; (?) *Oe. spetsbergense* Wittr. 1874, p. 37 and *in* Hirn 1900, p. 316, Pl. L, fig. 322.

Smaller; oogonium 1–5; vegetative cell 5–8×15–48μ; oogonium 18–25×18–26μ; oospore 16–23×15–19μ; antheridium 5–7×9–12μ.

United States: New Jersey, Michigan, Illinois, Massachusetts, Pennsylvania, Utah; Australia; Ko Chang; Ceylon; Austria, England, France, Germany, Italy, Spain, Norway, Sweden.

The variety is much more widely distributed and has smaller vegetative cells and shorter oogonia than the species. The small sized filaments with rather depressed-globose oogonia are characteristic.

4. **Oe. rufescens** Wittrock.

(Pl. XI, fig. 105.)

1870, p. 134; 1874, p. 32; Hirn 1900, p. 76, Pl. I, fig. 4; Collins 1909, p. 229; P. B. A. No. 521.

Dioecious, macrandrous; oogonium 1–3, obovoid- or depressed-obovoid-globose, pore median, rimiform; oospore globose or depressed-globose, filling oogonium or nearly so, spore wall smooth; antheridium to 12-seriate; sperm 1; female vegetative cell 8–10×34–70μ, male 7–9×30–54μ; oogonium 22–24×22–30μ; oospore 21–23×17–22μ; antheridium 6–8×8–12μ.

United States: Connecticut, Rhode Island, Michigan, Illinois, Alabama, Ohio; Austria, Denmark, England, Germany, Sweden, Latvia; South Africa.

4a. Var. **exiguum** (Elfving) Tiffany nov. comb.

(Pl. XI, fig. 106.)

Oe. rufescens f. *exiguum* (Elfv.) Hirn 1900, p. 76, Pl. 1, fig. 5; *Oe. exiguum* Elfv. *in* Hirn 1895, p. 19.

Vegetative cells a little smaller; oospore subdepressed-globose; antheridium 3; vegetative cell 5–9×22–88μ; oogonium 22–24×20–28μ; oospore 20–22×17–23μ; antheridium 5×10–12μ.

United States: Illinois, Alabama, Mississippi; Finland, France; Southern Tibet.

4b. Var. **lundellii** (Wittrock) Tiffany.

(Pl. XI, fig. 107.)

1929, p. 75; *Oe. Lundellii* Wittr. 1874, p. 32; *Oe. Rothii* Breb. *in* Rabenh. Alg. Eur. No. 1374, 1862; *Oe. rufescens* Wittr. subsp. *Lundellii* (Wittr.) Hirn 1900, p. 77, Pl. I, fig. 6; *Oe. rufescens* Wittr. subsp. *Lundellii* (Wittr.) Hirn f. *elongatum* Hirn 1900, p. 78, Pl. I, fig. 8; P. B. A. No. 1428.

Vegetative cells wider in proportion to oogonium than in type; oogonium depressed-globose; vegetative cell 8–12×30–75μ; oogonium 22–25×21–27μ; oospore 19–2?×15–22μ; antheridium 7–9×6–12μ.

United States: Maine, California; Austria, England, Finland, France, Germany, Hungary, Sweden.

The species and the varieties resemble *Oe. cryptoporum* (No. 3) except in their dioecious habit and are separated from each other chiefly on the basis of relative dimensions. The varieties are so widely distributed and so uniformly separable from the species that they must be regarded as distinct even though similar.

5. **Oe. calcareum** Cleve.

(Pl. XI, fig. 108.)

In Wittrock 1870, p. 135; (?) *Vesiculifera compressa* Hassall 1845, p. 204, Pl. 53, fig. 4; Hirn 1900, p. 78, Pl. I, fig. 9.

Dioecious, macrandrous; oogonium 1 or rarely 2, depressed-globose, with median pore; oospore depressed-globose, filling oogonium, wall smooth; antheridium to 8-seriate; sperm 1; vegetative cell 11–14× 22–56μ; oogonium 27–30×21–23μ; oospore 26–28×20–21μ; antheridium 10–11×9–12μ.

England, Denmark, Sweden, Latvia; South Africa.

The filaments of this species are often incrusted with lime. The depressed-globose oospore completely filling the oogonium and the robust appearance of the short-celled vegetative filaments are characteristic.

6. **Oe. sociale** Wittrock.

(Pl. XI, fig. 109.)

In Wittr. & Nordst. Alg. Exs. No. 401, 1882; *Oe. ochroleucum* Kuetz. *in* Rabenh. Alg. Eur. No. 1280, 1862; Hirn 1900, p. 79, Pl. II, fig. 12.

Dioecious, macrandrous; oogonium 1, subglobose, pore median; oospore globose (or subglobose), quite filling oogonium, cell wall smooth; antheridium 1–5, sperms 2, division horizontal; vegetative cell 9–16× 30–130μ; oogonium 30–38×33–42μ; oospore (26–) 28–35×28–35μ; antheridium 12–14×8–11μ.

United States: Illinois, Alabama, Mississippi; British Columbia; Austria, Germany, Sweden, Latvia; India, Tibet, Burma.

The oospore is usually quite globose. It is easily separable from its dioecious relatives by its larger size and by the presence of two sperms in the antheridium.

7. **Oe. cymatosporum** Wittrock and Nordstedt.

(Pl. XII, figs. 112 and 113.)

In Wittr. 1870, p. 121; *Oe. Magnusii* Wittr. *in* Hirn 1895, p. 11; Hirn 1900, p. 80, Pl. II, fig. 13.

Monoecious; oogonium 1 or rarely 2, subdepressed-globose, pore median, rimiform; oospore depressed-globose, filling or not filling oogonium, spore wall of three layers: outer smooth, middle scrobiculate,

inner smooth; antheridium 1–4, subepigynous, subhypogynous, hypogynous, or scattered; sperm 1; vegetative cell 8–10×32–70μ; oogonium 30–40×27–40μ; oospore 27–35×22–33μ; antheridium 7–10×9–15μ.

United States: Massachusetts, Mississippi; Austria, England, Finland, France, Hungary, Sweden.

This species resembles *Oe. magnusii* below from which it is distinguished by its monoecious habit, its larger oogonia, and its oospores not usually filling the oogonia.

8. **Oe. magnusii** Wittrock.
(**Pl. XII, fig. 115.**)

1874, p. 38; Hirn 1900, p. 81, Pl. II, fig. 14; Wittr. and Nordst. Alg. Ex. No. 109.

Dioecious, macrandrous (perhaps monoecious also); oogonium 1–3, depressed-globose, pore median, rimiform; oospore depressed-globose, quite filling oogonium, spore wall of three layers: outer layer smooth, middle layer scrobiculate, inner layer smooth; antheridium to 8-seriate, sperm 1; vegetative cell 7–10×12–40μ; oogonium 24–27×21–26μ; oospore 22–25×18–23μ; antheridium 8–10×5–11μ.

United States: Illinois, Michigan, Massachusetts; British Columbia; Finland, Germany, Sweden.

Easily separable from *Oe. cymatosporum* (No. 7). According to Wittrock it is sometimes monoecious.

9. **Oe. suecicum** Wittrock.
(**Pl. XII, fig. 116.**)

1872, p. 5; 1874, p. 30; West 1891, p. 109, Pl. 18, fig. 2; (?) *Oe. trichosporum* Itzig. *in* Rabenh. 1868, p. 426; Hirn 1900, p. 82, Pl. II, fig. 15; Collins 1909, p. 230; Heering 1914, p. 193, fig. 281; Tiffany 1926, p. 89, Pl. V, figs. 57 and 58.

Dioecious, macrandrous; oogonium 1, subglobose, pore median; oospore globose, nearly filling oogonium, outer spore wall echinate, inner smooth; antheridium 2–6, sperm 1; basal cell elongate; terminal cell apically obtuse; vegetative cell 9–14×30–90μ; oogonium 32–38×34–41μ; oospore 30–37×30–37μ; antheridium 10–12×13–17μ.

United States: Iowa, Illinois, Massachusetts; Australia; Austria, Denmark, Finland, France, Germany, Latvia, Iceland, Norway, Sweden; British Columbia; South Africa.

9a. Form **australe** G. S. West.
(**Pl. XII, fig. 117.**)

1909, p. 45, fig. 6 E.

Vegetative cell somewhat larger; spines larger and moré sparse; vegetative cell 14–16×56–80μ; oogonium 40–41×40–41μ; oospore (without spines) 31–33×31–33μ.

Africa: Yan Yean Reservoir, Victoria.

The species and the variety constitute the only dioecious macrandrous members of the genus having echinate oospores.

10. **Oe. varians** Wittrock and Lundell.

(Pl. XII, fig. 120.)

In Wittr. 1874, p. 11; *Oe. polymorphum* Wolle 1887, p. 73, Pl. LXXIV, figs. 16–19; Hirn 1900, p. 89, Pl. IV, fig. 23; Collins 1909, p. 232; Heering 1914, p. 206, fig. 298; Tiffany 1926, p. 99, Pl. VII, figs. 75 and 76.

Monoecious, (or sometimes dioecious); oogonium 1, or rarely more, depressed- or subdepressed-pyriform-globose, pore nearly superior; oospore globose, not filling oogonium, spore wall smooth; antheridium to 9-seriate, scattered; sperms 2, division horizontal; basal cell elongate; terminal cell apically obtuse; vegetative cell 12–16×35–144μ; oogonium 34–50×34–55μ; oospore 31–41×30–41μ; antheridium 11–15×5–7μ.

United States: Iowa, New Jersey, Illinois; Patagonia; Austria, Finland, Sweden; South Africa.

The typical plants of this species have a nearly superior pore, and the oospore usually does not fill the irregularly shaped oogonium. Transeau has observed both dioecious and monoecious forms from Illinois. (See also Hirn *loc. cit.*).

11. **Oe. urbicum** Wittrock.

(Pl. XII, figs. 118 and 119.)

1874, p. 13; *Oe. tumidulum* Pringsh. 1855, p. 158, Pl. 1, figs. 26 and 27; Hirn 1900, p. 91, Pl. V, fig. 26.

Monoecious; oogonium 1, ellipsoid-globose, pore a little above median or nearly superior; oospore globose, not filling oogonium, spore wall smooth; antheridium few celled; sperms 2, division horizontal; vegetative cell 15–19×40–110μ; oogonium 46–55×58–63μ; oospore 33–46×33–46μ; antheridium 14–16×5–7μ.

Germany.

In general appearance this species is similar to *Oe. varians* above and *Oe. tyrolicum* (No. 14). It is distinguished from the former by its size and tendency toward ellipsoid oogonia; from both by the variable position of the pore.

12. **Oe. obsoletum** Wittrock.

(Pl. XII, fig. 121.)

1874, p. 9; *Oe. vernale* Wittr. 1872, p. 1; Hirn 1900, p. 83, Pl. II, fig. 16.

Monoecious; oogonium 1, subglobose or subdepressed-globose, pore a little above supramedian; oospore subdepressed-globose, not filling oogonium, spore wall smooth; antheridium 1–3, subepigynous; sperm 1; vegetative cell 9–15×30–75μ; oogonium 34–39×34–43μ; oospore 30–34×28–32μ; antheridium 8–9×12–16μ.

United States: Pennsylvania; England, Sweden.

Similar to *Oe. plusiosporum* below and distinguished from it by the usually depressed-globose appearance of the oospore. The oospore of *Oe. plusiosporum* is more regularly globose and its oogonium is more nearly ellipsoid.

13. **Oe. plusiosporum** Wittrock.
(**Pl. XII, fig. 122.**)

1874, p. 11; Wolle 1887, p. 72, Pl. 74, figs. 20 and 21; Hirn 1900, p. 84, Pl. II, fig. 17.

Monoecious; oogonium 1, subglobose or subellipsoid-globose, with pore a little above median; oospore globose, rarely subglobose, not quite filling oogonium, spore wall smooth; antheridium to 6-seriate; sperm (?) 1; terminal cell obtuse; vegetative cell 12–19×24–77μ; oogonium (28–) 34–45×35–50μ; oospore (25–) 30–39×30–39μ; antheridium 12–14 ×8–12μ.

United States: Pennsylvania, New Jersey, California; Columbia; British Columbia; Sweden, Finland, Rumania.

See *Oe. obsoletum* above.

14. **Oe. tyrolicum** Wittrock.
(**Pl. XII, fig. 123.**)

1874, p. 12; Hirn 1900, p. 91, Pl. IV, fig. 25; Heering 1914, p. 206, fig. 299; Collins 1918, p. 65; Tiffany 1926, p. 99, Pl. VII, fig. 77.

Monoecious; oogonium 1 (rarely 2), ellipsoid-globose or occasionally obovoid, pore nearly superior; oospore usually globose, not filling oogonium, spore wall smooth; antheridium 1–4; sperms 2, division horizontal; basal cell elongate; terminal cell apically obtuse; vegetative cell 15–24×45–120μ; oogonium 45–53×57–70μ; oospore 40–48×40–48μ; antheridium 12–21×9–11μ.

United States: Massachusetts, Iowa; Austria.

Distinguished by its more nearly ellipsoid oogonia and globose oospores. Separated from *Oe. varians* (No. 10) by its larger dimensions and from *Oe. cardiacum* var. *carbonicum* (No. 15c) by its monoecious habit.

15. **Oe. cardiacum** (Hassall) Wittrock.
(**Pl. XIII, figs. 124 and 125.**)

Vesiculifera cardiaca Hass. 1845, p. 203, Pl. 51, fig. 4; *Oe. cardiacum* Wittr. 1870, p. 135; *Oe. lautumniarum* Wittr. *in* Hirn 1896, p. 3; (?) *Pringsheimia inaequalis* Wood 1872, p. 195, Pl. 18, fig. 1; Hirn 1900, p. 85, Pl. III, fig. 19; Collins 1909, p. 231; Heering 1914, p. 194, fig. 273; Tiffany 1926, p. 89.

Dioecious, macrandrous; oogonium usually 1, subglobose to subcordiform-globose, with a supramedian pore; oospore globose, not filling the oogonium, spore wall smooth; antheridium 1–10; sperms 2, division horizontal; basal cell elongate; terminal cell apically obtuse; female vegetative cell 18–30×60–200μ, male 15–25×45–170μ; oogonium 48–70×58–78μ; oospore 42–60×42–60μ; antheridium 15–21×10–14μ.

United States: Iowa, Illinois, Pennsylvania, Oregon, Ohio, Connecticut; Africa; Paraguay; Ontario; Australia; England, Denmark, Finland, France, Germany, Switzerland, Sweden.

15a. Form **interjectum** Hirn.
(**Pl. XIII, fig. 127.**)

1900, p. 86, Pl. III, fig. 21.

Pore of oogonium more nearly superior than in the type; vegetative cell 19–29×60–190μ; oogonium 45–60×63–81μ; oospore 44–58×43–58μ.

England, Sweden.

15b. Form **pulchellum** (Hassall) Hirn.
(**Pl. XIII, fig. 126.**)

1900, p. 86, Pl. III, fig. 20; *Vesiculifera pulchella* Hass. 1845, p. 199, Pl. 50, fig. 3.

Vegetative cell 25–37×40–125μ; oogonium 57–73×68–78μ; oospore 56–66×56–66μ.

England, France.

15c. Var. **carbonicum** Wittrock.
(**Pl. XIII, fig. 128.**)

In Wittr. and Nordst. Exs. 1883; *Oe. carbonicum* Wittr. 1874, p. 33; Hirn 1900, p. 87, Pl. IV, fig. 22; Tiffany 1926, p. 90, Pl. I, fig. 5; P. B. A. No. 1781.

Oogonium 1–2, obovoid to globose-ovoid, pore nearly superior; oospore obovoid-ellipsoid to globose-ellipsoid; female vegetative cell 14–30×40–200μ, male 14–25×40–150μ; oogonium 42–56×50–80μ; oospore 40–52×46–65μ; antheridium 13–20×12–15μ.

United States: Iowa, Illinois, Ohio; Austria, England, Denmark, Germany, Sweden.

15d. Var. **minus** Lemmermann.
(**Pl. XIII, fig. 129.**)

1909, p. 191, as v. *minor;* Heering 1914, p. 194; Tiffany 1926, p. 90, Pl. I, fig. 8.

Oogonium and oospore smaller; female vegetative cell 16–28×25–75μ, male 14–23×25–75μ; oogonium 30–45×35–50μ; oospore 28–42×28–40μ; antheridium 12–15×5–6μ.

United States: Iowa, Kentucky; Germany.

The "cardiacum" group is rather variable, and the varieties are not always clearly separated. The differentiating characters used in the key are those including shape and size of oospore and relative lengths of vegetative cells. Upon these bases the divisions above seem tenable. See also *Oe. glabrum* (No. 17).

16. **Oe. franklinianum** Wittrock.
(**Pl. XIII, fig. 131.**)

In Wittr. and Nordst. Alg. Exs. No. 309, 1880; Wolle 1887, p. 89, figs. 7–9; Hirn 1900, p. 88, Pl. II, fig. 18; Collins 1909, p. 231; Heering 1914, p. 194; Tiffany 1926, p. 89, Pl. IV, figs. 43–44.

Dioecious, macrandrous; oogonium 1, subglobose, with a supramedian pore; oospore globose, almost filling oogonium, spore wall

smooth; antheridium 1–4; sperms 2, division horizontal; female vegetative cell 9–12×30–95μ, male 8–10×25–90μ; oogonium 26–31×29–41μ; oospore 24–30×24–30μ; antheridium 8–9×5–7μ.

United States: Iowa, Illinois, New Jersey, Pennsylvania; Brazil; Australia.

This species also resembles *Oe. cardiacum* (No. 15) but is distinguished by its smaller dimensions throughout.

17. **Oe. glabrum** Hallas.

(Pl. XIII, fig. 130.)

1905, p. 408, fig. 18; Hirn 1906, p. 14, Pl. I, fig. 2.

Dioecious, macrandrous; oogonium 1 (rarely 2), obovoid, pore superior; oospore globose or subglobose, not filling oogonium, spore wall smooth; antheridium 5–8; sperms 2, division vertical; terminal cell (sometimes the oogonium) broadly apiculate; female vegetative cell 16–26×120–240μ, male 21–25×60–150μ; oogonium 56–58×63–86μ; oospore 42–49×44–63μ; antheridium 20–22×7–9μ.

Denmark.

This species in general appearance is near the "cardiacum" group. Its vertical division of the two sperms, the small size of its oospore in comparison to the oogonium, and the uniformly superior pore are characters that identify it and make it tenable as a species.

18. **Oe. lautumniarum** Wittrock.

(Pl. XIV, figs. 132 and 133.)

In Wittr. and Nordst. Alg. Exs. No. 7, 1877; Hirn 1900, p. 92, Pl. V, fig. 27.

Dioecious, macrandrous; oogonium 1, rarely 2, subobovoid-globose, pore a little above median (rarely nearly superior); oospore subglobose, or sometimes subangular, filling oogonium, wall smooth, rarely thickened; antheridium 1–4; female vegetative cell 16–22×40–110μ, male 15–20×45–100μ; oogonium 40–49×45–51μ; oospore 36–46×35–47μ; antheridium 14–17×7–10μ.

British Columbia; Finland, Germany, Sweden, Latvia.

This species is separable from the "cardiacum" group largely by the varying position of the oogonial pore (from nearly median to nearly superior) and by a combination of cell sizes and shapes not found in any one of this group.

19. **Oe. intermedium** Wittrock.

(Pl. XIV, fig. 134.)

In Wittr. and Nordst. Alg. Exs. No. 708, 1886; *Oe. fragile* Wittr. *in ibid.* No. 4, 1877; *Oe. vaucherii* (Le Cl.) Al. Br. *in ibid.* No. 14, 1877, and *in* Rabenh. Alg. Eur. No. 2499, 1877; Hirn 1900, p. 94, Pl. V, fig. 31.

Monoecious; oogonium 1, obovoid to obovoid-globose, pore superior; oospore globose or obovoid-globose, filling oogonium or nearly so, spore

wall smooth and thick; antheridium 1–4, subepigynous or hypogynous or rarely scattered, sperms 2, division horizontal; vegetative cell 15–18×45–80μ; oogonium 31–37×34–45μ; oospore 30–36×33–41μ; antheridium 14–16×5–10μ.

United States: Illinois, Ohio, Mississippi; Austria, Finland, Sweden, Latvia, Germany; India; Siberia.

19a. Var. **fennicum** Tiffany.

(**Pl. XIV, fig. 135.**)

1929, p. 74; *Oe. intermedium* Wittr. forma *valida* Hirn 1900, p. 95, Pl. V, fig. 32; *Oe. intermedium* Wittr. forma West 1909a, p. 239.

Oogonium and oospore considerably larger; vegetative cell 17–19×50–120μ; oogonium 38–46×42–60μ; oospore 35–40×35–40μ; antheridium 13–18×6–8μ.

United States: Michigan; Finland; Egypt.

Oe. intermedium resembles *Oe. fragile* (No. 24) in general appearance, particularly those specimens that reach the upper limits of dimensions. It is rather intermediate between *Oe. fragile* and *Oe. globosum* (No. 21). Its size and location of antheridia are distinctive characters in this monoecious group with regularly superior pore. The variety *fennicum* is larger and its oogonium is not filled by the oospore.

20. **Oe. hirnii** Gutwinski.

(**Pl. XIV, figs. 136 and 137.**)

1896, p. 2, Pl. 5, fig. 1; Hirn 1900, p. 93, Pl. V, fig. 29; West and West 1902, p. 12, Pl. I, fig. 1–3.

Monoecious; oogonium 1, subglobose or subobovoid, with superior pore; oospore globose, not filling oogonium, spore wall smooth; antheridium 1–2, subepigynous; sperms 2, division horizontal; vegetative cell (sometimes slightly capitellate) 8–13×28–80μ; oogonium 32–37×32–39μ; oospore 28–31×28–31μ; antheridium 8–11×4–9μ.

Austria, Ireland.

20a. Var. **africanum** G. S. West.

(**Pl. XIV, fig. 138.**)

1907, p. 98; Tiffany 1926, p. 100, Pl. III, fig. 24.

Oogonium globose to subglobose; antheridium 1–3; vegetative cell, broadly capitellate, 13–15×33–60μ; oogonium 39–40×38–40μ; oospore 33–36×33–36μ; antheridium 13–14×5–6μ.

United States: Iowa; Africa.

The species is near *Oe. globosum* below in description, differing in its smaller size and its commonly subobovoid oogonia. The variety *africanum* is very distinct and is the only poriferous form in the monoecious group of the genus having broadly capitellate cells.

21. **Oe. globosum** Nordstedt.
(**Pl. XIV, fig. 139.**)

1878, p. 20, Pl. 2, fig. 16; Hirn 1900, p. 94, Pl. V, fig. 30.

Monoecious; oogonium 1, globose or subglobose, pore superior; oospore globose, quite filling oogonium, spore wall smooth; antheridium 1–7, subepigynous or subhypogynous or scattered; sperms 2, division horizontal; basal cell elongate; terminal cell setiform; vegetative cell 10–14×40–95μ; oogonium 32–40×32–46μ; oospore 30–37×28–37μ; antheridium 9–12×4–8μ.

United States: Illinois, Massachusetts; Australia; Greece, Serbia.

The relation of this species to *Oe. hirnii* (No. 20) and to *Oe. intermedium* (No. 19) is discussed under these latter forms.

22. **Oe. zigzag** Cleve.
(**Pl. XV, figs. 143 and 144.**)

In Wittr. 1870, p. 120; Hirn 1900, p. 101, Pl. VII, fig. 42.

Monoecious; oogonium 1, globose or obovoid-globose, pore superior; oospore of same form as oogonium and quite filling it, spore wall smooth, thick; antheridium 1, subepigynous or subhypogynous, alternating with oogonium and vegetative cell; sperms 2, division horizontal; basal cell elongate; terminal cell apically obtuse; vegetative cell 15–20×30–80μ; oogonium 45–63×52–63 (–67)μ; oospore 43–60×(44–) 48–58 (–63)μ; antheridium 15–19×8–15μ.

Sweden.

The short, few-celled filaments of *Oe. zigzag* are quite unmistakable. It bears some resemblance to the dioecious *Oe. alternans* (No. 139) and is perhaps closely related to *Oe. curtum* (No. 23). From the latter it is distinguished by its shorter filaments, by its single oogonium, and by its single antheridium alternating with a vegetative cell.

23. **Oe. curtum** Wittrock and Lundell.
(**Pl. XV, fig. 149.**)

In Wittr. 1870, p. 121; *Oe. curvum* Pringsh. *in* Roumeguere Alg. Exs. No. 793; Hirn 1900, p. 102, Pl. VI, fig. 41; Skuja 1927, p. 98, Pl. II, fig. 11.

Monoecious; oogonium 1–4, obovoid-globose or subglobose, pore superior; oospore of same form as oogonium, which it nearly fills, spore wall smooth, often thick; suffultory cell occasionally larger than vegetative cell; antheridium 1–4, subepigynous, sometimes terminal; sperms 2, division horizontal; basal cell elongate; vegetative cell 12–22× 25–110μ; oogonium 38–55×37–54μ; oospore 36–52×35–51μ; antheridium 10–17×8–13μ.

Finland, Germany, Sweden, Latvia.

Similar to *Oe. zigzag* (No. 22). Skuja (1927) reports *Oe. curtum* with 10-12 cells (and often 20) in a filament. *Oe.*

zigzag rarely has more than 6-8 cells in the filament. Skuja (1927) also records the membrane of the vegetative cell as being spirally punctate.

24. **Oe. fragile** Wittrock.
(**Pl. XV, fig. 145.**)

1870, p. 120; 1872a, p. 24; Wolle 1887, p. 71, Pl. 74, figs. 4–6; *Oe. Candollei* (Le Cl.) Breb. *in* Roumeguere Alg. Exs. No. 347; Hirn 1900, p. 96, Pl. V, figs. 33 and 34; Collins 1909, p. 232, fig. 81; Heering 1914, Pl. IV, fig. 36; P. B. A. No. 1477.

Monoecious; oogonium 1, globose or subobovoid-globose, with superior pore; oospore globose, filling oogonium, spore wall smooth; antheridium 1–3; sperms 2, division horizontal; basal cell elongate; vegetative cell 12–17×50–120μ; oogonium 42–50×44–55μ; oospore 39–46×39–46μ; antheridium 12–15×10–12μ.

United States: Iowa, Illinois, Mississippi, Massachusetts, Pennsylvania, Michigan; British Columbia; Patagonia; South Africa; Australia; France, Finland, Sweden, Latvia.

24a. Var. **abyssinicum** Hirn.
(**Pl. XV, fig. 147.**)

1900, p. 97, Pl. VI, fig. 35.

Oogonium smaller than the type; antheridium to 6-seriate; vegetative cell 12–17×25–100μ; oogonium 38–45×40–50μ; oospore 36–43×36–44μ; antheridium 11–15×6–14μ.

Africa.

24b. Var. **robustum** (West and West) Tiffany nov. comb.
(**Pl. XV, fig. 146.**)

Oe. zigzag Cleve var. *robustum* West and West 1903, p. 36; *ibid. in* West 1904, p. 60, fig. 12B; *ibid. in* Hirn 1906, p. 24, Pl. I, fig. 3.

Oogonium usually globose; antheridium 2; vegetative cell 19–23×40–90μ; oogonium 53–58×50–60μ; oospore 51–56×47–53μ; antheridium 19×5–7μ.

England.

Oe. fragile is characterized by its usually globose spores completely filling the oogonia, its size, and monoecious habit. Cf. *Oe. globosum* (No. 21) and *Oe. intermedium* (No. 19). The variety *abyssinicum* is more slender and has a larger number of seriate antheridia than the species. Variety *robustum* is considerably larger than either. The latter was originally described by W. and G. S. West as a variety of *Oe. zigzag* (No. 22). Its pluricellular habit and number of antheridia place it outside the few-celled *zigzag*. Its globose oospore completely filling the oogonium and its subepigynous and subhypogynous antheridia are characters that seem nearest to *Oe. fragile*.

25. **Oe. vaucherii** (Le Clerc) Al. Braun; Wittrock.

(Pl. XV, figs. 150 and 151.)

(?) *Prolifera vaucherii* Le Cl. 1817, p. 474, Pl. 23, fig. 4; (?) *Oe. vaucherii* Braun 1855, p. 40, Pl. 2, fig. 13; Wittr. 1870, p. 121; (?) *Oe. diandronites* Carter 1858, p. 31, Pl. 3, figs. 3, 9–11; (?) *Oe. monandronites* Carter 1858, p. 38; Hirn 1900, p. 97, Pl. VI, fig. 36; *Oe. vaucherii* (Le Cl.) Al. Br.; Wittr. f. *insulare* Hirn 1900, p. 99, Pl. VI, fig. 37; Collins 1909, p. 232; Heering 1914, p. 207, fig. 303; Tiffany 1926, p. 100, Pl. IV, fig. 35; P. B. A. No. 1786.

Monoecious; oogonium 1, obovoid to subovoid-globose, pore superior; oospore globose to subglobose, not filling oogonium, spore wall smooth and sometimes thick; antheridium 1–4; sperms 2, division horizontal; basal cell elongate; vegetative cell 20–30×32–118μ; oogonium 40–58×45–65μ; oospore 35–54×35–55μ; antheridium 17–30×6–15μ.

United States: Massachusetts, Michigan, Iowa, Illinois, Ohio, Mississippi; India; Denmark, France, Germany, Switzerland, Italy, Sweden, Latvia.

Oe. vaucherii resembles *Oe. intermedium* (No. 19) and *Oe. fragile* (No. 24). Hirn's f. *insulare* is not distinct and is included with the species. The dimensions given above include the variations observed for the American material.

26. **Oe. richterianum** Lemmermann.

(Pl. XVI, fig. 156.)

1895, p. 26, figs. 1–3; *Oe. paludosum* (Hass.) Kuetz. *in* Hirn 1895, p. 14; Hirn 1900, p. 117, Pl. XII, fig. 63.

Monoecious; oogonium 1–2, obovoid or subellipsoid, pore superior; oospore subobovoid or subellipsoid (rarely globose-ellipsoid), filling oogonium or not, spore wall smooth; antheridium 1–6, subhypogynous or subepigynous or scattered; sperms 2, division horizontal; basal cell elongate; vegetative cell 12–21×36–126μ; oogonium 36–48×48–74μ; oospore 35–43×43–59μ; antheridium 12–15×6–10μ.

United States: Massachusetts; British Columbia; Germany, Finland.

Distinguished by its combination of dimensions and by the horizontal division of the antheridium. Cf. *Oe. upsaliense* (No. 29).

27. **Oe. pseudoboscii** Hirn.

(Pl. XX, fig. 186.)

1900, p. 291, Pl. XIII, fig. 67; *Oe. neglectum* Hirn 1895, p. 21, Pl. 1, fig. 1; Silfvenius 1903, p. 15, fig.; Iwanoff 1901, p. 48; Hirn 1906, p. 48, Pl. II, fig. 6.

Monoecious; oogonium 1, subobovoid, pore superior; oospore ellipsoid-ovoid or ellipsoid, inflating lower part of oogonium, otherwise not filling it, spore wall smooth; antheridium 1–2, subepigynous; sperms 2, division horizontal; vegetative cell 8–14×64–275μ; oogonium 41–50×75–105μ; oospore 38–45×48–60μ; antheridium 11–12×10–11μ.

United States: Illinois, Alabama, Massachusetts; Finland, Russia.

Iwanoff and Silfvenius (*loc. cit.*) both found material of this species which proved it to be monoecious and not dioecious (Hirn 1900, 1906). It is characterized by the relatively short oospore within a much longer oogonium. The diameter of the oospore is such that the lower part of the oogonium is really inflated. It bears some resemblance to *Oe. paludosum* (No. 53) and *Oe. boscii* (No. 55). From both it is distinguished by its smooth oospores. It is unlike *Oe. boscii* in its monoecious habit.

28. **Oe. sodiroanum** Lagerheim.
(Pl. XVI, figs. 153 and 154.)

1890, p. 81; Hirn 1900, p. 118.

Monoecious; oogonium 1, ellipsoid-obovoid, pore superior; oospore ellipsoid, not filling oogonium at upper end, spore wall smooth; antheridium subhypogynous or subepigynous or scattered, 1–9; sperms 2, division vertical; vegetative cell 20–24×44–84μ; oogonium 40–45×70–90μ; oospore 38–42×56–64μ; antheridium 20–22×6–8μ.

United States: Michigan; Ecuador.

This species originally described incompletely from Ecuador by Lagerheim was collected nearly forty years later in Michigan by Miss Alma B. Ackley. The above description is based on the Michigan material. There can be no question of the validity of the species. It resembles in general appearance *Oe. oviforme* (No. 30), *Oe. upsaliense* (No. 29), and *Oe. richterianum* (No. 26). It is readily distinguished from these (Cf. No. 29) in dimensions and habit. The antheridia occur in series and when present at the end of the filament give the plant a curved appearance, not unlike that of the androsporangial filaments of *Oe. spectabile* (No. 186).

29. **Oe. upsaliense** Wittrock.
(Pl. XVI, fig. 157.)

1870, p. 125; 1872a, p. 22; 1874, p. 14, Pl. I, fig. 4; *Oe. tumidulum* (Roth) *in* Areschoug Alg. Exs. No. 236, 1864; Hirn 1900, p. 115, Pl. XII, fig. 60; Wittr. and Nordst. Alg. Exsicc. No. 18; P. B. A. No. 1576.

Monoecious; oogonium 1, obovoid or suboblong-ellipsoid, pore superior; oospore same form as oogonium (which it fills), spore wall smooth; antheridium 1–3, subhypogynous; antheridium, oogonium, and vegetative cell alternating; sperms 2, division vertical; vegetative cell varying much in same filament; suffultory cell up to 27μ in diameter; basal cell elongate; terminal cell obtuse; vegetative cell 13–20×55–160μ; oogonium 45–50×66–100μ; oospore 42–47×60–75μ; antheridium 15–18×7–10μ.

United States: Michigan, New Hampshire, Ohio, Illinois; Greenland; France, Germany, Sweden, Latvia.

29a. Var. **fennicum** Hirn.

(Pl. XVI, fig. 158.)

1895, p. 14; 1900, p. 116, Pl. XII, fig. 61.

Oogonium and oospore larger, ellipsoid; vegetative cell 13–20×55–175μ; suffultory cell 25–33×40–66μ; oogonium 63–68×75–85μ; oospore 61–64×70–78μ; antheridium 15–20×8–13μ

Finland.

This smooth-spored species is one of a few in the genus combining the monoecious habit with the tendency toward ellipsoid oogonia. It is distinguished from *Oe. oviforme* (No. 30) by its slightly smaller size, its varying diameter of vegetative cell, and by the rather characteristic alternation of antheridium, oogonium, and vegetative cell in the filament. *Oe. sodiroanum* (No. 28) is smaller and has shorter vegetative cells. *Oe. upsaliense* bears some resemblance to *Oe. richterianum* (No. 26) but in the latter the sperms result from a horizontal division of the antheridium, not a vertical division. The variety *fennicum* has much larger oogonia and antheridia. The smaller suffultory cell is usually characteristic of both the species and the variety.

30. **Oe. oviforme** (Lewin) Hirn.

(Pl. XVI, fig. 152.)

1900, p. 116, Pl. XII, fig. 62; *Oe. urbicum* Wittr. var. *oviforme* Lewin 1888, p. 17, Pl. 2, fig. 43; Heering 1914, p. 210, fig. 308; Tiffany 1926, p. 100, Pl. VIII, figs. 78 and 79.

Monoecious; oogonium 1, obovoid to ellipsoid-obovoid, pore superior; oospore obovoid to ovoid (rarely almost globose), filling or not filling the oogonium, spore wall smooth, thick; antheridium 1–4, epigynous, hypogynous, or scattered; sperms 2, division vertical; basal cell elongated; vegetative cell 15–23×40–135μ; oogonium 48–55×(56–)65–80μ; oospore 46–53×50–63μ; antheridium 16–19×7–12μ.

United States: Iowa; Spain.

The material distributed from Spain shows a more uniformly obovoid oogonium than is common in the Iowa samples: the latter approach the ellipsoid-obovoid variation. Cf. *Oe. upsaliense* (No. 29).

31. **Oe. geniculatum** Hirn.

(Pl. XVI, fig. 155.)

1900, p. 106, Pl. VIII, fig. 48; P. B. A. No. 411.

Monoecious; oogonium 1, obovoid or obovoid-globose, pore superior; oospore globose or subdepressed-globose, not filling oogonium, spore wall smooth and thick; antheridium 1–5, subepigynous or subhypogynous or scattered, sometimes alternating with vegetative cells; sperms (?) 2, division (?) horizontal; vegetative cell 37–48×60–135μ; oogonium 56–63×56–68μ; oospore 48–59×48–59μ; antheridium 37–44×5–9μ.

United States: California.

This species is near *Oe. capilliforme* (No. 37) and *Oe. anomalum* (No. 40). It is larger than either and has somewhat larger oogonia in proportion to the size of the vegetative cells than is the case in *Oe. anomalum*. The peculiar curvature (from which the specific name is derived) of the filaments, due to the opening of the antheridia, is usually characteristic of the species.

32. **Oe. suboctangulare** West and West.
(Pl. XVII, fig. 160.)

1902, p. 129, Pl. 17, figs. 1 and 2; Hirn 1906, p. 23, Pl. I, fig. 4.

Monoecious; oogonium 1, longitudinally rectangular in optical section, broadly inflated, membrane 3.4–3.8μ thick, yellow, pore superior; oospore subrectangular-ellipsoid, filling oogonium except at the corners; antheridium 2, scattered; vegetative cell 50–54$\times$175–240μ; oogonium 53–67$\times$82–92μ; oospore 50–60$\times$73–85μ; antheridium 41–48$\times$25–27μ.

Ceylon.

The rectangularly appearing oogonium slightly exceeding the vegetative cells in diameter is a distinctive characteristic.

33. **Oe. martinicense** Hirn.
(Pl. XVII, fig. 159.)

1900, p. 134, Pl. XVI, fig. 92; *Oe. crassum* (Hass.) Wittr. *in* Wolle 1887, p. 74, Pl. 76, figs. 2 and 3; Collins 1909, p. 240.

Monoecious; oogonium 1, obovoid or subobovoid, pore superior; oospore obovoid or obovoid-ellipsoid, quite filling oogonium, spore wall smooth, often thick; antheridium 1–5, hypogynous; sperms 2, division vertical; vegetative cell 33–37$\times$115–240μ; oogonium (63–)68–74$\times$96–125μ; oospore 66–72$\times$81–96μ; antheridium 33–35$\times$5–7μ.

United States: Iowa, Kansas; Island of Martinique.

In appearance this species resembles *Oe. landsboroughi* (No. 48) or *Oe. crassum* (No. 49), both of which, however, are dioecious.

34. **Oe. kurzii** Zeller.
(Pl. XVII, fig. 163.)

1873, p. 189; 1873a, p. 189; Hirn 1900, p. 135, Pl. XVI, fig. 93.

Monoecious; oogonium 1, rarely in series, obovoid or subellipsoid, pore superior; oospore subglobose or ellipsoid, not filling oogonium, spore wall smooth; antheridium hypogynous or scattered, to 15-seriate; sperms 2, division vertical; terminal cell apically obtuse; vegetative cell 44–52$\times$90–250μ; oogonium 70–95$\times$111–130μ; oospore 67–86$\times$80–93μ; antheridium 44–52$\times$6–16μ.

United States: Pennsylvania, Arkansas, Mississippi; India.


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This species is quite easily recognized by its monoecious habit, large size, and subglobose to ellipsoid oospores not filling the oogonia.

35. **Oe. capillare** (Linnaeus) Kuetzing.
(Pl. XVIII, figs. 164 and 165.)

Conferva capillare L. 1753, p. 1166; *Oe. capillare* Kuetz. 1843, p. 255, Pl. 12, fig. II, 1–10; Kuetz. 1853, p. 13, Pl. 40, fig. 3; *Oe. capillare* Kuetz. var. *flavescens in* Rabenh. Alg. Europe 1861; *Oe. stagnale* Kuetz. *in* Rabenh. *ibid.* 1883; Hirn 1900, p. 112, Pl. XI, fig. 58; Heering 1914, p. 197, fig. 278; Tiffany 1926, p. 91, Pl. IV, figs. 39 and 40.

Dioecious, macrandrous; oogonium 1, not or scarcely exceeding the vegetative cell in diameter, cylindrical to subcylindrical, pore superior; oospore globose to cylindric-globose to ovoid, not or completely filling oogonium, spore wall smooth; antheridium 1–4, often alternating with vegetative cell; sperms 2, division horizontal; basal cell elongate, terminal cell broadly apiculate to obtuse; female vegetative cell 35–56× 36–120μ, male 35–50×35–90μ; oogonium 40–60×45–75μ; oospore 30–52×35–65μ; antheridium 30–48×5–10μ.

United States: Iowa; Austria, Denmark, Finland, France, Germany, Spain, Italy, Russia, Sweden, Latvia; Africa (Victoria).

35a. Form **stagnale** (Kuetzing; Wittrock) Hirn.
(Pl. XVIII, fig. 166.)

1900, p. 113, Pl. X, fig. 57; *Oe. stagnale* Kuetz. 1849, p. 368, and 1853, p. 13, Pl. 41, fig. 2; Wittrock 1874, p. 31.

Oospore subcylindrical or cylindrical-globose, sometimes constricted at the middle, not filling oogonium; female vegetative cell 38–50×40–100μ, male 35–45×36–90μ; oogonium 40–60×55–75μ; oospore 36–57×40–60μ; antheridium 33–42×5–9μ.

Germany, Latvia, Spain.

This species and its variety are rather readily distinguished from others by having oogonia which scarcely exceed the vegetative cells in diameter. They are to be compared with *Oe. suboctangulare* (No. 32) and *Oe. geniculatum* (No. 31), both of which are monoecious. The variety *stagnale* is separable from the type on dimensions and shape of oogonium.

36. **Oe. plagiostomum** Wittrock.
(Pl. XIV, fig. 140.)

Oe. sp. Wittr. 1872a, p. 24, Pl. 1, fig. 11; Wittr. 1874, p. 41; Hirn 1900, p. 100, Pl. VI, fig. 39; Collins 1918, p. 62; Heering 1914, p. 196, fig. 276; Tiffany 1926, p. 92.

Dioecious, macrandrous; oogonium 1, obovoid-globose, with superior pore; oospore globose to subglobose, usually filling oogonium, spore wall smooth and thickened; antheridium 1–6, often alternating with vegetative cell; basal cell elongate; vegetative cell 22–27×65–120μ; oogonium 42–49×50–60μ; oospore 41–47×42–49μ; antheridium 20–24× 8–10μ.

United States: Illinois, Massachusetts, Iowa, Ohio, Mississippi; Denmark, Sweden; India; South Africa.

36a. Var. **gracilius** Wittrock.

(Pl. XIV, figs. 141 and 142.)

1878, p. 142; Hirn 1900, p. 101, Pl. VI, fig. 40; Collins 1909, p. 233; Tiffany 1926, Pl. IV, figs. 37 and 38.

Smaller than the type, with vegetative cell usually shorter; vegetative cell 20–25×40–100μ; oogonium 36–42×46–57μ; oospore 34–39×36–44μ; antheridium 19–22×7–10μ.

United States: Iowa, New York, Illinois, Ohio, Mississippi; Germany; Mexico; South Africa.

The species and variety are separated mainly on the basis of size. The rather regularly globose oospores, with heavy walls, within obovoid-globose oogonia are characteristic.

37. **Oe. capilliforme** Kuetzing; Wittrock.

(Pl. XIX, figs. 172 and 173.)

Kuetz. 1853, p. 12. Pl. 37, fig. 3; Wittrock 1872a, p. 21; 1874, p. 31; *Oe. dioicum* Petrovsky 1861, p. 611, Pl. 13, fig. 6–10; Hirn 1900, p. 107, Pl. VIII, fig. 49; Collins 1909, p. 234; Heering 1914, p. 196, fig. 282; Tiffany 1926, p. 92, Pl. III, figs. 22 and 23.

Dioecious, macrandrous; oogonium 1, obovoid to subovoid, with superior pore; oospore variable, ovoid-globose, cylindric-globose, subglobose, or globose, not filling oogonium, spore wall smooth; antheridium 2–8, often alternating with the vegetative cell; sperms 2, division horizontal; basal cell elongate, terminal cell apically obtuse or apiculate; female vegetative cell 28–38×42–120μ, male 25–30×40–100μ; oogonium 42–50×51–62μ; oospore 37–45×40–50μ; antheridium 20–25×8–10μ.

United States: Missouri, Iowa, Ohio, Mississippi, Illinois; France, Russia, Sweden; Patagonia; S. Africa.

37a. Form **debaryanum** (Chmielevsky) Hirn.

(Pl. XIX, fig. 174.)

1900, p. 108, Pl. VIII, fig. 50; *Oe. De Baryanum* Chmiel. 1889, p. 1, Pl. 1, figs. 1 and 2; Tiffany 1926, p. 92, Pl. III, figs. 20 and 21.

Oospore globose or subglobose; female vegetative cell 25–37×38–130μ, male 22–27×35–100μ; oogonium 46–56×52–66μ; oospore 38–50×40–53μ; antheridium 18–24×5–10μ.

United States: Iowa; Greenland; Russia.

37b. Form **lorentzii** (Magnus and Wille) Hirn.

(Pl. XIX, fig. 175.)

1900, p. 109, Pl. IX, fig. 51; *Oe. lorentzii* Magnus and Wille *in* Wille 1884, p. 51, Pl. 3, figs. 99–101.

Oogonium obovoid to obovoid-globose; oospore usually globose or subglobose, sometimes cylindric-globose; female vegetative cell 26–34×

25–100μ, male 24–30×25–90μ; oogonium 40–53×40–65μ; oospore 37–47×38–54μ; antheridium 22–30×5–10μ.

Uruguay.

37c. Var. **australe** Wittrock.

(Pl. XIX, figs. 176 and 177.)

In Wittr. and Nordst. Exs. 1886; *Oe. princeps* (Hass.) Wittr. *in* Tilden Amer. Alg. 1894; Hirn 1900, p. 109, Pl. IX, fig. 52; *Oe. capilliforme* Kuetz.; Wittr. var. *australe* Wittr. f. *uberosporum* Hirn 1900, p. 110, Pl. IX, fig. 53; Tiffany 1926, p. 92.

Oogonium obovoid-globose to subglobose; female vegetative cell 24–36×26–100μ, male 22–33×40–100μ; oogonium 37–53×43–60μ; oospore 35–50×36–55μ; antheridium 21–26×4–9μ.

United States: Minnesota, Iowa, New York, South Dakota, Nebraska, California; Africa; Uruguay, Argentine, Brazil; Mexico; Vancouver.

37d. Var. **diversum** (Hirn) Tiffany.

(Pl. XIX, fig. 178.)

1929, p. 75; *Oe. capilliforme* Kuetz.; Wittr. var. *australe* Wittr. f. *diversum* Hirn 1900, p. 110, Pl. IX, fig. 54; *Oe. stagnale* Kuetz. *in* Tilden Amer. Alg. 1896.

Dimensions larger throughout; female vegetative cell 34–46× 45–130μ, male 33–40×50–120μ; oogonium 46–56×46–70μ; oospore 43–52×40–58μ; antheridium 30–37×6–11μ.

United States: Iowa, Colorado, Montana, Minnesota.

The "capilliforme" group is readily recognized by the smaller male vegetative filaments and shape of oogonia. The group is variable within itself, however, and the above varieties are recognized on the basis of differences in shape of oogonia and in dimensions.

38. **Oe. princeps** (Hassall) Wittrock.

(Pl. XVIII, figs. 167-169.)

Vesiculifera princeps Hass. 1842, p. 388; *V. capillaris* Hass. 1845, p. 195, Pl. 50, figs. 1 and 2; *Oe. princeps* Wittr. 1874, p. 42; Hirn 1900, p. 289, Pl. X, fig. 56.

Dioecious, macrandrous; oogonium 1, little tumid, subobovoid, pore superior; oospore globose or subglobose, not filling oogonium, spore wall smooth; terminal cell apiculate; antheridium 1–7; vegetative cell 33–42×40–133μ; oogonium 54–63×67–80μ; oospore 48–58×50–60μ; antheridium 32–38×8–20μ.

United States: Minnesota, Mississippi; England.

I have seen specimens of this alga from both Minnesota and Mississippi with immature antheridia which appear to belong with the oogonial filaments. I have therefore placed the species in the dioecious group. The cells of the antheridial filaments are somewhat longer than those of the male plants. It should be compared with the monoecius *Oe. geniculatum* (No. 31) and the dioecious *Oe. capilliforme* (No. 37). It is more robust than the latter.

39. **Oe. biforme** Nordstedt.

(Pl. XVII, figs. 161 and 162.)

In Wittrock and Nordstedt Exs. 1880; Hirn 1900, p. 147, Pl. XXII, fig. 112.

Dioecious, macrandrous; oogonium 1 (rarely 2), pore superior, cylindric-obovoid; oospore oblong-ellipsoid to subglobose or nearly globose, generally not filling oogonium, spore wall smooth; antheridium to 21-seriate; sperms 2, division vertical; female vegetative cell 22–32×55–140μ; male 18–28×45–140μ; oogonium 37–52×48–90μ; oospore 36–48×40–70μ; antheridium 18–28×6–15μ.

Brazil, Paraguay, Ecuador.

Near *Oe. oboviforme* (No. 46) and *Oe. grande* (No. 45); distinguished chiefly by its cylindric-obovoid oogonium.

40. **Oe. anomalum** Hirn.

(Pl. XVIII, figs. 170 and 171.)

1900, p. 112, Pl. X, fig. 55; *Oe. stagnale* Kuetz. var. *variabilis* Lewin 1888, p. 17, Pl. 3, figs. 44–48; Heering 1914, p. 197, fig. 277; Tiffany 1926, p. 91, Pl. I, figs. 6 and 7.

Dioecious, macrandrous; oogonium 1, subovoid or cylindric-ovoid, pore superior; oospore globose or subglobose, not filling oogonium, spore wall smooth; antheridium 4–13, sperms 2, division vertical; terminal cell apically obtuse; female vegetative cell 40–50×80–300μ, male 33–42×80–240μ; oogonium 54–64×68–75μ; oospore 48–60×52–61μ; antheridium 30–40×6–18μ.

United States: Iowa; Spain.

This species has some of the appearances of *Oe. capillare* (No. 35), particularly in the relatively small difference between the diameter of the vegetative cells and that of the oogonia.

41. **Oe. fabulosum** Hirn.

(Pl. XXV, figs. 215 and 216.)

1900, p. 114, Pl. XI, fig. 59.

Dioecious, macrandrous; oogonium 1, little tumid, cylindrical, pore superior; oospore globose or ellipsoid, not filling oogonium in length, spore wall smooth; antheridium seriate; sperms 2, division vertical; vegetative cell 74–85×115–210μ; oogonium 81–96×104–133μ; oospore 75–89×78–104μ; antheridium 68–80×7–22μ.

Brazil.

41a. Var. **maximum** (West) Hirn.

(Pl. XXV, figs. 217 and 218.)

1906, p. 13, Pl. II, fig. 5; *Oe. maximum* West 1901, p. 75, Pl. IV, figs. 39–41.

Oogonium wall thick; oospore subglobose to subcylindrical, filling oogonium or nearly so; basal cell elongate; terminal cell obtuse or broadly apiculate; vegetative cell 70–93×105–335μ; oogonium 75–107×75–136μ; oospore 70–100×65–110μ; antheridium 65–86×7–20μ.

Siam (Koh-chang).

41b. Var. **columbianum** G. S. West.

(**Pl. XXV, fig. 219.**)

1914, p. 1048, text fig. 3D.

Vegetative cell more slender; oogonium a little longer and more tumid; oospore more ellipsoid than the type; vegetative cell 56–70× 248–425μ; oogonium 98–100×163–174μ; oospore 81–84×124–128μ.

Columbia.

41c. Var. **punctatum** Lemmermann.

1910, p. 313.

Oogonium not tumid; oospore globose, not filling oogonium in length, spore wall yellow-brown, densely punctate; vegetative cell 64–75× 210–245μ; oogonium 64–75×101–113μ; oospore 63–71×63–71μ.

Paraguay.

Oe. fabulosum with its three varieties represents the largest size attained by any species of the genus so far recorded. The variety *punctatum* is easily separable by its punctate oospore, although unfortunately Lemmermann left no figure; *columbianum* is the most slender; *maximum* is slightly larger than the species.

42. **Oe. rivulare** (Le Clerc) Al. Braun.

(**Pl. XXIV, figs. 209 and 210.**)

(?) *Prolifera rivularis* Le Cl. 1817, p. 472, Pl. 23, fig. 1; *Oe. rivulare* Al. Br. 1855, p. 23, Pl. 1, figs. 1–10; Hirn 1900, p. 119, Pl. XII, fig. 66.

Dioecious, macrandrous; oogonium 1–7, obovoid, pore superior; oospore obovoid, ellipsoid, or subglobose, not filling oogonium longitudinally, spore wall smooth; antheridium to 13-seriate; sperms 2, division horizontal; basal cell elongate; female vegetative cell 35–45× 110–350μ, male 30–36×120–280μ; oogonium 70–85×130–160μ; oospore 55–70×65–100μ; antheridium 21–28×14–26μ.

United States: Iowa, Florida, Massachusetts; Denmark, England, Austria, France, Scotland, Germany, Sweden.

Very readily recognized by its large size and particularly by its oospore which is much smaller than the oogonium.

43. **Oe. pachyandrium** Wittrock.

(**Pl. XX, figs. 179 and 180.**)

In Wittr. and Nordst. Alg. Exs. No. 5, 1877; Hirn 1900, p. 142, Pl. XX, fig. 104.

Dioecious, macrandrous; oogonium 1–3, subobovoid or obovoid-ellipsoid, pore superior; oospore ellipsoid, not filling oogonium (rarely inflating it), spore wall smooth; antheridium 1–4; sperms 2, division vertical; female vegetative cell 30–36×80–220μ, male 32–45×60–160μ; oogonium 53–57×84–108μ; oospore 51–54×69–85μ, antheridium 30–43 ×11–20μ.

United States: Pennsylvania, New Jersey, Massachusetts; Sweden.

This plant is very near *Oe. grande* (No. 45), but is distinguished by having male filaments larger than the female.

44. **Oe. mexicanum** Wittrock.

(Pl. XXI, figs. 188 and 189.)

1878, p. 138; Hirn 1900, p. 147, Pl. XXII, fig. 111.

Dioecious, macrandrous; oogonium 1, cylindric-obovoid, pore superior; oospore cylindric-obovoid, quite or nearly filling oogonium; spore wall smooth; antheridium to 8-seriate; sperms 2, division vertical; female vegetative cell 34–41×60–140μ, male 30–38×60–114μ; oogonium 53–63×76–110μ; oospore 51–60×63–80μ; antheridium 28–35×7–17μ.

United States: South Dakota, Massachusetts; Mexico.

This species is close to *Oe. grande* below, being usually distinguished by its larger and considerably shorter vegetative cells and by its more cylindric oogonia.

45. **Oe. grande** Kuetzing; Wittrock.

(Pl. XXII, figs. 195 and 196.)

In Wittr. and Nordst. Alg. Exs. No. 502, 1883; Kuetz. 1845, p. 200, 1853, p. 12, Pl. 37, fig. 1; Hirn 1900, p. 143, Pl. XXI, figs. 105–106; Collins 1909, p. 242; Heering 1914, p. 202, fig. 288; Tiffany 1926, p. 93, Pl. II, figs. 14–16; P. B. A. No. 811.

Dioecious, macrandrous; oogonium 1–5, subobovoid, pore superior; oospore of the same form as oogonium, which it completely fills or not, spore wall smooth; antheridium 1–10; sperms 2, division vertical; basal cell elongated; female vegetative cell 28–37×70–210μ, male 28–33×70–175μ; oogonium 49–60×86–110μ; oospore 47–58×60–94μ; antheridium 25–33×11–18μ.

United States: Iowa, Maine, Massachusetts, Pennsylvania, California, Michigan, Illinois, Ohio, Minnesota, Mississippi, Connecticut; Ontario; Australia; Austria, Sweden, Switzerland.

45a. Form **gemelliparum** (Pringsheim) Hirn.

(Pl. XXII, fig. 200.)

1900, p. 145, Pl. XXI, fig. 107; *Oe. gemelliparum* Pringsh. 1858, p. 71, Pl. 5, fig. 10; *Oe. landsboroughi* (Hass.) Wittr. var. *gemelliparum* (Pringsh.) Wittr. 1874, p. 36.

Oogonium ellipsoid-ovoid, antheridium seriate; vegetative cell 20–27×60–200μ; oogonium 55–57×75–80μ; oospore 49–51×65–69μ.

Germany.

45b. Var. **aequatoriale** Wittrock.

(Pl. XXII, fig. 201.)

In Wittr. and Nordst. Alg. Exs. No. 1016, 1893; Hirn 1900, p. 145, Pl. XXI, fig. 108; *Oe. grande* Kuetz.; Wittr. var. *aequatoriale* Wittr. f. *hortense* Wittr. *in* Hirn 1900, p. 145, Pl. XXI, fig. 109.

Vegetative cell 26–33×70–165μ; oogonium 44–51×75–100μ; oospore 42–49×50–81μ.

Ecuador; Greenland.

45c. Var. **angustum** Hirn.

(Pl. XXII, figs. 198 and 199.)

1900, p. 146, Pl. XXI, fig. 110; P. B. A. No. 410.

Vegetative cell and oogonium elongated; antheridium to 36-seriate; oogonia sometimes 4; vegetative cell, female 19–30×70–330μ, male 19–25×80–225μ; oogonium 42–52×62–110μ; oospore 40–50×60–89μ; antheridium 18–22×7–15μ.

United States: Massachusetts, Mississippi, Michigan, Illinois; Brazil.

45d. Var. **majus** Hansgirg.

(Pl. XXII, fig. 197.)

1886, p. 45; *Oe. grande* forma *robusta* Hirn 1900, p. 144; Collins 1918, p. 63; *Oe. grande* Kuetz.; Wittr. var. *robustum* (Hirn) Tiffany 1924, p. 186, Pl. III, fig. 7, and 1926, p. 94, Pl. II, fig. 19.

Larger than the type; female vegetative cell 36–46×80–200μ, male 32–42×80–200μ; oogonium 52–68×75–90μ; oospore 50–64×68–88μ; antheridium 30–36×10–16μ.

United States: Illinois, Iowa, Michigan, Ohio, Massachusetts; Austria, Czecko Slovakia, Latvia.

Oe. grande is one of our commonest species. The subobovoid oogonia often in series, with superior pore, the accompanying smaller male filaments with vertical division of the antheridium are distinctive characters. The varieties are distinguished on the basis of size and differences in shape of oogonia.

The common occurence of the distinct, robust variety of *Oe. grande* led to the varietal name *robustum* (Tiffany 1924). Hansgirg's description of the variety *majus* is so near that given above that the prior name must be used, in spite of its relegation by Hirn (1900) to be synonymous with the robust form of the type. Skuja (1927) records a robust form of *Oe. grande* with slightly smaller dimensions, which I have included under the variety *majus*. The dimensions of this variety are from the American material.

46. **Oe. oboviforme** Wittrock.

(Pl. XX, figs. 184 and 185.)

1878, p. 140; De Toni 1889, p. 74; Hirn 1900, p. 141, Pl. XX, fig. 103; Collins 1909, p. 241.

Dioecious, macrandrous; oogonium 1, obovoid, pore superior; oospore obovoid (rarely ellipsoid-obovoid), about filling oogonium, spore wall smooth; antheridium to 19-seriate, sperms 2, division vertical; basal cell elongate; female vegetative cell 21–33×72–280μ; male 21–31×72–270μ; oogonium 55–65×80–107μ; oospore 54–61×70–85μ; antheridium 21–28×5–13μ.

Brazil; Mexico.

Distinguished from *Oe. mexicanum* (No. 44) by longer vegetative cells. Its obovoid and slightly larger oogonia usually separate it from *Oe. grande*, above.

47. **Oe. subrectum** Hirn.
(**Pl. XX, figs. 181-183.**)

1900, p. 141, Pl. XX, fig. 102.

Dioecious, macrandrous; oogonium 1–2, subellipsoid or obovoid-ellipsoid, pore superior; oospore ellipsoid or globose-ellipsoid, filling or nearly filling oogonium, spore wall smooth, often thick; antheridium to 9-seriate, sperms 2, division vertical; basal cell elongate; terminal cell apically obtuse; vegetative cell, female, 27–35×160–340μ, male 26–33×104–300μ; oogonium 70–83×83–103μ; oospore 65–80×75–93μ; antheridium 22–28×8–14μ.

Brazil.

Characterized among the species with obovoid-ellipsoid oogonia by its size and the relatively long vegetative cells.

48. **Oe. landsboroughi** (Hassall) Wittrock.
(**Pl. XXIV, figs. 211 and 212.**)

Vesiculifera landsboroughi Hass. 1842, p. 289, and 1845, p. 197, Pl. 51, fig. 2; *Oe. landsboroughi* Wittr. 1874, p. 35; *Oe. gemelliparum* Pringsh. *in* Rabenh. Alg. Eur. No. 1118, 1861; *Oe. gemelliparum* v. *majus* Wittr. 1870, p. 137; *Oe. tumidulum* Kuetz. *in ibid* No. 1468, 1863; Hirn 1900, p. 135, Pls. XVI and XVII, figs. 94 and 95; Collins 1909, p. 241; Heering 1914, p. 200, fig. 285; Tiffany 1926, p. 93, Pl. II, figs. 12 and 13; P. B. A. No. 663.

Dioecious, macrandrous; oogonium 1–2, (rarely 3), obovoid to ovoid, pore superior; oospore ovoid to ellipsoid, filling or not filling the oogonium, spore wall smooth; antheridium up to 30-seriate; sperms two, division vertical; basal cell elongate, terminal cell obtuse; female vegetative cell 31–40×90–240μ, male 30–37×120–225μ; oogonium 63–78×85–115μ; oospore (55–) 59–70×73–102μ; antheridium 27–35×9–20μ.

United States: Iowa, Ohio, Connecticut, Michigan, Massachusetts, New York, Mississippi; British Columbia; Paraguay, Uruguay; Mexico; Austria, England, Finland, France, Germany, Norway, Russia, Sweden.

48a. Var. **norvegicum** Wittrock.
(**Pl. XXIV, figs. 213 and 214.**)

In Wittr. and Nordst. Alg. Exs. No. 204, 1879; *Oe. landsboroughi* var. *robustum* Wittr. *in* Wittr., Nordst. and Lagerh. Alg. Exs. No. 1215, 1896; Hirn 1900, p. 137, Pl. XVII, figs. 97 and 98; Tiffany 1926, p. 93.

Vegetative cells shorter but of larger diameter; female vegetative cell 38–45×60–160μ, male 36–45×55–135μ; oogonium 64–73×70–105μ; oospore 60–70×67–90μ; antheridium 35–45×8–15μ.

United States: Iowa; Norway; Brazil; Mexico.

It is rather difficult to indicate the exact differences between the *landsboroughi* group and the *crassum* group in the genus,

although one can scarcely confuse the two after some familiarity with them. The shape of the oogonia is quite similar in each, but the oospore is perhaps the most distinctive characteristic. The oospore of *landsboroughi* varies from ovoid to ellipsoid while the oospore of *crassum* varies from ellipsoid to nearly globose. Globose oospores are never present in *Oe. landsboroughi*. The variety *norvegicum* has stouter and shorter vegetative cells. Compare also with *Oe. subrectum* (No. 47) and *Oe. grande* (No. 45).

49. **Oe. crassum** (Hassall) Wittrock.

(Pl. XXIII, figs. 202 and 203.)

(?) *Vesiculifera crassa* Hass. 1842, p. 389; *Oe. crassum* Wittr. 1872a, p. 20, Pl. 1, figs. 4–6; Hirn 1900, p. 139, Pl. XVIII, fig. 99; Heering 1914, p. 200, fig. 286; Tiffany 1926, p. 93, Pl. II, figs. 17 and 18.

Dioecious, macrandrous, oogonium 1–2, ovoid to obovoid-ellipsoid, pore superior; oospore ellipsoid to globose, filling or not filling oogonium, spore walls smooth; antheridium 2–25; sperms 2, division vertical; female vegetative cell 36–50×72–340μ, male 30–36×72–260μ; oogonium 60–78×85–120μ; oospore 58–76×75–96μ; antheridium 28–32×10–20μ.

United States: Iowa, Florida, Ohio, Michigan, Mississippi, Alabama, Indiana; Austria, England, Germany, Sweden; South Africa.

49a. Form **amplum** (Magnus and Wille) Hirn.

(Pl. XXIII, figs. 204 and 205.)

1900, p. 139, Pls. XVIII and XIX, fig. 100; *Oe. amplum* Magnus and Wille *in* Wille 1884, p. 40, Pl. 2, figs. 65 and 66; *Oe. crassum* (Hass.) Wittr. *in* Wille 1884, p. 39, Pl. 2, fig. 64; (?) *Oe. rivulare* (Le Cl.) Al. Br. var. *major* Wolle 1887, p. 92, Pl. 76, fig. 7 and 8.

Of larger dimensions; vegetative cell, female 46–54×70–160μ, male 42–50×65–200μ; oogonium 75–90×83–115μ; oospore 72–85× 77–100μ; antheridium 40–50×8–20μ.

United States: Ohio, Illinois, Mississippi, (?) Florida, Michigan; Uruguay, Brazil.

49b. Var. **longum** Transeau.

(Pl. XXIV, fig. 208.)

1918, p. 237.

Elongated oogonium and oospore; vegetative cell, female 40–52 ×100–240μ, male 36–44×100–180μ; oogonium 68–84×120–180μ; oospore 66–80×100–125μ; antheridium 34–40×8–14μ.

United States: New York (Short Point Bay, Oneida Lake).

49c. Var. **subtumidum** Hirn.

(Pl. XXIII, figs. 206 and 207.)

1900, p. 140, Pl. XIX, fig. 101.

Longer vegetative cells; oogonium and oospore larger than in type; vegetative cell, female 42–50×120–250μ, male 40–48×120–240μ; oogonium 75–85×96–137μ; oospore 67–79×84–100μ; antheridium 34–45×7–15μ.

Brazil; South Africa.

For a discussion of the chief characteristics of the *crassum* group, see notes under *Oe. landsboroughi* (No. 48). The variety *amplum* is larger than the species proper and has shorter vegetative cells than the variety *subtumidum*. Fritsch's form of *crassum* from South Africa is nearest the variety *subtumidum*. The variety *longum* is readily characterized by its elongated oogonia and oospores.

50. **Oe. exocostatum** Tiffany.

(Pl. XXVII, figs. 235-237.)

1921, p. 272, Pl. I, figs. A-F, 1926, p. 94, Pl. V, figs. 51–54.

Dioecious, macrandrous, oogonium 1–2, ellipsoid to ellipsoid-globose, occasionally terminal, pore superior; oospore of the same form as the oogonium, which it very nearly completely fills, spore wall of two layers: the outer marked by 13–15 longitudinal ribs, inner smooth; suffultory cell swollen; male filament a little more slender than the female, antheridium 3–7; sperms 2, division horizontal; basal cell elongate; female vegetative cell (13–) 18–25×72–140μ, male (13–) 16–20 ×48–100μ; suffultory cell 22–30×60–90μ; oogonium 40–52×60–96μ; oospore 38–41×56–68μ; antheridium 12–16×7–12μ.

United States: Iowa, Ohio.

This species is readily distinguished by the presence of longitudinal ribs on the outer layer of the oospore wall. Otherwise it is similar in appearance to *Oe. crenulatocostatum* (No. 57).

51. **Oe. kjellmanii** Wittrock; Hirn.

(Pl. XXVI, fig. 223.)

1900, p. 127, Pl. XIV, fig. 82; Wittr. 1880, *in* Wittr. and Nordst. Alg. Exs. No. 306.

Dioecious, macrandrous; oogonium 1, obovoid or rarely subellipsoid, pore superior; oospore ellipsoid or subellipsoid, not completely filling oogonium, spore wall of 3 layers: outer layer internally ribbed, middle layer with 35–45 slightly crenulate longitudinal ribs, anastomosate, inner layer smooth; antheridium to 30-seriate; sperms 2, division vertical; female vegetative cell 15–22×45–120μ; male 14–18×56–120μ; oogonium 41–50×60–75μ; oospore 39–47×48–57μ; antheridium 12–15× 4–12μ.

Borneo.

Characterized by the large number of longitudinal ribs on the middle layer of the oospore.

52. **Oe. paulense** Nordstedt and Hirn.
(**Pl. XXVI, fig. 224.**)

In Hirn 1900, p. 292, Pl. XIV, fig. 80; Schmidle 1901, p. 344, Pl. XII, fig. 1; Hirn 1906, p. 45, Pl. II, fig. 5.

Monoecious; oogonium 1, subellipsoid or ellipsoid-ovoid, pore superior; oospore ellipsoid, not or quite filling oogonium, spore wall of three layers: outer layer smooth, middle layer with 18–22 longitudinal ribs, entire and sometimes anastomosate, inner layer smooth; antheridium 1–2, subepigynous; sperms 2, division horizontal; vegetative cell 10–15×50–120μ; oogonium 33–38×43–68μ; oospore 30–36×38–45μ; antheridium 10–14×6–8μ.

Brazil; Australia.

Schmidle's record of this species from South America definitely placed it in the monoecious group. Its small size and fewer ribs on the oospore are characteristic.

53. **Oe. paludosum** (Hassall) Wittrock.
(**Pl. XXVI, fig. 231.**)

Oe. paludosum Wittr. 1870, p. 124; (?) *Vesiculifera paludosa* Hass. 1845, p. 199, Pl. 52, fig. 3; Hirn 1900, p. 120, Pl. XIII, fig. 69; Collins 1909, p. 237.

Monoecious; oogonium 1, ellipsoid, pore superior; oospore ellipsoid, filling oogonium, spore wall in three layers: outer and middle layers with 27–35 longitudinal ribs, continuous, rarely anastomosate; antheridium 1–8, scattered, often in the upper part of the filament; sperms 2, division vertical; vegetative cell 15–20×50–140μ; oogonium 39–48×66–84μ; oospore 36–45×54–63μ; antheridium 14–16×6–13μ.

United States: Illinois, Pennsylvania; British Columbia, Norway, England, Sweden.

53a. Var. **americanum** Nordstedt.
(**Pl. XXVII, fig. 233.**)

In Hirn 1900, p. 121, Pl. XIII, fig. 72; Collins 1909, p. 237.

Oogonium larger; vegetative cell 14–23×45–156μ; oogonium 54–63×75–90μ; oospore 49–57×69–75μ; antheridium 12–18×7–12μ.

United States: South Carolina.

53b. Var. **parvisporum** Hirn.
(**Pl. XXVI, fig. 232.**)

1900, p. 120, Pl. XIII, fig. 70; (?) *Oe. pringsheimiana* Archer 1868, p. 295; (?) *Oe. archerianum* Cooke 1884, p. 157; Borge 1913, p. 63, fig. 1.

Oogonium subellipsoid or suboblong-ellipsoid; oospore not filling oogonium; antheridium subepigynous or subhypogynous or scattered; vegetative cell 15–20×45–120μ; oogonium 38–44×70–86μ; oospore 35–41×54–60μ; antheridium 15–17×7–12μ.

United States: Illinois, Michigan, Ohio; Spain, Sweden.

Oe. paludosum is to be compared with *Oe. boscii* (No. 55) from which it differs in being monoecious. The two varieties are distinguished chiefly by relative sizes and by differently shaped and incompletely filled oogonia.

54. **Oe. leiopleurum** Nordstedt and Hirn.
(**Pl. XXVI, figs. 221 and 222.**)

In Hirn 1900, p. 126, Pl. XIV, fig. 79; *Oe. kjellmanii* Wittr. *in* Nordst. 1888a, p. 196.

Dioecious, macrandrous; oogonium 1–4, obovoid (or ellipsoid-obovoid) or subellipsoid, pore superior; oospore obovoid-ellipsoid or subellipsoid, usually filling oogonium, spore wall in three layers: outer and middle layers with 26–30 longitudinal ribs, entire, sometimes anastomosate, inner layer smooth; antheridium to 24-seriate, sperms 2, division horizontal; basal cell elongate; terminal cell apically obtuse; female vegetative cell 15–25×45–170μ, male 15–17×45–85μ; oogonium 40–51×65–83μ; oospore 39–49×50–68μ; antheridium 15–17×7–15μ.

Africa.

To be compared with *Oe. boscii* below. Its large number of seriate antheridia and usually completely filled oogonia are characteristic.

55. **Oe. boscii** (Le Clerc) Wittrock.
(**Pl. XXVI, figs. 225 and 226.**)

1874, p. 34; (?) *Prolifera Boscii* Le Clerc 1817, p. 474, Pl. 23, fig. 5; *Conferva vesicata* Ag. *in* Desmaz. Exs. 1845; Hirn 1900, p. 122, Pl. XIII, fig. 73; Wittr., Nordst. and Lagerh. Alg. Ex. No. 1213.

Dioecious, macrandrous; oogonium 1 (rarely 2), oblong-ellipsoid, pore superior; oospore ellipsoid, not nearly filling oogonium longitudinally, spore wall of three layers: outer and middle layers with 27–35 continuous, rarely anastomosate, longitudinal ribs; antheridium 1–8, scattered, often in upper part of filament; sperms 2, division vertical; vegetative cell, female 14–23×45–135μ, male 13–18×52–108μ; oogonium 39–51×75–110μ; oospore 36–43×56–70μ; antheridium 13–14 ×6–16μ.

United States: Connecticut, Massachusetts, Iowa, California, Illinois, Ohio, Mississippi; Austria, England, Finland, France, Germany, Switzerland, Norway, Latvia, Sweden; Brazil; Greenland; British Columbia.

55a. Form **dispar** Hirn.
(**Pl. XXVI, fig. 230.**)

1900, p. 124, Pl. XIV, fig. 76; P. B. A. No. 1226.

Oospore smaller, ellipsoid-globose or subglobose; vegetative cell 14–21×60–170μ; oogonium 38–45×70–92μ; oospore 34–43×44–55μ.

United States: Massachusetts, Pennsylvania, California.

55b. Var. **notabile** Lemmermann.

(Pl. XXVI, fig. 229.)

1898, p. 511, Pl. 5, figs. 21–23; Hirn 1900, p. 125, Pl. XIV, fig. 78.

Oogonium suboblong-obovoid; oospore obovoid or ellipsoid-obovoid; vegetative cell 15–20×60–150μ; oogonium 45–50×90–105μ; oospore 44–49×75–85μ.

Germany.

55c. Var. **occidentale** Hirn.

(Pl. XXVI, figs. 227 and 228.)

1900, p. 125, Pl. XIV, fig. 77, P. B. A. No. 1671.

Smaller; vegetative cell 8–15×50–165μ; oogonium 33–38×75–100μ; oospore 32–37×45–50μ; antheridium 12–13×10–16μ.

United States: Maine.

To be compared with *Oe. paludosum* (No. 53) and *Oe. leiopleurum* (No. 54).

56. **Oe. margaritiferum** Nordstedt and Hirn.

(Pl. XXVII, fig. 234.)

In Hirn 1900, p. 128, Pl. XV, fig. 83.

Dioecious, macrandrous; oogonium 1, suboblong-ellipsoid or subobovoid-ellipsoid or subellipsoid, pore superior; oospore ellipsoid or globose-ellipsoid, usually not filling oogonium longitudinally (rarely quite filling it), spore wall of three layers: outer and middle layer with 30–35 granulate, anastomosate, longitudinal ribs, inner layer smooth; antheridium to 10-seriate; sperms 2, division vertical; female vegetative cell 23–28×82–190μ, male 17–23×70–160μ; oogonium 50–63×82–100μ; oospore 48–61×55–75μ; antheridium 18–20×7–13μ.

Brazil.

The granulate ribs of the oospore are distinctive. Compare with *Oe. kjellmanii* (No. 51).

57. **Oe. crenulatocostatum** Wittrock.

(Pl. XXVIII, figs. 240 and 241.)

1878, p. 139; (?) *Oe. apiculatum* Wolle 1877, p. 188; Hirn 1900, p. 129, Pl. XV, fig. 84; Collins 1909, p. 239; Heering 1914, p. 198, fig. 280; Tiffany 1926, p. 94, Pl. V, figs. 48–50.

Dioecious, macrandrous; oogonium 1–6, obovoid to subellipsoid, often terminal, pore superior; oospore of the same form as the oogonium, which it nearly or quite fills, outer spore wall smooth, median wall with 14–20 longitudinal ribs, crenulate and sometimes anastomosing, inner wall smooth; antheridium 2–6, often alternating with vegetative cell; sperms 2, division horizontal; terminal cell obtuse to broadly apiculate; female vegetative cell 10–18×25–125μ, male 9–13×32–80μ; oogonium 30–36×40–65μ; oospores 28–34×37–55μ; antheridium 9–12×9–14μ.

United States: Pennsylvania, Iowa, New York, Massachusetts, Ohio, Illinois, Connecticut, New Hampshire, Michigan.

57a. Form **cylindricum** Hirn.

(**Pl. XXVIII, fig. 244.**)

1900, p. 129, Pl. XV, fig. 85; *Oe. boscii* (Le Cl.) Wittr. *in* P. B. A. No. 118, 1895.

Oogonium and oospore cylindric-oblong or more rarely ellipsoid or obovoid-ellipsoid; ribs of oospore scarcely crenulate; vegetative cell 11–16×44–150μ; oogonium 30–36×42–81μ; oospore 27–34×40–65μ.

United States: Massachusetts, Connecticut, Missouri, Illinois, New Hampshire.

57b. Var. **aureum** Tilden.

(**Pl. XXVIII, fig. 245.**)

In Amer. Algae, Nos. 123 and 186, 1896; 1898, p. 90, Pl. 8, figs. 1–3; Hirn 1900, Pl. XV, p. 130, fig. 87.

Oospore obovoid to globose-ellipsoid, not completely filling oogonium, middle spore wall with dentate ribs (sometimes nearly areolate); vegetative cell 10–13×35–110μ; oogonium 30–35×38–50μ; oospore 29–33×35–43μ; antheridium 10×10μ.

United States: Colorado.

57c. Var. **longiarticulatum** Hansgirg.

(**Pl. XXVIII, figs. 242 and 243.**)

1888, p. 46; *Oe. calosporum* Hirn 1895, p. 20, Pl. 1, fig. 3; Hirn 1900, p. 130, Pl. XV, fig. 86.

Oogonium single; oospore obovoid to nearly ellipsoid, not filling oogonium, ribs of median layer of spore wall distinctly crenate; vegetative cell 12–15×60–90μ; oogonium 27–30×58–60μ; oospore 24–27×44–52μ.

United States: Michigan, Massachusetts; Austria, Finland; Brazil.

There exists considerable variation in the members of the *crenulatocostatum* group. The crenate or crenulate ribs (sometimes nearly smooth), the usually seriate oogonia, and small size are characteristic. Cf. *Oe. exocostatum* (No. 50). The variety *aureum* has dentate ribs which sometimes appear nearly areolate. It is felt, after examining hundreds of specimens of this group, that the above form and varieties are usually sufficiently distinct to be recognized. Ecological variants are common and to give varietal distinction to each of these is merely to make a difficult situation worse. Plants of *longiarticulatum* from Brazil are slightly smaller in all dimensions than those given above (Borge).

58. **Oe. arcyosporum** Nordstedt and Hirn.
(**Pl. XXVIII, fig. 247.**)

In Hirn 1900, p. 104, Pl. VII, fig. 44.

Monoecious; oogonium 1–5, obovoid to ellipsoid-globose, pore superior; oospore ellipsoid-globose to subglobose, not usually filling oogonium, spore wall of three layers: outer smooth, median areolate, inner smooth; antheridium 1–4, subepigynous to subhypogynous; vegetative cell 13–20×50–200μ; oogonium 41–55×43–68μ; oospore 38–50×40–55μ; antheridium 11–15×8–12μ.

Brazil.

The only monoecious form with an areolate oospore wall.

59. **Oe. areolatum** Lagerheim.
(**Pl. XXVIII, figs. 248-250.**)

1890, p. 80 and 89; Hirn 1900, p. 105, Pl. VII, fig. 45; Tiffany 1926, p. 91.

Dioecious, macrandrous; oogonium 1–4, obovoid or obovoid-globose, with superior pore; oospore subellipsoid or ellipsoid-globose, filling or not filling oogonium, middle layer of spore wall areolate; antheridium 3–12, sperms 2; basal cell elongate; terminal cell apically obtuse; female vegetative cell 16–21×65–165μ, male 15–19×60–140μ; oogonium 48–60×60–75μ; oospore 45–57×48–60μ; antheridium 14–17×8–10μ.

United States: Iowa, Ohio; Ecuador, Brazil. ♀♂

This species is to be compared with *Oe. hoehnei* (No. 202). It is one of the few dioecious macrandrous forms with areolate oospores.

60. **Oe. dictyosporum** Wittrock.
(**Pl. XXVIII, fig. 246.**)

1874, p. 13; Hirn 1900, p. 103, Pl. VII, fig. 43; Tiffany 1926, p. 99.

Monoecious; oogonium 1–2, obovoid-globose, with superior pore; oospore globose to ellipsoid-globose, usually not filling oogonium, outer layer of spore wall reticulate, inner smooth; antheridium 1–3, subepigynous; sperms 2; vegetative cell 11–16×25–95μ; oogonium 33–40×38–46μ; oospore 28–38×30–40μ; antheridium 8–13×5–10μ.

United States: Iowa; Brazil; Africa.

60a. Form **westii** Tiffany.

1929, p. 74; *Oe. dictyosporum* Wittr. forma West 1907, p. 98.

Oogonium and oospore ovoid-ellipsoid; a little larger; vegetative cell 14–16×50–80μ; oogonium 42×52μ; oospore 40×50μ; antheridium 13×8–9μ.

Africa.

The only monoecious representatives of the genus with reticulate oospores are *Oe. dictyosporum* and its f. *westii*. The latter is a little larger than the type and is better recognized as a form until we have more data on its distinctive characteristics.

61. **Oe. foveolatum** Wittrock.

(Pl. XXIX, fig. 252.)

1878, p. 133; Hirn 1900, p. 106, Pl. VII, fig. 46.

Monoecious; oogonium 1–2, obovoid to subellipsoid-globose, with superior pore; oospore globose to subellipsoid-globose, filling or not filling oogonium, outer spore wall scrobiculate; antheridium 1–7; sperms two, division horizontal; basal cell elongate, terminal cell apically obtuse; vegetative cell 14–23×35–115μ; oogonium 37–49×38–57μ; oospore 33–46×34–48μ; antheridium 15–19×8–12μ.

Brazil; St. Thomas Island.

The only monoecious representative of the genus with scrobiculate oospores.

62. **Oe. scrobiculatum** Wittrock.

(Pl. XXIX, figs. 258 and 259.)

In Wittr. and Nordst. Alg. Exs. No. 1018, 1893; Hirn 1900, p. 133, Pl. XV, fig. 90.

Dioecious, macrandrous; oogonium 1–3, obovoid or subellipsoid, pore superior; oospore of same form as oogonium and nearly filling it, outer spore wall scrobiculate, inner smooth; antheridium 1–?, sperms 2, division horizontal; female vegetative cell 16–24×50–144μ, male 15–19×45–110μ; suffultory cell 21–30×34–90μ; oogonium 40–48×60–88μ; oospore 39–45×48–57μ; antheridium 13–15×8–12μ.

Ecuador.

Cf. *Oe. verrucosum* (No. 63) and *Oe. tiffanii* (No. 64).

63. **Oe. verrucosum** Hallas.

(Pl. XXXI, figs. 272-274.)

1905, p. 408, fig. 17; Hirn 1906, p. 24, Pl. II, fig. 8.

Dioecious, macrandrous; oogonium 1–2, broadly ellipsoid or obovoid-globose, pore superior; oospore globose or ellipsoid-globose, not filling oogonium, middle layer of spore wall scrobiculate; suffultory cell tumid; antheridium 4–?; sperms 2, division horizontal; basal cell elongate; terminal cell, frequently an oogonium, obtuse; vegetative cell, female 11–26×45–200μ; oogonium 56–68×56–94μ; oospore 52–64×44–68μ; antheridium 16×16μ; suffultory cell 19–49×30–145μ; basal cell 30–35×45–160μ.

United States: Michigan; Denmark.

Cf. *Oe. scrobiculatum* above and *Oe. tiffanii* below. The antheridial filaments of *Oe. verrucosum* are very short, usually consisting only of a holdfast cell and a few antheridial cells.

64. **Oe. tiffanii** Ackley.

(Pl. XXX, figs. 261-263.)

1929, p. 304, Pl. XXXVI, figs. 15 and 16.

Dioecious, macrandrous; oogonium 1–2, subdepressed-globose or broadly pyriform-globose, pore superior; oospore globose, nearly filling

oogonium, median layer of spore wall scrobiculate; suffultory cell enlarged; antheridium 1–7, division horizontal, sperms 2; basal cell ellipsoid-elongate; vegetative cell 21–22×100–240μ; suffultory cell 25–32×100–230μ; oogonium 64–76×65–69μ; oospore 54–65×55–66μ; antheridium 19–21×14–20μ.

United States: Michigan (Muskegon Lake).

Oe. tiffanii is to be compared with *Oe. scrobiculatum* (No. 62) and *Oe. verrucosum* above. These three normally have smaller suffultory cells and are thus separated from Nos. 65-69.

65. **Oe. punctatum** Wittrock.

(Pl. XXIX, figs. 255 and 256.)

1878, p. 142; De Toni 1889, p. 84; Hirn 1900, p. 132, Pl. XV, fig. 89.

Dioecious, macrandrous; oogonium 1–4, obovoid (rarely globose-obovoid), pore superior; oospore obovoid, nearly filling oogonium (rarely subglobose and not filling oogonium), outer spore wall scrobiculate; antheridium 1–5, often alternating with vegetative cell; sperms 2, division horizontal; basal cell elongate terminal cell (often oogonium) apically obtuse; vegetative cell 15–22×42–128μ; oogonium 38–45×52–65μ; oospore 37–43×43–55μ; antheridium 15–17×6–10μ.

Mexico.

Oe. punctatum, *Oe. argenteum* (No. 66), *Oe. wyliei* (No. 67), and *Oe. americanum* (No. 68) should be compared in identifying forms with scrobiculate oospores and non-tumid suffultory cells. They are easily separable on the basis of size.

66. **Oe. argenteum** Hirn.

(Pl. XXIX, figs. 253 and 254.)

Hirn 1900, p. 289, Pl. VII, fig. 47; Ackley 1929, p. 302.

Dioecious, macrandrous; oogonium 1, obovoid-globose to globose, pore superior (rarely supramedian); oospore ovoid to globose, outer layer of spore wall scrobiculate; antheridia 3–4, sperms 2, division horizontal; basal cell elongate; female vegetative cell (14–) 20–28×80–160μ, male 20–22×70–160μ; oogonium 44–52×48–62μ; oospore 43–48×44–50μ; antheridium 22×8μ.

United States: Michigan; Brazil.

The figure of *Oe. argenteum* in Pl. XXIX is that of Hirn and represents also one of the variations occurring in the Michigan material. The outer oospore wall of the alga seen by Hirn (1900) is undoubtedly scrobiculate. Ornamentations on oospore walls are quite regularly constant for a given species, appearing definitely on one layer or another. The Michigan specimens (Ackley 1929) contained oospores whose middle wall layer was scrobiculate with an apparently smooth and very thin outer layer. It is perhaps best to include, for the present at least,

only those specimens that conform to the above description. If it develops that these forms with a middle scrobiculate wall may also have the outer wall scrobiculate, the description will have to be emended accordingly. The former had best be considered a form:

66a. Form **michiganese** Tiffany nov. f.

Oe. argenteum Hirn (in part) *in* Ackley 1929, p. 302, Pl. XXXV, fig. 3-6.

Middle wall of oospore scrobiculate; pore of oogonium supramedian; otherwise as in the type.

United States: Michigan.

67. **Oe. wyliei** Tiffany.

(Pl. XXX, figs. 264-267.)

1926, p. 90, Pl. I, figs. 1-4.

Dioecious, macrandrous; oogonium 1–4, globose to ovoid, pore superior; oospore globose to ovoid, filling or not filling oogonium, outer spore wall irregularly scrobiculate; antheridium 1–4; sperms 2, division horizontal; basal cell elongate; terminal cell, often an oogonium, apically obtuse or broadly apiculate; vegetative cell 16–24×80–170μ; oogonium 52–64×68–112μ; oospore 48–60×52–64μ; antheridium 16–19 ×8–18μ.

United States: Iowa, Michigan.

See *Oe. punctatum* (No. 65).

68. **Oe. americanum** Transeau.

(Pl. XXXI, figs. 275 and 276.)

1917, p. 231.

Dioecious, macrandrous; oogonium 1, globose to depressed-globose, pore superior; oospore globose, ellipsoid-globose, or depressed-globose, filling oogonium or not, spore wall of three layers: median layer scrobiculate; antheridium 1–5, frequently alternating with vegetative cell; sperms 2, division horizontal; basal cell elongate; terminal cell obtuse; female vegetative cell 28–48×40–100μ, male vegetative cell 24–30× 40–100μ; oogonium 40–76×48–70μ; oospore 38–74×46–56μ; antheridium 20–28×4–12μ.

United States: Michigan, Illinois.

See *Oe. punctatum* (No. 65).

69. **Oe. taphrosporum** Nordstedt and Hirn.

(Pl. XXXI, figs. 270 and 271.)

In Hirn 1900, p. 133, Pl. XVI, fig. 91; Collins 1909, p. 239; P. B. A. No. 813.

Dioecious, macrandrous; oogonium 1–6, obovoid or obovoid-ellipsoid, pore superior; oospore globose or ellipsoid globose, not filling oogonium, outer layer of spore wall scrobiculate, inner layer smooth; antheridium 2–?; terminal cell, sometimes an oogonium, obtuse; basal cell elongate;

vegetative cell 25–38×100–375μ; oogonium 70–83×81–113μ; oospore 58–65×62–70μ; antheridium 24–32×8–12μ.

United States: Massachusetts, Michigan, Illinois; Brazil; India; Columbia.

This species is readily recognized by its large size and its scrobiculate oospore, the latter not filling the oogonium. West (1914) recorded the alga from Columbia with vegetative cells 19-22μ in diameter, and with oogonia and oospores slightly smaller than the dimensions given above.

70. **Oe. pseudacrosporum** Wittrock.

(**Pl. XXX, figs. 268 and 269.**)

In Hirn 1900, p. 193, Pl. XXXII, fig. 196.

Monoecious; oogonium 1, ellipsoid, operculate, division supreme, lid very small and often deciduous; oospore ellipsoid, completely filling oogonium, spore wall coalescing with that of oogonium, longitudinally ribbed, ribs evidently crenulate; antheridium 1–4, hypogynous or subepigynous; sperms 2, division horizontal; basal cell elongate; terminal cell long, setiform; vegetative cell 9–13×32–110μ; oogonium (27–) 32–37×(40–) 45–56μ; antheridium 8–10×6–10μ.

United States: Iowa, Florida; Sweden.

Its monoecious habit, supreme operculum, and ribbed oospore are characteristic. It should be compared with the nannandrous *Oe. acrosporum* (No. 195).

71. **Oe. paucocostatum** Transeau.

(**Pl. XXXII, fig. 277.**)

1914, p. 300, Pl. XXVIII, fig. 5; Collins 1918, p. 66; Tiffany 1926, Pl. V, figs. 55 and 56.

Dioecious, macrandrous; oogonium 1, ellipsoid, operculate, division superior; oospore ellipsoid, nearly filling the oogonium, outer wall smooth, median wall longitudinally ribbed, ribs 15–19 in number, inner wall smooth; antheridium 2–8, sperms 2, division horizontal; terminal cell obtuse, basal cell usually elongate; vegetative cell, female (15–) 19–25 ×70–160μ; oogonium 54–60×70–104μ; oospore 50–56×66–90μ; antheridium 18–23×8–12μ.

United States: Illinois, Iowa, Ohio.

71a. Var. **gracilis** Tiffany.

(**Pl. XXXII, fig. 278.**)

1921, p. 273; 1926, p. 99.

Somewhat smaller than the species, oospore ellipsoid or occasionally globose-ellipsoid, completely filling the oogonium or not filling the oogonium; otherwise similar to the type; vegetative cell 15–20×66–120μ; oogonium 48–52×70–88μ; oospore 44–48×60–70μ; antheridium 17–20× 8–12μ.

United States: Ohio, Iowa.

Oe. paucocostatum is characterized among the species with ellipsoid oogonia and longitudinally ribbed oospores by the small number of ribs and by its relatively smaller dimensions. Its nearest relative is the larger *Oe. australianum* (No. 72).

72. **Oe. australianum** Hirn.

(**Pl. XXXII, figs. 283 and 284.**)

1900, p. 192, Pl. XXXI, fig. 192.

Dioecious, macrandrous; oogonium 1–2, ellipsoid, operculate, division superior; oospore ellipsoid or globose-ellipsoid, practically filling oogonium, median layer of spore wall longitudinally ribbed, ribs 17–23, sometimes anastomosing; antheridium to 6-seriate; vegetative cell 17–22×70–170μ; oogonium 59–74×74–96μ; oospore 56–70×59–74μ; antheridium 14–16×10–15μ.

Australia.

Cf. *Oe. paucocostatum*, above.

73. **Oe. tumidulum** (Kuetzing) Wittrock.

(**Pl. XXXII, figs. 281 and 282.**)

1874, p. 35; *Conferva tumidula* English Botany No. 1670 *in* Kuetz. Dec. Alg. No. 60, 1833; Hirn 1900, p. 191, Pl. XXXI, fig. 191.

Dioecious, macrandrous; oogonium 1, subellipsoid, operculate, division superior; oospore ellipsoid or globose-ellipsoid, quite filling oogonium, outer layer of spore wall with 40–50 longitudinal ribs granulate and sometimes anastomosate, inner layer smooth; antheridium to 45-seriate; sperms 2, division horizontal; vegetative cell, female 18–25×65–125μ, male 15–20×60–120μ; oogonium 52–63×78–90μ; oospore 49–58×61–75μ; antheridium 15–20×9–15μ.

Germany.

Oe. tumidulum is the only dioecious, macrandrous member of the genus having the combination of subellipsoid oogonia with superior pore and more than 40 longitudinal ribs on the oospore. Cf. the monoecious *Oe. insigne* (No. 75).

74. **Oe. nobile** Wittrock.

(**Pl. XXXII, fig. 279.**)

1874, p. 14; Hirn 1900, p. 189, Pl. XXX, fig. 188.

Monoecious; oogonium 1 (very rarely 2), ellipsoid or subobovoid-ellipsoid, operculate, division superior; oospore ellipsoid-globose or globose, not filling oogonium, spore wall of three layers: outer layer smooth, middle layer with 30–35 continuous longitudinal ribs, rarely anastomosate, inner layer smooth; antheridium 1–3, hypogynous; sperms 2, division horizontal; vegetative cell 16–20×80–180μ; oogonium 57–65×67–90μ; oospore 48–55×50–58μ; antheridium 15–19×9–13μ.

Norway.

74a. Var. **minus** Hirn.

(**Pl. XXXII, fig. 280.**)

1900, p. 190, Pl. XXX, fig. 189; *Oe. insignis* Hirn var. *minus* Hirn 1895, p. 15.

Larger oospore, ellipsoid, filling oogonium; vegetative cell 13–20×80–240μ; oogonium 60–63×85–100μ; oospore 56–59×68–80μ; antheridium 16–19×12–17μ.

United States: Massachusetts; Finland.

Oe. nobile is near the larger *Oe. insigne* (No. 75) and differs from *Oe. tumidulum* (No. 73) in being monoecious. The variety *minus* sometimes has smaller vegetative cells and always a larger oospore than the type.

75. **Oe. insigne** Hirn.

(**Pl. XXXIII, fig. 285.**)

1895, p. 14, Pl. 1, fig. 2; 1900, p. 191, Pl. XXX and XXXI, fig. 190.

Monoecious; oogonium 1, ellipsoid-obovoid, operculate, division superior; oospore ellipsoid, quite filling oogonium, spore wall of three layers: outer smooth, inner longitudinally ribbed, the ribs quite entire, anastomosate, 40–45 in number, inner smooth; antheridium 1–7, subepigynous, rarely scattered; sperms 2, division horizontal; vegetative cell (18–) 25–38×75–210μ; oogonium 70–78×100–120μ; oospore 65–75×88–104μ; antheridium 23–27×15–23μ.

Finland.

Cf. *Oe. tumidulum* (No. 73) and *Oe. nobile* (No. 74).

76. **Oe. excisum** Wittrock and Lundell.

(**Pl. XXXIV, fig. 317.**)

In Wittr. 1872, p. 3, Pl. 1, figs. 1–4; Hirn 1900, p. 153, Pl. XXIV, fig. 126.

Monoecious; oogonium 1, subconically oblong, medianly plicate with about 9 longitudinal undulations, operculate, division median and broad; oospore ellipsoid with a median constriction, not filling oogonium, spore wall smooth; antheridium 1–2, subepigynous or hypogynous, often terminal; sperm (?) 1; basal cell subhemispherical; terminal cell apically obtuse; vegetative cell 3–6×14–44μ; oogonium 13–15×18–26μ; oospore 9–12×15–18μ; antheridium 3–4×6–7μ; basal cell 8–9×4–5μ.

Finland, Sweden, Latvia.

Oe. excisum is one of the very few species of the genus having an oospore with a median constriction. It is near *Oe. pusillum* (No. 221), from which it differs in having undulate folds in the oogonium.

77. **Oe. inversum** Wittrock.

(**Pl. XXXIII, figs. 295-297.**)

1876, p. 47, Pl. 13, figs. 22–24; (?) *Oe. monticchii* Fiorini-Mazzanti 1860, p. 259, Pl. 1, figs. 3, 4, 4a, 4b; Hirn 1900, p. 179, Pl. XXVIII, fig. 171; *Oe. inversum* Wittr. var. *subclusum* Wittr. *in* Wittr. and Nordst. Alg. Exs. No. 26, 1877; *Oe. inversum* Wittr. f. *subclusum* (Wittr.) Hirn 1900, p. 180, Pl. XXVIII, fig. 172; Heering 1914, p. 203, fig. 290; Tiffany 1926, p. 95, Pl. VI, figs. 59–62.

Dioecious, macrandrous; oogonium 1, globose, operculate, division inferior; oospore globose, quite filling the oogonium, spore wall smooth; antheridium 1–8; sperm 1; vegetative cell capitellate; basal cell subhemispherical, not elongate; filament not infrequently incrusted with lime; female vegetative cell 12–14×25–100μ, male 9–11×20–80μ; oogonium (28–) 32–35×30–34μ; oospores (27–) 30–32×27–30μ; antheridium 10–12×9–12μ; basal cell 13–20×7–14μ.

United States: Iowa; Australia; Austria, France, Germany, Sweden, Switzerland; Africa.

Easily distinguished among the macrandrous species by the inferior position of the operculum. It is in some respects similar to *Oe. infimum* below. The f. *subclusum*, according to the Iowa material (Tiffany 1926), is merely an ecological variant and is not tenable. The variations of the species proper include the form.

78. **Oe. infimum** Tiffany.

(**Pl. XXXIII, figs. 289-292.**)

1924, p. 183, Pl. II, figs. 6–9; 1926, p. 95, Pl. VI, figs. 59–62.

Dioecious, macrandrous; oogonium 1, globose or subglobose (or the basal part extended, appearing subpyriform-globose), operculate, division at the lowest extremity of the oogonium; oospores globose or subglobose, membrane smooth; male plants a little larger than the female; antheridium 1–10; sperms 2; vegetative cells distinctly capitellate; basal cell of filament subhemispherical, not elongated; filaments not infrequently incrusted with lime; female vegetative cells 12–18× 60–140μ, male 16–20×60–140μ; oogonium 40–48×41–50μ; oospore 40–44×38–42μ; antheridium 14–20×8–12μ; basal cell 30–42×16–24μ.

United States: Iowa.

Oe. infimum is the only known member of the genus with the operculum located at the lowest extremity of the oogonium. It is further characterized by its evidently capitellate vegetative cells.

79. **Oe. howardii** West.

(**Pl. XXXIII, fig. 293.**)

1904a, p. 281, Pl. 464, figs. 1–5; Hirn 1906, p. 16, Pl. III, fig. 9.

Dioecious, macrandrous; oogonium 1–2, globose (or subglobose), operculate, division median, distinct; oospore globose (or subdepressed-globose) filling oogonium; antheridium to 16-seriate, sperm (?) 1; vegetative cell broadly capitellate; basal cell subhemispherical, scarcely elongate; vegetative cell, female 9–12×20–44μ; male 7–9×16–35μ; oogonium 29–33×29–33μ; oospore 25–29×25–29μ; antheridium 7–9× 8–14μ; basal cell 14–16×10–11μ.

West Indies: Barbados.

79a. Var. **minus** Tiffany.

(**Pl. XXXIII, fig. 294.**)

1927, p. 204, Pl. IX, figs. 6 and 7 (as v. *minor*).

Smaller than the type; vegetative cell 7–9×27–48μ; oogonium 26–29×28–36μ; oospore 24–26×24–26μ; antheridium 7–8×10–12μ; basal cell 12–14×10–12μ.

United States: Illinois.

Oe. howardii has broadly capitellate vegetative cells as in *Oe. infimum* (No. 78) and *Oe. inversum* (No. 77), but differs from both in the median position of its operculum. It is perhaps nearest *Oe. latiusculum* (No. 81), the latter being larger and possessing a very wide division of the oogonium. The variety *minus* is characterized chiefly by its smaller size and subspherical basal cell.

80. **Oe. pratense** Transeau.

(**Pl. XXXIV, figs. 298 and 299.**)

1914, p. 297, Pl. XXIX, figs. 9–12; Collins 1918, p. 66; Tiffany 1926, p. 96, Pl. I, figs. 10 and 11.

Dioecious, macrandrous; oogonium 1 (rarely 2), subdepressed-globose or broadly pyriform-globose, operculate, division median, narrow but distinct; oospore depressed-globose or subglobose, filling or nearly filling oogonium, spore wall smooth; antheridium 1–2, usually alternating with vegetative cell; sperm 1; basal cell elongate; vegetative cell, female 10–17×35–95μ, male 8–15×32–82μ; oogonium 33–40×35–50μ; oospore 32–38×28–35μ; antheridium 10–14×13–18μ.

United States: Illinois, Iowa, Ohio, Alabama, Mississippi, Michigan.

Oe. pratense is distinguished from *Oe. latiusculum* below by the narrow opening of the operculum and by its cylindrical vegetative cells. The latter character together with its larger size separates it from *Oe. howardii* (No. 79). The basal cell of *Oe. pratense* is uniformly elongate. Among the monoecious forms it bears some resemblance to *Oe. acmandrium* (No. 82) and *Oe. psaegmatosporum* (No. 83).

81. **Oe. latiusculum** Tiffany.

(**Pl. XXXIII, figs. 287 and 288.**)

1924, p. 182, Pl. III, figs. 4–6; 1926, p. 96, Pl. VI, figs. 72–74.

Dioecious, macrandrous; oogonium 1–2, globose to ellipsoid-globose; oogonium operculate, division median, very wide; oospore of the same form as the oogonium which it very nearly or completely fills, wall smooth; male plant somewhat larger than the female; antheridium 1, usually alternating with a single vegetative cell, sperm 1; vegetative cell distinctly capitellate; basal cell of filament subhemispherical, not elongated; filament not infrequently incrusted with lime; female veg-

etative cell 10–18×16–40μ, male 14–20×16–40μ; oogonium 32–36× 32–40μ; oospore 28–32×28–34μ; antheridium 14–18×12–20μ; basal cell 16–24×12–16μ.

United States: Iowa, Mississippi, Alabama, Kentucky.

The wide operculum, the capitellate vegetative cells, the single antheridium alternating with a vegetative cell, and the subhemispherical basal cell are characteristic of the species.

82. **Oe. acmandrium** Elfving.
(**Pl. XXXIV, fig. 300.**)

In Hirn 1895, p. 13; Hirn 1900, p. 150, Pl. XXIII, fig. 120.

Monoecious; oogonium 1–2, depressed-globose or subglobose, operculate, division median and narrow; oospore depressed-globose or subglobose, filling oogonium, wall smooth; antheridium 1–3, subepigynous, epigynous, or hypogynous, often terminal; sperm single; basal cell elongate; vegetative cell 7–10×30–80μ; oogonium 30–35× 28–38μ; oospore 28–33×25–29μ; antheridium 8–10×10–15μ.

United States: Illinois; Finland, Sweden; India.

Cf. *Oe. pratense* (No. 80) and *Oe. psaegmatosporum* below.

83. **Oe. psaegmatosporum** Nordstedt.
(**Pl. XXXIV, fig. 301.**)

1877, p. 24, Pl. 3, fig. 1–3; Hirn 1900, p. 150, Pl. XXIII, fig. 121.

Monoecious; oogonium 1–5, broadly pyriform-globose, operculate, division median, narrow but distinct; oospore depressed-globose to globose, inflating the middle part of oogonium, spore wall (?) smooth; antheridium to 15-seriate, hypogynous, cell a little tumid; sperm single; vegetative cell 9–10×56–80μ; oogonium 28–33×33–40μ; oospore 27–31×24–27μ; antheridium 9–12×6–10μ.

Denmark, Sweden.

Near *Oe. acmandrium* above, differing in its pyriform-globose and medianly inflated oogonia and many-seriate antheridia.

84. **Oe. minus** Wittrock.
(**Pl. XXXIV, fig. 302.**)

1874, p. 9; *Oe. punctato-striatum* var. *minor* Wittr. 1870, p. 123; *Oe. spirogranulatum* Schmidle 1894, p. 43, Pl. 7, fig. 1; Hirn 1900, p. 151, Pl. XXIII, fig. 122.

Monoecious; oogonium 1, pyriform-globose or depressed-globose, operculate, division median, wide; oospore depressed-globose, not filling oogonium, spore wall smooth; antheridium to 10-seriate, subepigynous or subhypognous or rarely scattered, cells a little tumid; sperm 1; vegetative cell somewhat capitellate; wall of vegetative cell and of oogonium spirally punctate; basal cell depressed-globose or subhemispherical, wall vertically plicate; vegetative cell 9–13×30–78μ; oogonium 34–46×28–42μ; oospore 30–42×26–36μ; antheridium 9–13× 3–5μ.

United States: Massachusetts, Michigan; Finland, Germany, Spain, Norway, Sweden, Latvia, Russia.

Oe. minus is one of the few species of the genus with spirally punctate vegetative cell and oogonial walls. It is easily separable from the nannandrous *elegans* (No. 155) and the macrandrous *punctatostriatum* (No. 85) not only by its monoecious habit but also by its size.

85. **Oe. punctatostriatum** De Bary.
(Pl. XXXIV, figs. 303 and 304.)

1854, p. 47, Pl. 2, figs. 15 and 16; Hirn 1900, p. 152, Pl. XXIII, fig. 123.

Dioecious, macrandrous; oogonium 1, depressed-globose, operculate, division median, rather wide and distinct; oospore depressed globose, not filling oogonium, spore wall smooth; antheridium to 10-seriate; sperm 1; wall of vegetative cell and oogonium spirally punctate; basal cell depressed-globose or subhemispherical, wall vertically plicate; female vegetative cell 18–22×38–128μ, male 16–19×33–108μ; oogonium 48–55×38–48μ; oospore 40–51×35–42μ; antheridium 16–19×6–12μ; basal cell 28–31×21–25μ.

United States: Iowa, Illinois, Florida, Michigan; England, Finland, France, Ireland, Germany, Norway, Russia, Latvia, Sweden; Brazil; Greenland; Australia; British Columbia.

Cf. *Oe. minus* above.

86. **Oe. capitellatum** Wittrock.
(Pl. XXXIV, fig. 315.)

1874, p. 7; *Oe. piliferum* Wittr. 1870, p. 122, and 1872, p. 23; Hirn 1900, p. 149, Pl. XXIII, fig. 18.

Monoecious; oogonium 1, subdepressed or depressed globose, operculate, division median, narrow but distinct; oospore depressed globose, completing (or nearly so) oogonium, spore wall smooth; antheridium 1–2, subepigynous or hypogynous or rarely scattered; sperm (?) 1; vegetative cell capitellate; basal cell subhemispherical; terminal cell piliform; vegetative cell 6–9×20–60μ; oogonium 20–25×17–23μ; oospore 18–23×15–19μ; antheridium 6–7×8–9μ; basal cell 16–18×6–8μ.

United States: Ohio, Illinois, Mississippi, Alabama; British Columbia; Denmark, Finland, Sweden; Turkestan; Caucasus; Burma.

Among the species with capitellate vegetative cells it is characterized by its monoecious habit and small size. It differs from *Oe. quadratum* below in the absence of angular-globose oogonia.

87. **Oe. quadratum** Hallas.

(**Pl. XXXIV, figs. 306-308.**)

1905, p. 405, fig. 12; Hirn 1906, p. 19, Pl. III, fig. 10.

Monoecious; oogonium 1–4, angular-globose, operculate, division median; oospore angular-globose, filling oogonium, spore wall smooth; antheridium 1, alternating with vegetative cell; vegetative cell capitellate; basal cell subhemispherical; vegetative cell 5–12×25–140μ; oogonium 22–28×28–33μ; oospore 20–26×26μ; antheridium 10–12× 12–14μ; basal cell 7–12×6–9μ.

Denmark.

Cf. *Oe. capitellatum* above.

88. **Oe. bohemicum** Hirn.

(**Pl. XXXVI, fig. 344.**)

1900, p. 169, Pl. XXVII, fig. 154; Heering 1914, p. 216, fig. 327; Tiffany 1926, p. 101, Pl. III, fig. 30.

Monoecious; oogonium 1, globose, operculate, division superior; oospore globose, filling oogonium, spore walls smooth; antheridium 1–4, subepigynous; sperms 2, division horizontal; vegetative cell capitellate, 10–16×21–66μ; oogonium 42–45×46–49μ; oospore 40–43× 40–43μ; antheridium 9–10×5–7μ.

United States: Iowa; Austria.

This is the largest of the monoecious species combining the median location of the operculum and the capitellate vegetative cell. The dimensions above, from the Iowan material, also include those of the Austrian specimens.

89. **Oe. mitratum** Hirn.

(**Pl. XXXVI, figs. 334 and 335.**)

1895, p. 22, Pl. 1, fig. 7; 1900, p. 302, Pl. XXIV, fig. 132.

Dioecious, macrandrous; oogonium 1–4, globose or subglobose, operculate, division supramedian or superior, narrow but distinct; oospore globose (rarely subglobose), filling oogonium, spore wall smooth; antheridium 1–5, subepigynous, sperms 2, division horizontal; vegetative cell often broadly capitellate; vegetative cell 5–10×18–80μ; oogonium 18–24×20–28μ; oospore 17–23×17–22μ; antheridium 6–9×6–8μ.

United States: Illinois; Austria, Finland, Sweden.

Hirn (1900) records this species as doubtfully monoecious, but material from Illinois (Transeau) shows it to be definitely dioecious, macrandrous. The emended description was supplied from the Illinois material. Cf. *Oe. petri* below.

90. **Oe. petri** Wittrock.

(**Pl. XXXVI, fig. 332.**)

1874, p. 6; Hirn 1900, p. 154, Pl. XXIV, fig. 127.

Monoecious; oogonium 1 (rarely 2), pyriform or pyriform-globose, operculate, division a little above median; oospore subdepressed or

depressed-globose, filling oogonium, spore wall smooth; antheridium 1–2, hypogynous or epigynous or subepigynous; sperm 1; basal cell elongate; terminal cell apically obtuse; vegetative cell 6–7×32–48μ; oogonium 21–24×22–29μ; oospore 20–23×16–19μ; antheridium 5–7×9–11μ.

Germany, Spain, Sweden; Ceylon.

91. **Oe. trioicum** Woronichin.

1923, p. 99.

Dioecious macrandrous, or monoecious; oogonium 1–3, sometimes terminal, ellipsoid, operculate, division superior; oospore ellipsoid or subovoid, spore wall smooth, faintly violet; antheridium 1–6, hypogynous in monoecious filament, scattered or terminal in male filament; terminal cell obtusely rounded; basal cell attenuate; male plants 130–330μ long; vegetative cell 4–5×12–22μ; oogonium 25–27×13–16μ; oospore 20–21×14μ; antheridium 4×3μ.

Near Baku, in Azerbaijan (west coast of the Caspian).

This plant according to Woronichin is both dioecious, macrandrous and monoecious, in this respect similar to *Oe. varians* (No. 10). It should be compared with the macrandrous *pringsheimii* (No. 95) and the monoecious *gracillimum* (No. 114). Unfortunately no figure is available.

92. **Oe. welwitschii** West and West.

(**Pl. XXXVII, figs. 351 and 352.**)

1897, p. 5; Hirn 1900, p. 174, Pl. XXVIII, fig. 162; Tiffany 1926, p. 97, Pl. IV, figs. 41 and 42.

Dioecious, macrandrous; oogonium 1–3, subovoid-globose, operculate, division superior; oospore globose, filling or not filling oogonium, spore wall smooth; antheridium 2; female vegetative cell 20–28×25–84μ, male 17–20×35–80μ; oogonium 43–50×43–52μ; oospore 35–43×35–42μ; antheridium 16–18×7–9μ.

United States: Iowa, Illinois, Alabama; Africa.

This species is near *Oe. iowense* below, but differs in having at once both larger vegetative cells and smaller oogonia. It may be near the imperfectly known *dioicum* (No. 94) and is larger than *Oe. pringsheimii* (No. 95).

93. **Oe. iowense** Tiffany.

(**Pl. XXXVII, figs. 353-355.**)

1924, p. 181, Pl. III, figs. 1–3; 1926, p. 97, Pl. VI, figs. 69–71.

Dioecious, macrandrous; oogonium 1–2, globose, or ellipsoid-globose, operculate, division superior; oospore of the same form as the oogonium, which it completely fills or not, spore wall smooth; antheridium 1–25, sperms 2, division horizontal; basal cell of filament commonly elongated; vegetative cell 10–16×44–100μ; oogonium 52–60×60–80μ; oospore 45–56×50–64μ; antheridium 10–12×10–20μ; basal cell 16–24×60–80μ.

United States: Iowa, Ohio, Kentucky.

This species is easily recognized by the considerable difference between the diameter of the vegetative cells and that of the relatively much larger oogonia. Its oogonia are larger than those of *Oe. welwitschii* above.

94. **Oe. dioicum** Carter.

(**Pl. XXXVII, figs. 356 and 357.**)

1858, p. 30, Pl. 3, figs. 1–2, 5–8, 13–16; Hirn 1900, p. 175, Pl. XXVIII, fig. 163.

Dioecious, macrandrous; oogonium 1, obovoid-globose, operculate, division superior; oospore globose, not filling oogonium, spore wall smooth; male plants a little smaller than female; antheridium 10–20, sperms (?) 2, division vertical; female vegetative cell about 32×80–110μ, male about 28×70–95μ; oogonium about 82×92μ.

India.

No data beyond those of Carter are available, and *Oe. dioicum* is retained here largely because it cannot be definitely discarded upon our present knowledge of the species.

95. **Oe. pringsheimii** Cramer; Wittrock.

(**Pl. XXXV, figs. 325 and 326.**)

Cramer 1859, p. 17, Pl. 1, fig. C 1–4; Wittr. 1870, p. 135; Wittr. 1874, p. 33, Pl. 1, figs. 16 and 17; Hirn 1900, p. 170, Pl. XXVII, fig. 155; *Oe. pachydermatosporum* Nordst. 1878, p. 21, Pl. 2, fig. 13–15; *Oe. pringsheimii* Cram.; Wittr. var. *Nordstedtii* Wittr. f. *pachydermatosporum* (Nordst.) Hirn 1900, p. 173, Pl. XXVII, fig. 160; Collins 1909, p. 246; Heering 1914, p. 202, fig. 284; Tiffany 1926, p. 98, Pl. V, figs. 45 and 46.

Dioecious, macrandrous; oogonium 1–6, subovoid-globose, operculate, division superior; oospore globose, nearly filling oogonium, spore wall smooth, often thickened; antheridium to 10-seriate, often alternating with vegetative cell; sperms 2, division horizontal; basal cell elongate, terminal cell broadly apiculate or obtuse; female vegetative cell 14–20×28–100μ, male 12–16×24–64μ; oogonium 35–43×36–46μ; oospore 30–37×30–37μ; antheridium 10–15×6–9μ.

United States: Iowa, New York, Pennsylvania, Florida, Ohio, Utah; Africa, Afghanistan; Australia; Austria, Denmark, England, Finland, Italy, Norway, Latvia, Sweden, Switzerland.

95a. Var. **abbreviatum** Hirn.

(**Pl. XXXV, fig. 331.**)

1900, p. 173, Pl. XXVII, fig. 161.

Smaller; vegetative cell broader; oogonium 1, obovoid-globose, nearly filled by oospore; vegetative cell 10–13×15–39μ; oogonium 28–32×30–35μ; oospore 27–30×27–30μ.

Brazil.

95b. Var. **nordstedtii** Wittrock.

(**Pl. XXXV, figs. 327-330.**)

In Wittr. and Nordst. Alg. Exs. No. 8, 1877; *Oe. ciliare* De Notaris 1868, p. 120; *Oe. franklinianum* Wittr. *in* Tilden Amer. Alg. No. 2, 1894; *Oe. nordstedtii* Wittr. 1872, p. 6, Pl. 1, figs. 7 and 8; *Oe. pringsheimii* var. *varians* Nordst. 1888, p. 11, Pl. 1, fig. 9; *Oe. pachydermatosporum* Nordst. *in* Lewin 1888, p. 18, Pl. 3, fig. 56; Hirn 1900, p. 171, Pl. XXVII, figs. 156–158; *Oe. pringsheimii* Cram.; Wittr. var. *nordstedtii* Wittr. f. *euganeorum* (Wittr.) Hirn 1900, p. 172, Pl. XXVII, fig. 159; *Oe. euganeorum* Wittr. 1874, p. 39; Tiffany 1926, p. 98, Pl. V, fig. 47.

Smaller than the type, oogonium 1–2; oospore not filling oogonium; female vegetative cell 10–16×20–76μ, male 9–15×18–68μ; oogonium 28–39×36–45μ; oospore 26–34×27–34μ; antheridium 9–12×8–9μ.

United States: Minnesota, California, Iowa, Illinois, Ohio, Michigan; Austria, England, Finland, Latvia, Germany, Italy, Switzerland, Spain; India; Patagonia; Greenland; Samoa.

Oe. pringsheimii is characterized by its subovoid-globose oogonia and superior position of the operculum, among the dioecious species. Its oogonia are smaller than either *Oe. iowense* (No. 93) or *Oe. welwitschii* (No. 92). The variety *abbreviatum* has shorter vegetative cells and var. *nordstedtii* is more slender than the type.

96. **Oe. nodulosum** Wittrock.

(**Pl. XXXIX, figs. 374 and 375.**)

1872a, p. 22, Pl. 1, figs. 8–10; 1874, p. 13, Pl. 1, figs. 2 and 3; Borge 1899, p. 6, Pl. 1, fig. 3; Hirn 1900, p. 187, Pl. XXIX, fig. 184.

Monoecious; oogonium 1–2, obovoid-globose or more rarely obovoid-ellipsoid, operculate, division superior; oospore globose or subglobose or more rarely globose-ellipsoid, nearly filling oogonium, spore wall smooth, often thick; antheridium 1–3, subepigynous or hypogynous; sperms 2, division horizontal; basal cell elongate, not constricted; terminal cell obtuse or apiculate; vegetative cell, with two undulate constrictions, 20–29×30–140μ; oogonium 48–57×56–73μ; oospore 46–53×49–56μ; antheridium 18–25×7–9μ.

Australia; China; Patagonia; England, Sweden.

96a. Var. **commune** Hirn.

(**Pl. XXXIX, fig. 376.**)

1900, p. 187, Pl. XXX, fig. 185; *Oe. nodulosum* Wittr. *in* P. B. A. No. 74, 1895, and *in* Hirn 1895, p. 13; Collins 1909, p. 248.

Oogonium subobovoid-ellipsoid to ellipsoid or more rarely globose-ellipsoid; vegetative cell 22–29×35–140μ; oogonium 64–74×70–90μ; oospore 56–70×67–80μ; antheridium 18–26×7–10μ.

United States: Massachusetts; Finland, Sweden.

The nodulose character of the vegetative cells is very distinctive. *Oe. sphaerandrium* (No. 105) sometimes has nodulose cells, but it is much smaller. Var. *commune* has larger

oogonia and oospores. *Oe. undulatum* (No. 119), a nannandrous species, has vegetative cells four times undulate-constricted while *Oe. nodulosum* has two undulate constrictions.

97. **Oe. porrectum** Nordstedt and Hirn.
(**Pl. XXXVIII, figs. 361 and 362.**)

In Hirn 1900, p. 186, Pl. XXIX, fig. 183.

Dioecious, macrandrous; oogonium 1, oblong, operculate, division superior; oospore ellipsoid or globose-ellipsoid, not filling oogonium longitudinally, spore wall smooth; antheridium to 4-seriate; sperms 2, division horizontal; female vegetative cell 7–10×25–55μ, male 6–9×25–62μ; oogonium 24–27×44–53μ; oospore 23–24×25–28μ; antheridium 6–7×6–8μ.

Brazil.

98. **Oe. nanum** Wittrock; Tiffany.
(**Pl. XXXVI, figs. 342 and 343.**)

Wittrock 1874, p. 37; Hirn 1900, p. 305, Pl. XXIX, fig. 174; Tiffany 1926, Pl. VI, figs. 63–65.

Dioecious, macrandrous; oogonium 1–3, ovoid to broadly ellipsoid, operculate, division superior; oospore ovoid to globose-ellipsoid, usually filling the oogonium, spore wall smooth; antheridium 1–3, sperm 1; basal cell subhemispherical; terminal cell, often an oogonium, apically obtuse; vegetative cell, often irregularly swollen, 6–10×15–33μ; oogonium 24–28×30–36μ; oospore 21–27×23–30μ; antheridium 7–10×8–11μ; basal cell 14–17×12–16μ.

United States: Iowa; India.

Originally found in India, this species was only completely described from the Iowan material. It bears some resemblance to *Oe. pisanum* below. It is found almost entirely epiphytic on submerged leaves, on Pithophora, on Cladophora, and on other species of Oedogonium.

99. **Oe. pisanum** Wittrock.
(**Pl. XXXVIII, figs. 363 and 364.**)

1876, p. 50, Pl. 13, fig. 28; *Oe. subpisanum* Lewin 1888, p. 17, Pl. 3, figs. 49–52; Hirn 1900, p. 181, Pl. XXIX, fig. 175; Heering 1914, p. 203, fig. 291; Tiffany 1926, p. 97.

Dioecious, macrandrous; oogonium 1 (rarely 2–3), ellipsoid-ovoid to ovoid, operculate, division superior; oospore ovoid to ellipsoid, nearly filling oogonium, spore wall smooth; antheridium 1–4; sperms 2, division horizontal; basal cell elongate; terminal cell piliferous; vegetative cell 5–12×12–72μ; oogonium 23–29 (–32) ×34–43 (–45)μ; oospore 21–25×27–37μ; antheridium 4–9×5–9μ.

United States: Iowa, Illinois, Ohio, Mississippi; Austria, Italy, Spain; Africa.

99a. Var. **gracilis** Transeau and Tiffany.
(Pl. XXXVIII, figs. 365 and 366.)
1919, p. 241; Tiffany 1926, p. 98, Pl. III, figs. 31–34.

Oogonium and oospore ellipsoid to ellipsoid-ovoid; vegetative cell, female 6–9×18–48μ, male 5–8×16–45μ; oogonium 16–20×20–30μ; oospore 15–18×18–28μ; antheridium 5–7×5–10μ.

United States: Iowa, Illinois, Mississippi.

The combination of small size, elongate basal cell, and piliferous terminal cell is sufficient to characterize the species. The presence of subhemispherical basal cells in *Oe. nanum* (No. 98) easily separates it from *Oe. pisanum*. The variety *gracilis* is smaller. Often epiphytic on other species of algae.

100. **Oe. pyriforme** Wittrock.
(Pl. XXXVII, fig. 348.)
1874, p. 39; Hirn 1900, p. 303, Pl. XXV, fig. 137.

Monoecious; oogonium 1, pyriform, operculate, division superior; oospore pyriform, filling or not filling oogonium, spore wall smooth; antheridium 1–3, subepigynous, epigynous, hypogynous, or scattered; sperms 2, division horizontal; vegetative cell 13–16×48–90μ; oogonium 40–46×(44–)48–60μ; oospore 36–42×36–44μ; antheridium 10–12×8–12μ.

Tasmania; British Columbia.

The pyriform oogonium is characteristic. The dimensions of *Oe. pyriforme* separate it from *Oe. simplex* (No. 102) and *Oe. pyrulum* (No. 103). Originally found in Tasmania, the above complete description is furnished from material collected in British Columbia by Mr. G. H. Wailes.

101. **Oe. gunnii** Wittrock.
(Pl. XXXIV, fig. 318.)
1874, p. 37; Hirn 1900, p. 298, Pl. XXIII, fig. 119.

Monoecious; oogonium 1–4, subdepressed- or depressed-globose, operculate, division median, narrow but distinct; oospore same form as oogonium and filling it, spore wall smooth, outer layer thick and hyaline, inner brown; antheridium subepigynous; vegetative cell 6–9×30–85μ; oogonium 23–29×19–29μ; oospore 22–27×17–23μ; antheridium 6×12μ.

United States: Alabama; Australia.

Material collected in Alabama by Professor E. N. Transeau shows *Oe. gunnii* to be definitely monoecious. Its distinctly narrow median division of the oogonium separates it from the imperfectly known *Oe. poecilosporum* (No. 224).

102. **Oe. simplex** Hirn.

(**Pl. XXXVI, fig. 340.**)

1900, p. 158, Pl. XXIV, fig. 135.

Monoecious; oogonium 1, obovoid-pyriform, operculate, division superior; oospore globose, ellipsoid or obovoid-globose, not filling oogonium, spore wall smooth; antheridium 1–?, subepigynous; sperms 2, division horizontal; vegetative cell 11–13×35–58μ; oogonium 26–32× 33–40μ; oospore (22–) 24–30×23–30μ; antheridium 8–10×7–10μ.

Brazil.

Cf. *Oe. pyriforme* (No. 100).

103. **Oe. pyrulum** Wittrock.

(**Pl. XXXVII, fig. 349.**)

1872, p. 2; Hirn 1900, p. 158, Pl. XXV, fig. 136.

Monoecious; oogonium 1, globose-pyriform, operculate, division superior; oospore subdepressed-globose or subglobose, not filling oogonium, spore wall smooth; antheridium 1, epigynous or hypogynous or rarely subepigynous; basal cell elongate; terminal cell apically broadly acute; vegetative cell 8–11×30–75μ; oogonium 30–33×31–35μ; oospore 26–29×24–28μ; antheridium 8–9×10–11μ.

Sweden; Ceylon.

103a. Var. **amplius** W. R. Taylor.

(**Pl. XXXVII, fig. 350.**)

1928, p. 107, Pl. 13, figs. 1–4 (as v. *amplior*).

Larger oogonium; vegetative cell 9–12×40–64μ; oogonium 34–40× 30–44μ; oospore 26–28×26–28μ, not filling oogonium; antheridium subepigynous 10×6μ.

British Columbia.

Oe. pyrulum is separated from the species of the genus having pyriform or subpyriform oogonia largely by dimensions. The variety *amplius* has larger oogonia than the type and more nearly approaches the size of *Oe. pyriforme* (No. 100).

104. **Oe. loricatum** Hirn.

(**Pl. XXXVI, fig. 339.**)

1895, p. 22, Pl. 1, fig. 6; 1900, p. 156, Pl. XXIV, fig. 133.

Monoecious; oogonium 1 (rarely 2), subpyriform-globose, sometimes subglobose, operculate, division superior; oospore subglobose or subdepressed-globose, quite filling oogonium, spore wall smooth; antheridium 1–2, subepigynous; sperms 2, division horizontal; vegetative cell 8–11×30–75μ; oogonium 23–28×23–40μ; oospore 22–26×21–24μ; antheridium 7–8×5–7μ.

Finland.

This species is similar to *Oe. pithophorae* (No. 106) below, but the latter has globose and slightly larger oospores.

105. **Oe. sphaerandrium** Wittrock and Lundell.
(**Pl. XXXVI, fig. 337.**)

In Wittr. 1874, p. 7; *Oe. subcapitellatum* Hirn 1895, p. 13, Pl. 1, fig. 1; Hirn 1900, p. 155, Pl. XXIV, figs. 129 and 130; Borge 1913, p. 31, fig. 2.

Monoecious; oogonium 1–4, subpyriform- to subdepressed-globose, operculate, division a little above median; oospore subdepressed- or depressed-globose, nearly filling oogonium, spore wall smooth, antheridium to 6-seriate, subepigynous or scattered; sperm 1; vegetative cell capitellate, sometimes nodulose; basal cell subhemispherical, terminal cell piliform; vegetative cell 4–10×6–40μ; oogonium 18–23× 18–23μ; oospore 16–21×14–19μ; antheridium 6–8×5–6μ.

Austria, Finland, Germany, Sweden; Siberia.

The capitellate (sometimes nodulose) vegetative cells, the small size, and supramedian operculum are characteristic.

106. **Oe. pithophorae** Wittrock.
(**Pl. XXXVI, fig. 338.**)

1878, p. 141; Hirn 1900, p. 157, Pl. XXIV, fig. 134.

Monoecious; oogonium 1, pyriform-globose, operculate, division superior; oospore globose, almost filling oogonium, spore wall smooth, often thickened; antheridium 1–?, subepigynous; basal cell elongate; vegetative cell 9–11×24–48μ; oogonium 26–30×27–35μ; oospore 25–29×24–29μ; antheridium 8–10×7–9μ.

St. Thomas, West Indies.

Epiphytic on *Pithophora cleveana* Wittrock.

Cf. *Oe. porrectum* (No. 97).

107. **Oe. autumnale** Wittrock.
(**Pl. XXXVI, fig. 341.**)

1874, p. 11; Hirn 1900, p. 167, Pl. XXVI, fig. 151.

Monoecious; oogonium 1, obovoid-globose, operculate, division superior; oospore globose or subglobose, completing oogonium (or nearly so), spore wall smooth; antheridium 1–2, subepigynous, hypogynous, or scattered; sperms 2, division horizontal; basal cell elongate; terminal cell broadly apically acute; vegetative cell 16–20×25–50μ; oogonium 39–45×45–51μ; oospore 37–42×37–44μ; antheridium 15–18×9–10μ.

United States: Pennsylvania; Finland, Italy, Sweden, Latvia.

Cf. *Oe. crispum* (No. 109).

108. **Oe. obesum** (Wittrock) Hirn.
(**Pl. XXXVII, fig. 347.**)

1900, p. 166, Pl. XXVI, fig. 148; *Oe. pyrulum* Wittr. var. *obesum* Wittr. 1876, p. 44, Pl. 13, fig. 20.

Monoecious; oogonium 1, obovoid-globose, operculate, division superior; oospore globose, not quite filling oogonium, spore wall smooth, often thickened; antheridium 1–2, subepigynous or more rarely sub-

hypogynous; sperms 2, division horizontal; vegetative cell 12–15×35–75μ; oogonium 40–43×38–44μ; oospore 33–35×33–35μ; antheridium 11–14×10–15μ.

United States: Massachusetts; Austria, Bulgaria, Finland, France; Ceylon; Brazil.

Cf. *Oe. crispum* (No. 109).

109. **Oe. crispum** (Hassall) Wittrock.

(Pl. XXXV, fig. 319.)

Vesiculifera crispa Hass. 1845, p. 203, Pl. 52, fig. 8; *Oe. crispum* Wittr. 1874, p. 10; 1876, p. 45; *Oe. rostellatum* Pringsh. 1858, p. 69, Pl. 5, fig. 1; (?) *Vesiculifera vernalis* Hass. 1843, p. 434; (?) *V. candollei* Hass. 1845, p. 208, Pl. 52, fig. 9; *Oe. vernale* Wittr. 1874, p. 10; *Oe. crispum* (Hass.) Wittr. var. *elongatum* Wittr. 1876, p. 45; *Oe. hispanicum* Lewin 1888, p. 16, Pl. 2, figs. 40–42; Hirn 1900, p. 159, Pl. XXV, figs. 138 and 139; *Oe. crispum* (Hass.) Wittr. f. *vernale* (Hass.; Wittr.) Hirn 1900, p. 161, Pl. XXV, fig. 141; Heering 1914, p. 214, fig. 334; Tiffany 1926, p. 101, Pl. III, fig. 29.

Monoecious; oogonium usually 1, obovoid-globose, operculate, division superior; oospore globose or subglobose, quite filling the oogonium, spore wall smooth; antheridium 1–5, subepigynous or hypogynous; sperms 2, division horizontal; basal cell elongate, terminal cell apically obtuse; vegetative cell (10–) 12–16×35–80μ; oogonium 37–45×41–53μ; oospore 35–43×37–43μ; antheridium 8–14×7–12μ.

United States: Colorado, Pennsylvania, California, Michigan, Mississippi, Illinois, Ohio, Iowa, Alaska; Austria, England, Denmark, Finland, France, Germany, Italy, Spain, Sweden; Africa; Asia; Australia; Bolivia; Patagonia; Greenland; Vancouver, British Columbia.

109a. Form **granulosum** (Nordstedt) Hirn.

(Pl. XXXV, fig. 322.)

1900, p. 162, Pl. XXV, fig. 142; *Oe. crispum* (Hass.) Wittr. var. *granulosum* Nordst. 1877, p. 24; De Toni 1889, p. 37.

Oogonium subglobose, filled by oospore; antheridium subepigynous; spore wall of oospore punctate-granulate; vegetative cell 14–17×35–63μ; oogonium 40–43×42–45μ; oospore 37–40×37–40μ; antheridium 11–13×8–11μ.

Sweden.

109b. Form **inflatum** Hirn.

(Pl. XXXV, fig. 323.)

1900, p. 161, Pl. XXV, fig. 140; *Oe. vesicatum* Link var. *flavescens* Kuetz. *in* Rabenh. Alg. Sachs. No. 271, 1853; *Oe. rostellatum* Pringsh. *in ibid.* No. 2275, 1872.

Oogonium obovoid-globose; vegetative cell 12–16×35–95μ; oogonium 40–50×45–53μ; oospore 37–45×38–45μ; antheridium 8–12×9–12μ.

United States: Michigan, Florida, Mississippi; Switzerland, Sweden, Germany; South Africa.

109c. Var. **gracilescens** Wittrock.
(**Pl. XXXV, fig. 321.**)

In Wittr. and Nordst. Alg. Exs. No. 509, 1883; *Oe. Lagerheimii* Wittr. *in ibid.* No. 1018, 1893; Hirn 1900, p. 162, Pl. XXV, fig. 143; P. B. A. No. 518.

More slender than the type; oogonium varying from obovoid-globose to subellipsoid; oospore globose to ovoid; vegetative cell 10–14×30–70μ; oogonium 33–39×33–51μ; oospore 32–37×33–42μ; antheridium 9–10×7–9μ.

United States: Massachusetts, Iowa, Missouri, Ohio, Illinois, Mississippi, Louisiana, Minnesota; Austria; Brazil; Morocco, Angola.

109d. Var. **hawaiense** Nordstedt.
(**Pl. XXXV, fig. 320.**)

1878, p. 20, Pl. 2, figs. 9 and 10; Hirn 1900, p. 165, Pl. XXVI, fig. 147.

Oogonium subobovoid-globose to pyriform-globose, not filled by oospore; terminal cell mucronate or shortly setigerous; vegetative cell 10–16×20–64μ; oogonium 30–38×31–38μ; oospore 27–32×27–33μ; antheridium 8–11×6–8μ.

Hawaii.

109e. Var. **uruguayense** Magnus and Wille.
(**Pl. XXXV, fig. 324.**)

In Wille 1884, p. 39, Pl. 2, fig. 63; *Oe. crispum* (Hass.) Wittr. f. *gracilis in* Wittr. and Nordst. Alg. Exs. No. 704, 1886; Hirn 1900, p. 164, Pl. XXVI, fig. 145; *Oe. crispum* (Hass.) Wittr. var. *uruguayense* M. & W. f. *proprium* Hirn 1900, p. 164, Pl. XXVI, fig. 146.

Oogonium subobovoid-globose, usually filled by oospore; antheridium subepigynous or hypogynous or scattered; vegetative cell 10–14×16–51μ; oogonium 30–38×30–45μ; oospore 27–35×27–37μ; antheridium 8–13×6–12μ.

United States: Pennsylvania; Argentina, Brazil.

Oe. crispum is perhaps the commonest monoecious member of the genus among the operculate forms. Its vegetative cells are more slender than those of *Oe. autumnale* (No. 107) and there is less variation in the relative size of its oogonium and oospore than in *Oe. obesum* (No. 108). The forms and varieties of the species are separable from one another and the type largely on the basis of relative shapes and sizes of vegetative and reproductive cells. (See key).

110. **Oe. rupestre** Hirn.
(**Pl. XXXVI, fig. 345.**)

1900, p. 168, Pl. XXVI, fig. 152.

Monoecious; oogonium 1, suboboviform-globose, operculate, division superior; oospore globose, not filling oogonium, spore wall smooth; antheridium 1–3, subepigynous or hypogynous; sperms 2, division

horizontal; vegetative cell 20–27×26–67μ; oogonium 48–58×48–60μ; oospore 43–50 (–54) ×43–50 (–54)μ; antheridium 18–22×9–11μ.

Austria, France, Ireland, Latvia.

110a. Form **pseudautumnale** Hirn.

(**Pl. XXXVI, fig. 346.**)

1900, p. 169, Pl. XXVII, fig. 153.

A little smaller; vegetative cell 20–25×30–65μ; oogonium 44–49×45–55μ; oospore 43–47×43–47μ; antheridium 19–22×10–14μ.

United States: Mississippi; France, Germany.

Oe. rupestre has larger vegetative cells than any of the other monoecius operculate species with obovoid-globose to subglobose oogonia. It is to be compared with *Oe. crispum* (No. 109). F. *pseudautumnale* has smaller fruiting cells than the type.

111. **Oe. ahlstrandii** Wittrock.

(**Pl. XXXVIII, fig. 358.**)

In Wittr. and Nordst. Exs. No. 401, 1882; Hirn 1900, p. 183, Pl. XXIX, fig. 179; Collins 1909, p. 247.

Monoecious; oogonium 1, ellipsoid, operculate, division superior; oospore ellipsoid, filling oogonium, wall smooth; antheridium 1–2, hypogynous; sperms 2, division horizontal; terminal cell apically obtuse; vegetative cell 10–18×30–180μ; oogonium 35–42×57–69μ; oospore 34–41×53–62μ; antheridium 13–17×9–12μ.

United States: New York; Sweden, England.

The large oogonium of this species separates it from all other ellipsoid, operculate, monoecious forms, except the still larger *Oe. pachydermum*, below.

112. **Oe. pachydermum** Wittrock and Lundell.

(**Pl. XXXIX, figs. 377 and 378.**)

In Wittr. 1870, p. 125; Hirn 1900, p. 188, Pl. XXX, fig. 187.

Monoecious; oogonium 1 (rarely 2), ellipsoid, operculate, division superior, wall frequently thickened; oospore ellipsoid, not filling oogonium, spore wall smooth; antheridium 1–3, hypogynous or subepigynous, often terminal; sperms 2, division horizontal; basal cell elongate; terminal cell apiculate; vegetative cell 21–27×34–120μ; oogonium 50–70×75–100μ; oospore 40–60×50–80μ; antheridium 18–21×10–12μ.

Finland, Sweden.

Cf. *Oe. ahlstrandii* (No. 111).

113. **Oe. kirchneri** Wittrock.
(**Pl. XXXVIII, fig. 371.**)

1882, p. 104; *Oe. alternans* Kirch. 1878, p. 53; Hirn 1900, p. 183, Pl. XXIX, fig. 178.

Monoecious; oogonium 1, ellipsoid or obovoid-ellipsoid, operculate, division superior; oospore of same form as oogonium, nearly filling oogonium, spore wall smooth; antheridium 1–2, hypogynous and alternating with oogonium; sperms 2, division horizontal; terminal cell obtuse; vegetative cell 8–15×16–60μ; oogonium 20–24×34–48μ; oospore 19–23×32–41μ; antheridium 9–13×4–7μ.

Germany.

Chiefly characterized among those with ellipsoid, operculate oogonia by the alternation of oogonium and antheridium.

114. **Oe. gracillimum** Wittrock and Lundell.
(**Pl. XXXVIII, fig. 373.**)

In Wittr. 1874, p. 15; Wolle 1887, p. 74, Pl. 75, fig. 2; Hirn 1900, p. 184, Pl. XXIX, fig. 180; Collins 1909, p. 247; Heering 1914, p. 218, fig. 318; Tiffany 1926, p. 100, Pl. I, fig. 9.

Monoecious; oogonium 1, oblong, operculate, division superior; oospore oblong-ellipsoid, not filling oogonium, spore wall smooth; antheridium 1; sperms 2, division horizontal; basal cell elongate; vegetative cell 4–7×16–42μ; oogonium 14–19×34–40μ; oospore 13–17×24–32μ; antheridium 3–5×4–7μ.

United States: Iowa, Pennsylvania, Michigan, Illinois, Ohio, Mississippi, Kentucky; Sweden; Angola.

114a. Form **majus** West and West.

1897, p. 4; Hirn 1900, p. 184.

Vegetative cell 6–7×20–40μ; oogonium 20–23×32–35μ; oospore 17×24μ.

Africa.

Oe. gracillimum almost invariably has some oogonia with imperfectly developed oospores.

115. **Oe. oblongellum** Kirchner.
(**Pl. XXXVIII, fig. 372.**)

In Hirn 1900, p. 182, Pl. XXIX, fig. 177.

Monoecious; oogonium 1, ellipsoid-obovoid, operculate, division superior; oospore ellipsoid, nearly filling oogonium, spore wall smooth; antheridium 1–2, hypogynous or scattered; sperms 2, division horizontal; terminal cell obtuse; vegetative cell 7–9×14–35μ; oogonium 20–24×25–33μ; oospore 18–22×24–30μ; antheridium 6–8×4–12μ.

United States: Illinois, Mississippi; Germany; Burma.

Oe. oblongellum is near *Oe. oblongum*, below, but the latter almost invariably has oogonia not filled lengthwise by oospores; the former has oogonia nearly completely filled.

116. **Oe. oblongum** Wittrock.
(**Pl. XXXVIII, fig. 367.**)

1872, p. 2; 1874, p. 15; Hirn 1900, p. 185, Pl. XXIX, fig. 181; Heering 1914, p. 218, fig. 319; Collins 1918, p. 66; Tiffany 1926, p. 101, Pl. III, fig. 28.

Monoecious; oogonium 1, oblong, operculate, division superior; oospore ellipsoid to ovoid, not filling oogonium longitudinally, spore wall smooth; antheridium 1–3, sperms 2, division horizontal; basal cell elongate; vegetative cell 6–11×20–86μ; oogonium 20–26×41–60μ; oospore 19–23×30–36μ; antheridium 6–9×7–9μ.

United States: Iowa, Illinois, Mississippi; Siberia; New Caledonia; India; Austria, Denmark, Finland, Germany, Russia, Norway, Latvia, Sweden.

116a. Form **majus** (Nordstedt) Hirn.
(**Pl. XXXVIII, fig. 370.**)

1900, p. 185, Pl. XXIX, fig. 182; *Oe. oblongum* Wittr. var. *majus* Nordst. *in* Wittr. 1876, p. 45, Pl. 13, fig. 21.

Vegetative cell 8–11×35–75μ; oogonium 26–28×42–50μ; oospore 22–26×31–34μ; antheridium 8–9×9–10μ.

United States: Michigan; Finland, Italy, Sweden; Morocco.

116b. Form **sphaericum** (Hallas) Hirn.
(**Pl. XXXVIII, figs. 368 and 369.**)

1906, p. 18, Pl. III, fig. 12; *Oe. sphaericum* Hallas 1905, p. 406, fig. 13.

Oospore globose; vegetative cell 6–11×20–85μ; oogonium 21–28× 30–52μ; oospore 16–26×16–26μ; antheridium 8×6μ; basal cell 9×72μ.

Denmark.

Cf. *Oe. oblongellum* (No. 115). The f. *sphaericum* is easily separated from the species by its globose oospore; f. *majus* has slightly larger oogonia.

117. **Oe. itzigsohnii** De Bary.
(**Pl. XXXIX, figs. 379 and 380.**)

1854, p. 56, Pl. 3, figs. 29–32; Wittr. 1870, p. 123; *Oe. platygynum* Wittr. *in* Eichler 1893, p. 2, Pl. 9, fig. 2; Hirn 1900, p. 177, Pl. XXVIII, fig. 167.

Monoecious; oogonium 1, ellipsoid, with median, conically obtuse projections, appearing stellate in vertical view, with 7–10 radiations, operculate, division inframedian; oospore globose, not completing oogonium, spore wall smooth; antheridium 1–2; terminal cell apically obtuse or apiculate; vegetative cell 8–10×25–60μ; oogonium 34–40× 32–40μ; oospore 20–23×20–23μ; antheridium 8–9×8–15μ.

United States: Massachusetts; Germany, Poland, Sweden, Austria, England, Bulgaria, Denmark, Latvia, Russia, France.

117a. Form **heteromorphum** Hirn.
(**Pl. XXXIX, fig. 381.**)

1900, p. 178, Pl. XXVIII, fig. 168.

Processes on oogonium intermediate between conically obtuse projections and mammiform protuberances; vegetative cell 6–9× 30–110μ; oogonium 33–40×35–40μ; oospore 20–25×20–25μ.

Germany, Sweden.

117b. Var. **minus** West.
(**Pl. XXXIX, fig. 382.**)

1893, p. 97; 1897, p. 4; Hirn 1900, p. 178, Pl. XXVIII, fig. 169.

Smaller; processes of oogonium acutely rounded; vegetative cell 5–7×25–70μ; oogonium 28–30×28–30μ; oospore 16–20×16–20μ.

England.

Oe. itzigsohnii is near *Oe. mammiferum* below, but differs in having conically obtuse projections, instead of mammiform projections, on the oogonia. Var. *minus* is slightly smaller than the type and f. *heteromorphum* has oogonial projections somewhat intermediate between the species proper and *Oe. mammiferum*.

118. **Oe. mammiferum** Wittrock; Nordstedt.
(**Pl. XXXIX, figs. 383-385.**)

Wittr. 1874, p. 16; Nordst. 1877, p. 25, Pl. 3, figs. 4–6; *Oe. huillense* West 1897, p. 5, Pl. 365, figs. 7 and 8; Hirn 1900, p. 175, Pl. XXVIII, figs. 165 and 166.

Monoecious; oogonium 1 (rarely 2–3), ellipsoid, with mammiform projections appearing as 7–9 radiations seen vertically, operculate, division inframedian, very narrow; oospore globose or subdepressed-globose (rarely depressed-globose), not filling oogonium, spore wall smooth; antheridium 1, subepigynous; basal cell elongate; vegetative cell 5–8×20–56μ; oogonium 20–28×20–30μ; oospore 12–17 (–20) × 12–16μ; antheridium 6×7μ.

United States: Massachusetts; Norway, Sweden; India; Africa.

Cf. *Oe. itzigsohnii* above.

119. **Oe. undulatum** (Brebisson) Al. Braun; Wittrock.
(**Pl. XLII, fig. 407.**)

Conferva undulata Breb.; *Oe. undulatum* Al. Braun *in* De Bary 1854, p. 94; Wittr. 1870, p. 130; *Cymatonema confervaceum* Kuetz. 1849, p. 375 and 1853, p. 15, Pl. 47, fig. 1; Borge 1899, p. 4, Pl. 1, fig. 2; *Oe. undulatum* A. Br. var. *interrupte-incisum* Schroeder 1897, p. 10, Pl. 2, fig. 1; *Oe. sp.* Moebius 1894, p. 320, Pl. 1, fig. 21; *Oe. undulatum* A. Br. var. *Moebiusii* Schmidle 1896, p. 297, Pl. 9, fig. 1; *Oe. undulatum* (Breb.) Al. Br. var. *Moebiusii* Schmidle *in* Borge 1896, p. 5; Hirn 1900, p. 257, Pl. XLV, figs. 272–275.

Dioecious, nannandrous, gynandrosporous or idioandrosporous; oogonium 1–2, subglobose or ellipsoid-globose, operculate, division inferior, wide; oospore globose or subglobose, quite filling oogonium,

spore wall smooth, sometimes thick; androsporangium to 7-seriate; vegetative cell undulate (4 undulate constrictions); basal cell elongate, not undulate; terminal cell (sometimes oogonium) apically obtuse; dwarf male elongate-obconic, usually on suffultory cell, rarely on other vegetative cell near oogonium, antheridium interior; vegetative cell 15–22×45–110μ; oogonium 48–56×50–75μ; oospore 42–50×42–52 (–60)μ; androsporangium 15–21×7–14μ; dwarf male 8–10×48–65 (–70)μ.

United States: Michigan, Florida, Indiana; Uruguay; Australia; Manchuria, China; Austria, England, Finland, France, Germany, Norway, Poland, Sweden, Russia, Latvia; Columbia; Africa (Victoria).

119a. Var. **americanum** Transeau.

(**Pl. XLII, fig. 408.**)

1917, p. 232.

Vegetative cell as in type; oogonium much larger; vegetative cell 15–22×45–110μ; oogonium 58–68×60–80μ; oospore 48–60×48–56μ.

United States: Michigan.

119b. Form **senegalense** (Nordstedt) Hirn.

(**Pl. XLII, fig. 409.**)

1900, p. 261, Pl. XLV, figs. 276 and 277; *Oe. undulatum* (Breb.) A. Br. var. *senegalense* Nordst. 1880, p. 13; P. B. A. No. 73.

Oogonium and oospore smaller than the type; dwarf male shorter; oogonium to 5-seriate; vegetative cell with three median swellings repand, the terminal swelling entire, 15–22×45–110μ; oogonium 42–52×44–63μ; oospore 37–44×36–44μ; androsporangium 15–19×9–18μ; dwarf male 6–8×37–44μ.

United States: Massachusetts; Africa: Senegal.

The undulate vegetative cells are characteristic. It bears some relation in the vegetative state to *Oe. nodulosum* (No. 96). The var. *americanum* has considerably larger oogonia than the type and f. *senegalense* has slightly smaller fruiting cells. A number of variations of this species are on record in algological literature, but the two above seem the only really tenable ones outside the species proper.

120. **Oe. nebraskense** Ohashi.

(**Pl. XLII, figs. 410-413.**)

Oe. nebraskensis Ohashi 1926, p. 213, figs. 1–20.

Dioecious, nannandrous, gynandrosporous; oogonium 1–4, flask-shaped or obovoid, pore supramedian; oospore subspherical or ovoid, not quite filling oogonium, outer layer of spore wall smooth, middle layer punctate, inner layer smooth; androsporangium 1–4, basal cell elongate; terminal cell attenuate-obtuse; dwarf male curved, on suffultory cell,

antheridium exterior, 1–4; vegetative cell slightly capitellate; filament 20–41 (–50) celled; vegetative cell, terminal 9–12×170–305μ, median 20–27×57–160μ, basal 22–35×79–230μ; suffultory cell 41–58×93–130μ; oogonium 60–67×70–79μ; oospore 53–64×60–76μ; androsporangium 20–25×22–40μ; dwarf male stipe 12–19×47–68μ; antheridium 9–13×17–20μ.

United States: Nebraska (near Lincoln).

The only nannandrous species combining the characters of supramedian pore and punctate oospore.

121. **Oe. aster** Wittrock.

(**Pl. XLIII, fig. 416.**)

1872, p. 4; 1874, p. 29; De Toni 1889, p. 62; Hirn 1900, p. 198, Pl. XXXII, fig. 202; Fremy and Meslin 1926, p. 124, fig. 9.

Dioecious, nannandrous; oogonium 1, subdepressed-globose, pore median; oospore subdepressed-globose or subglobose, not completely filling oogonium; outer layer of spore wall echinate; suffultory cell sometimes a little swollen; terminal cell obtuse; dwarf male a little curved, on suffultory cell, stipe sometimes 2-celled, antheridium exterior, 1–2; vegetative cell 7–13×50–110μ; oogonium 33–35×34–39μ; oospore (with spines) 31–32×25–30μ; dwarf male stipe 6–7×20–25μ; antheridium 5–6×7–8μ.

United States: Illinois; Sweden, Germany, Latvia, France; Ceylon.

Oe. aster is near *Oe. pugens* (No. 125) but the latter is larger in all dimensions.

122. **Oe. hystricinum** Transeau and Tiffany.

(**Pl. XLIII, fig. 414.**)

1919, p. 240, Pl. XIV, figs. f-i; Tiffany 1926, p. 102, Pl. VIII, figs. 85 and 86.

Dioecious, nannandrous, idioandrosporous; oogonium 1, globose or somewhat obovoid, pore median; oospore globose to subglobose, nearly filling the oogonium, outer spore wall densely covered with spines; suffultory cells swollen; androsporangium 3–6; terminal cell obtuse; basal cell elongated; dwarf male nearly straight, resting on the suffultory cell, antheridium exterior, 1; female vegetative cell 8–15×42–100μ, male 6–9×50–67μ; suffultory cell 16–19×42–70μ; oogonium 30–40×36–53μ; oospore (including spines) 23–38×28–43μ; androsporangium 6–8×8–15μ; dwarf male stipe 6–10×20–32μ; antheridium 5–6×6–10μ.

United States: Illinois, Iowa.

This species is near *Oe. hystrix*, below, but differs in its smaller size and in its swollen suffultory cells.

123. **Oe. hystrix** Wittrock.

(**Pl. XLIII, fig. 417.**)

1870, p. 133; Wolle 1887, p. 87, Pl. 84, fig. 8; Hirn 1900, p. 213, Pl. XXV, fig. 218.

Dioecious, nannandrous, gynandrosporous (or possibly idioandrosporous); oogonium 1, ellipsoid, pore median; oospore ellipsoid,

nearly filling oogonium, outer spore wall echinate; androsporangium 1–3; terminal cell obtuse; dwarf male slightly curved, on suffultory cell; antheridium exterior, 1; vegetative cell 17–28×30–120μ; oogonium 38–48×45–65μ; oospore 37–46×43–55μ; androsporangium 17–18× 13–18μ; dwarf male stipe 10–11×22–25μ; antheridium 6–8×9–14μ.

United States: Pennsylvania; Finland, Germany, Sweden.

123a. Var. **canadense** Tiffany.

(**Pl. XLIII, fig. 418.**)

1929, p. 74; *Oe. hystrix* Wittr. *in* Skuja 1927, p. 99, Pl. II, fig. 13.

Pore inframedian; suffultory cell enlarged; vegetative cell 14–25× 80–125μ; suffultory cell 24–30×64–72μ; oogonium 40–53×52–64μ; oospore 38–48×40–60μ; androsporangium 16–20×15–30μ; antheridium 7–8×8–14μ; dwarf male stipe 9–12×28–40μ.

British Columbia; Latvia.

123b. Var. **subglobosum** Wittrock.

(**Pl. XLIII, fig. 419.**)

1872a, p. 22, Pl. 1, fig. 7; Hirn 1900, p. 214, Pl. XXXV, fig. 219.

Smaller; oogonium and oospore subglobose; vegetative cell 17–21× 35–93μ; oogonium 36–38×41–43μ; oospore 34–36×39–40μ; androsporangium 16–18×9–14μ; dwarf male stipe 10×23μ; antheridium 7×7μ.

Sweden.

The species is to be compared with *Oe. hystricinum* (No. 122). The variety *canadense* differs from the type in its inframedian pore and slightly swollen suffultory cell; var. *subglobosum* is smaller with subglobose oogonium.

124. **Oe. echinospermum** Al. Braun.

(**Pl. XLIII, figs. 420 and 421.**)

In Kuetzing 1849, p. 366; Kuetzing 1853, p. 12, Pl. 36, fig. 2; Wittr. 1870, p. 129; Hirn 1900, p. 199, Pl. XXXIII, fig. 204; P. B. A. No. 1673.

Dioecious, nannandrous, gynandrosporous or idioandrosporous; oogonium 1, ellipsoid-globose or subglobose, pore median; oospore globose, quite filling oogonium, outer layer of spore wall echinate; androsporangium 1–5; dwarf male a little curved, on suffultory cell, antheridium exterior, 1–2; vegetative cell 18–30×45–130μ; oogonium 39–50×41–57μ; oospore (with spines) 38–47×38–49μ; androsporangium 21–25×9–15μ; dwarf male stipe 10–15×26–35μ; antheridium 6–12× 6–15μ.

United States: Illinois, Ohio, Alabama, Mississippi, Massachusetts, New York, New Jersey, Pennsylvania, Michigan; Austria, Scotland, England, Germany, Latvia, Finland, France, Sweden; Australia; British Columbia.

124a. Var. **horridum** Hirn.

(**Pl. XLIII, fig. 422.**)

1900, p. 201, Pl. XXXIII, fig. 205; *Oe. echinospermum* A. Br. var. Wolle 1887, p. 86, Pl. 85, figs. 6-9.

Larger with longer and more dense spines; antheridium pluricellular.

United States: Florida.

The species is one of the most easily recognized among the nannandrous forms by its echinate oospore, median pore, and large dimensions (as compared with *Oe. hystrix*, *Oe. aster*, and *Oe. pungens*). The variety *horridum* has no record other than that of Wolle, and its retention in the genus is open to considerable question.

125. **Oe. pungens** Hirn.

(**Pl. XLIV, figs. 423 and 424.**)

1900, p. 199, Pl. XXXII, fig. 203.

Dioecious, nannandrous, gynandrosporous; oogonium 1, subdepressed-globose (or nearly subglobose), pore median or a little above median; oospore subglobose, almost filling oogonium, outer spore wall echinate; androsporangium 1–?, hypogynous; dwarf male a little curved, on suffultory cell, antheridium exterior, 1–2; vegetative cell 12–16×50–94μ; oogonium 40–48×40–50μ; oospore (with spines) 37–44×35–43μ; androsporangium 14–16×10–15μ; dwarf male stipe 9–12×20–30μ; antheridium 6–7×8–12μ.

United States: South Carolina, Illinois.

Cf. *Oe. aster* (No. 121).

126. **Oe. exospirale** Tiffany.

(**Pl. XLIV, figs. 425 and 426.**)

1924, p. 184, Pl. II, figs. 1–3; 1926, p. 102, Pl. IX, figs. 100–102.

Dioecious, nannandrous, idioandrosporous; oogonium 1 (rarely 2), subglobose or obovoid-globose (rarely subhexagonal), pore median; oospore globose or subglobose, nearly filling the oogonium, spore wall of two layers: outer layer marked by 5–8 spiral ribs uniting at the poles, the polar axis always placed in a transverse position, never parallel with the filament, the inner layer smooth; suffultory cell swollen; androsporangium 1–6; basal cell elongate; dwarf male a little curved, situated on the suffultory cell, with exterior antheridium 1–3; vegetative cell 8–12×60–88μ; suffultory cell 16–28×60–88μ; oogonium 40–44×44–48μ; oospore 32–38×38–40μ; androsporangium 12–16×14–20μ; dwarf male stipe 14–16×30–40μ; antheridium 8–12×14–16μ.

United States: Iowa, Ohio, Mississippi.

This species should be compared with *Oe. spirale* (No. 128) and *Oe. illinoisense* (No. 127). It differs from the former in having smaller oogonia and oospores and in its tumid suffultory

cells; it is separated from the latter on the basis of smaller dimensions.

127. **Oe. illinoisense** Transeau.
(**Pl. XLIV, figs. 431-433.**)

1914, p. 299, Pl. XXIX, figs. 6-8.

Dioecious, nannandrous, gynandrosporous; oogonium 1, subglobose to obovoid-globose, pore median; oospore globose or subglobose, nearly filling oogonium, outer spore wall with 4–7 spiral ribs, uniting at poles, polar axis always transverse to axis of filament; suffultory cell enlarged; androsporangium 1–5; basal cell elongate; dwarf male slightly curved, on suffultory cell; antheridium exterior, 1–4; vegetative cell 13–18×80–140μ; suffultory cell 32–40×50–80μ; oogonium 51–60×60–70μ; oospore 45–56×48–66μ; androsporangium 13–17×17–22μ; dwarf male stipe 14–17×37–57μ; antheridium 9–12×15–23μ.

United States: Illinois, Mississippi, Kentucky.

Cf. *Oe. exospirale*, above.

128. **Oe. spirale** Hirn.
(**Pl. XLIV, figs. 427 and 428.**)

1900, p. 201, Pl. XXXIII, fig. 206.

Dioecious, nannandrous, idioandrosporous; oogonium 1, subglobose or obovoid-globose, pore median; oospore globose or subglobose, not filling oogonium, spore wall double: outer layer with 4–7 spiral ribs, anastomosate, united at the poles, inner layer smooth; androsporangium 1–3; basal cell elongate; dwarf male a little curved, near oogonium, antheridium exterior, 1; vegetative cell 20–33×40–130μ; oogonium 52–60×52–60μ; oospore 46–56×46–56μ; androsporangium 17–22×11–14μ; dwarf male stipe 11–16×41–59μ; antheridium 10–11×18–20μ.

Asia (Java).

128a. Var. **acutum** West and West.
(**Pl. XLIV, fig. 430.**)

1902, p. 128, Pl. 17, figs. 3-5; Hirn 1906, p. 22, Pl. III, fig. 14.

Spiral ribs larger, irregularly and acutely dentate; vegetative cell 20–26×70–106μ; oogonium 46–56×54–60μ; oospore 37–45×37–45μ; dwarf male stipe 9–12×34–44μ; antheridium 8–9×14–18μ.

United States: Mississippi; Ceylon, India.

128b. Var. **latviense** Tiffany.
Pl. XLIV, fig. 429.)

1929, p. 75; *Oe. spirale* Hirn f. *in* Skuja 1927, p. 102, Pl. II, fig. 14 a-b.

Pore supramedian or superior; vegetative cell 16–20×65–120μ; oogonium 49–60×65μ; oospore (without ribs) 35–45×35–45μ, not filling oogonium, outer wall with 5–6 spirally arranged ribs; dwarf male 12×50μ.

Latvia.

The species should be compared with *Oe. exospirale* (No. 126). The variety *acutum* has smaller oospores and larger ribs; var. *latviense* has a distinctly above-median pore which is sometimes nearly superior.

129. **Oe. depressum** Pringsheim.

(Pl. XLVI, fig. 446.)

1858, p. 69, Pl. 5, fig. 5; Hirn 1900, p. 249, Pl. XLII, fig. 261.

Dioecious, nannandrous, gynandrosporous; oogonium 1 (rarely 2), depressed globose, pore median; oospore depressed globose, not filling oogonium; androsporangium 2-celled; dwarf male oblong-obovoid, on oogonium, antheridium interior; vegetative cell 8–9×25–54μ; oogonium 28×26μ; oospore 23×17–18μ; dwarf male 4–5×14–16μ.

Germany; Greenland.

Cf. *Oe. semiapertum*, below.

130. **Oe. semiapertum** Nordstedt and Hirn.

(Pl. XLVI, fig. 445.)

In Hirn 1900, p. 250, Pl. XLII, fig. 262.

Dioecious, nannandrous, gynandrosporous; oogonium 1 (rarely 2), subhexagonal-globose to subpyriform-globose, pore median, rimiform, extending nearly half way round the oogonium; oospore globose or subglobose, not filling oogonium, spore wall smooth; androsporangium 1–3, hypogynous or subepigynous; terminal cell apically obtuse; dwarf male subobovoid, on oogonium, antheridium interior; vegetative cell 9–12×38–105μ; oogonium 32–35×33–40μ; oospore 25–29×25–30μ; androsporangium 9–10×10–14μ; dwarf male 8–9×14–15μ.

French Guiana.

This species and *Oe. depressum*, above, are the smallest of nannandrous, medianly poriferous members of the genus having smooth and nearly globose oospores. *Oe. depressum* is separated by its smaller size and non-rimiform pore.

131. **Oe. gallicum** Hirn.

(Pl. XLVII, fig. 453.)

1900, p. 197, Pl. XXXII, fig. 201; *Oe. flavescens* Hass. *in* Roumeguere Alg. Exs. No. 1173.

Dioecious, nannandrous, (?) idioandrosporous; oogonium 1–2, subhexagonally globose, pore a little above median; oospore of same form as oogonium and quite filling it, spore wall smooth; dwarf male suberect, on suffultory cell (rarely oogonium), antheridium exterior, 1–2; vegetative cell 17–22×51–120μ; oogonium 43–48×44–54μ; oospore 41–46×39–44μ; dwarf male stipe 11–16×26–30μ; antheridium 8–9×7–11μ.

France.

Cf. *Oe. braunii*, below.

132. **Oe. braunii** Kuetzing; Pringsheim.

(**Pl. XLVII, fig. 458.**)

Kuetzing 1849, p. 366; 1853, p. 12, Pl. 36, fig. 3; Pringsheim 1858, p. 70, Pl. 5, fig. 6; Wolle 1887, p. 79, Pl. 79, figs. 6 and 7; *Oe. calcareum* Cleve var. *gaditanum* Lewin 1888, p. 18, Pl. 3, fig. 53; Hirn 1900, p. 194, Pl. XXXII, fig. 197; Collins 1909, p. 249; Heering 1914, p. 172; Tiffany 1926, p. 102.

Dioecious, nannandrous, gynandrosporous; oogonium 1, ovoid to subglobose, pore median; oospore globose, not filling oogonium, spore wall smooth; androsporangium 1–2; basal cell elongate; terminal cell apically obtuse; dwarf male usually on suffultory cell, stipe somewhat curved; antheridium exterior, 1; vegetative cells 13–15×25–60μ; suffultory cell 16–20×28–50μ; oogonium 30–37×33–43μ; oospore 27–33×27–33μ; androsporangium 13–15×11–12μ; dwarf male stipe 7–12×20–28μ; antheridium 5–8×9–10μ.

United States: Iowa, Illinois, New Jersey, Pennsylvania, Michigan; Austria, England, Denmark, Finland, France, Germany, Spain, Ireland, Latvia, Norway, Sweden; Africa; British Columbia.

132a. Var. **hafniense** (Hallas) Hirn.

(**Pl. XLVII, figs. 460-462.**)

1906, p. 10, Pl. III, fig. 13; *Oe. hafniense* Hallas 1905, p. 398, fig. 1.

A little smaller; idioandrosporous; oospore globose or angular-globose; vegetative cell 12–15×25–60μ; oogonium 23–30×28–35μ; oospore 21–28×21–28μ; dwarf male stipe 6–8×12–21μ; antheridium 7×7μ.

Denmark.

132b. Var. **zehneri** Tiffany.

(**Pl. XLVII, fig. 459.**)

1927, p. 204, Pl. IX, fig. 2.

Somewhat larger in all dimensions; oospore ovoid; vegetative cell 12–24×34–72μ; suffultory cell 21–32×48–52μ; oogonium 40–50×48–60μ; oospore 34–44×36–50μ; dwarf male stipe 8–10×16–24μ; antheridium 7–8×8–12μ.

United States: Indiana.

The species is near, but smaller than, *Oe. gallicum* (No. 131) and *Oe. flavescens*, below. Var. *hafniense* is smaller than the type and is idioandrosporous; var. *zehneri* is somewhat larger than the species and has ovoid oospores.

133. **Oe. flavescens** (Hassall) Wittrock).

(**Pl. XLIX, fig. 471.**)

(?) *Vesiculifera flavescens* Hass. 1845, p. 206, Pl. 53, fig. 9; *Oe. flavescens* Wittr. 1870, p. 127; *Oe. flavescens* (Hass.) Wittr. var. *gynandrosporum* Hirn 1895, p. 16; Hirn 1900, p. 196, Pl. XXXII, figs. 199 and 200; Collins 1909, p. 249; Heering 1914, p. 174, fig. 232; Tiffany 1926, p. 103, Pl. IX, fig. 95.

Dioecious, nannandrous, idioandrosporous or gynandrosporous; oogonium 1, ellipsoid-globose to subglobose, pore median; oospore

globose, not quite filling oogonium, spore wall smooth; androsporangium 1–9; dwarf male somewhat curved, on the suffultory cell; antheridium 1–2; vegetative cell 18–23×72–140μ; oogonium 49–52×51–60μ; oospore 45–49×45–49μ; androsporangium 17–20×8–18μ; dwarf male stipe 11–12×36–45μ; antheridium 9–10×15–20μ.

United States: Ohio, Mississippi, Alabama, Massachusetts, Minnesota, Iowa; England, Sweden, Finland.

Cf. *Oe. braunii* (No. 132).

134. **Oe. manschuricum** Skvortzow.

(Pl. XLVI, fig. 442.)

1926, p. 434, fig. 8.

Dioecious, nannandrous; oogonium 1, globose, pore supramedian; oospore globose or nearly so, not quite filling oogonium, outer spore wall echinate; dwarf male broadly egg-shaped, unicellular, on oogonium; vegetative cell 14–17×56–85μ; oogonium 30–31×37–38μ; oospore 26–28×26–30μ; dwarf male 13–24×20–37μ.

North Manchuria.

Characterized by its echinate oospores and supramedian pores. To be compared with *Oe. hystricinum* (No. 122) and *Oe. echinospermum* (No. 124).

135. **Oe. sexangulare** Cleve.

(Pl. XLVII, fig. 454.)

In Wittr. 1870, p. 131; Wolle 1887, p. 82, Pl. 79, figs. 8 and 9; *Oe. hexagonum* Kuetz. *in* Roumeguere Alg. Exs. No. 294 and *Oe. vesicatum* Link f. *fuscescens* Dupray *in loc. cit.* No. 687; Hirn 1900, p. 211, Pl. XXXV, fig. 216; P. B. A. No. 1679.

Dioecious, nannandrous, gynandrosporous; oogonium 1 (rarely 2), sexangular-ellipsoid, pore a little above median; oospore same form as oogonium and nearly filling it, spore wall smooth; suffultory cell sometimes slightly tumid; androsporangium 1–3; dwarf male on suffultory cell, a little curved, stipe of 2–3 cells, antheridium exterior, 1; vegetative cell 9–16×30–110μ; oogonium 29–33×33–39μ; oospore 27–31×31–36μ; androsporangium 13–14×10–14μ; dwarf male stipe 7–9×21–30μ; antheridium 6–7×9–12μ.

United States: Indiana, Mississippi, New York, Louisiana, Pennsylvania, Kentucky, Michigan; Austria, France, Norway, Sweden.

135a. Var. **angulosum** (Hallas) Hirn.

(Pl. XLVII, figs. 455 and 456.)

1906, p. 21, Pl. III, fig. 17; *Oe. angulosum* Hallas 1905, p. 402, fig. 7.

Smaller, oospore not filling oogonium; vegetative cell 10–14×15–54μ; oogonium 19–30×30–42μ; oospore 17–28×21–30μ; dwarf male stipe 6–7×18–21μ; antheridium 6×7μ.

Denmark.

135b. Var. **majus** Wille.

(**Pl. XLVII, fig. 457.**)

1880, p. 68; Hirn 1900, p. 212, Pl. XXV, fig. 217.

Larger, pore median; vegetative cell 15–23×30–68μ; oogonium 36–42 (–48)×(36–) 41–45μ; oospore 34–40×39–43μ; androsporangium 14–18×8–10μ; dwarf male stipe 7–9×18–30μ; antheridium 6–8×6–10μ.

United States: Mississippi, Massachusetts; Austria, Finland, Germany, Norway, Sweden.

The species is readily identified among the nannandrous forms by its sexangular-ellipsoid oogonia and oospores. Var. *angulosum* is smaller and var. *majus* is larger than the species.

136. **Oe. stellatum** Wittrock.

(**Pl. XLV, fig. 441.**)

1870, p. 129; 1874, p. 27, Pl. 1, fig. 15; (?) *Oe. spinospermum* Reinsch 1875, p. 81, Pl. 15, fig. 1; Hirn 1900, p. 265, Pl. XXXIV, fig. 210.

Dioecious, nannandrous, gynandrosporous; oogonium 1–3, obovoid-globose, pore superior; oospore globose, quite filling oogonium, outer spore wall with 4–7 somewhat spirally arranged ribs, appearing definitely dentate on the margin, sometimes anastomosate; androsporangium 1–3, usually subepigynous; basal cell elongate; terminal cell slender, subhyaline, apically obtuse; dwarf male suberect, on suffultory cell, antheridium 1–2; vegetative cell 15–35×40–225μ; oogonium 51–64×56–70μ; oospore (with ribs) 50–58×50–58μ; androsporangium 14–19×13–20μ; dwarf male stipe 11–13×45–52μ; antheridium 6–9×8–13μ.

United States: Alabama, Florida; Africa; Brazil; Australia; Finland, Germany, Italy, Sweden; Ceylon.

This alga is often placed with the species having spirally arranged ribs on the oospore. The ribs are really irregular rows of dentate spines, and I have thus separated it in the key.

137. **Oe. silvaticum** Hallas.

(**Pl. XLIX, fig. 472.**)

1905, p. 404; fig. 9; Hirn 1906, p. 21, Pl. III, fig. 16.

Dioecious, nannandrous, gynandrosporous; oogonium 1, ellipsoid-globose, pore superior; oospore globose, not filling oogonium; suffultory cell subtumid; dwarf male suberect, on suffultory cell, antheridium exterior; vegetative cell 12–15×65–120μ; suffultory cell 20×60μ; oogonium 37×50μ; oospore 28×28μ; androsporangium 7×17μ; dwarf male stipe 11×39μ; antheridium 7×7μ.

Denmark.

In general appearance this species resembles *Oe. flavescens* (No. 133), but differs in its smaller size and superior pore. The suffultory cells are not nearly so much enlarged relatively as in *Oe. borisianum*, below.

138. **Oe. borisianum** (Le Clerc) Wittrock.
(Pl. XLVIII, fig. 469.)

1874, p. 25; *Prolifera borisiana* Le Clerc 1817, p. 475, Pl. 23, fig. 6; *Oe. borisianum* Wittr. 1870, p. 132; *Vesiculifera aurea* Hassall 1842, p. 392; *V. borissii* Hassall 1845, p. 201, Pl. 52, fig. 7; *Oe. apophysatum* Al. Braun *in* Kuetzing 1849, p. 366, and 1853, p. 12, Pl. 35, fig. 5; *Oe. setigerum* Vaupell 1859, p. 17, Pl. 1. (?) *Androgynia mirabilis* Wood 1872, p. 196, Pl. 18, fig. 2; *Oe. birmanicum* Wittrock 1874, p. 24; Hirn 1900, p. 217, Pl. XXXVI, fig. 223; Collins 1909, p. 255; Heering 1914, p. 178, fig. 243; Tiffany 1926, p. 103, Pl. VIII, fig. 87; P. B. A. No. 517.

Dioecious, nannandrous, gynandrosporous or idioandrosporous; oogonium 1–5, obovoid or quadrangular-ellipsoid, pore superior; oospore ovoid to obovoid (often quadrangular-ovoid), not filling oogonium, spore wall smooth; androsporangium 1–7, usually in the upper part of the filament; basal cell elongate; terminal cell, often an oogonium, broadly apiculate, obtuse, or sometimes setiferous; dwarf male, somewhat curved, on suffultory cell; antheridium 2; vegetative cell 15–23×45–140μ; suffultory cell 31–38×50–92μ; oogonium (33–) 40–50×55–90μ; oospore 35–46×48–60μ; androsporangium 16–19×15–23μ; dwarf male stipe 12–18×35–47μ; antheridium 7–10×11–16μ.

United States: Iowa, Massachusetts, Utah, Michigan, California, Illinois, Ohio, Pennsylvania; British Columbia; Austria, England, Denmark, Finland, France, Germany, Spain, Sweden, Latvia; Brazil, Columbia, Paraguay; Australia; India; South Africa.

138a. Var. **westii** Tiffany and Brown.
(Pl. XLVIII, fig. 470.)

In Tiffany, 1929, p. 74; *Oe. borisianum* (Le Cl.) Wittr. *in* West 1903, p. 36.

Larger dimensions throughout; vegetative cell 17–19×130–180μ; suffultory cell 31–42×105–168μ; oogonium 53–60×67–88μ; oospore 49–58×49–58μ; antheridium 17×12–13μ.

United States: Michigan, Mississippi; England.

Oe. borisianum is one of the commonest nannandrous species. It is easily identified by the striking difference in size between the cells above the oogonia and the suffultory cells. F. *westii* is larger than the type.

139. **Oe. alternans** Wittrock and Lundell.
(Pl. XLVIII, fig. 463.)

In Wittr. 1874, p. 20; Hirn 1900, p. 251, Pl. XLII, fig. 263.

Dioecious, nannandrous, gynandrosporous; oogonium 1, subglobose, often alternating with vegetative cell, pore superior; oospore globose, filling oogonium, wall smooth, often thick; suffultory cell often subtumid; androsporangium 1–2, subepigynous or epigynous; basal cell elongate; terminal cell obtuse; dwarf male oblong, with an inferior constriction, on suffultory cell; vegetative cell 21–35×45–160μ; suffultory cell 26–40×52–160μ; oogonium 65–80×65–86μ; oospore 59–75×59–75μ; androsporangium 18–25×16–25μ; dwarf male 12–17×38–46μ.

Sweden.

Readily characterized by its short barrel-shaped vegetative cells, often alternating with oogonia.

140. **Oe. kitutæ** G. S. West.

1907, p. 98.

Dioecious, nannandrous; oogonium 1–2, subglobose or obovate-globose, pore superior; oospore globose, not filling oogonium, spore wall smooth; terminal cell obtuse; dwarf male elongate, slightly curved, smaller below, situated on oogonium or suffultory cell; antheridium interior (?); vegetative cell 26×130–180μ; oogonium 76–78×75–80μ; oospore 72×72μ; suffultory cell 44×132μ; dwarf male 12–13×58–66μ.

Africa.

West has left no figure for this species. It is to be compared with *Oe. borisianum* (No. 138) and *Oe. silvaticum* (No. 137).

141. **Oe. victoriense** G. S. West.

(**Pl. XLIX, fig. 473.**)

In Hardy 1906, p. 22; West 1909, p. 47, Pl. 6C.

Dioecious, nannandrous, gynandrosporous; oogonium 1, ellipsoid-globose to ellipsoid-doliiform, pore superior; oospore exactly globose, not filling oogonium, spore wall smooth; androsporangium 5–6 celled; dwarf male on suffultory cell, stipe curved, antheridia 2; suffultory cell broadly dilated; vegetative cell 25–29×50–87μ; oogonium 49×57μ; oospore 39×39μ; androsporangium 25–26×4–8μ; antheridium 7–8×4–5μ.

Africa (Victoria).

Resembles *Oe. crassiusculum*, below, but has single oogonia, nearly exactly globose oospores, and smaller oogonia.

142. **Oe. crassiusculum** Wittrock.

(**Pl. XLIX, fig. 474.**)

1870, p. 132, 1874, p. 24; Cooke 1884, p. 162, Pl. 60, fig. 5; Hirn 1900, p. 215.

Dioecious, nannandrous, gynandrosporous; oogonium 1–2, globose-obovoid or subglobose, pore superior; oospore ellipsoid-globose or globose, spore wall smooth and thickened, quite filling oogonium; androsporangium 2–5; dwarf male suberect, on or near suffultory cell, antheridium exterior, 1–?; vegetative cell 27–30×95–105μ; oogonium 54–60×60–75μ; oospore 51–57×52–63μ; androsporangium 26–28×10–18μ; dwarf male 13×60μ; antheridium 7–9×9–16μ.

United States: Ohio, Mississippi, Connecticut; Australia; England, Sweden.

142a. Var. **arechavaletæ** (Wittrock) Hirn.

(Pl. L, fig. 478.)

1900, p. 216, Pl. XXXVI, fig. 222; *Oe. arechavaletæ* Wittr. *in* Wittr. and Nordst. Exs. 1886 and *in* De Toni 1889, p. 55.

(?) Idioandrosporous; vegetative cell 21–29×32–110μ; oogonium 39–54×42–65μ; oospore 37–52×40–57μ; dwarf male 14–16×40–57μ; antheridium 9–14×10–16μ.

Uruguay.

142b. Var. **idioandrosporum** Nordstedt and Wittrock.

(Pl. XLIX, figs. 475 and 476.)

In Wittr. & Nordst. Exs. 1879; *Oe. huntii* Wood *in* Tilden Amer. Algae 1894; *Oe. crassiusculum* Wittr. *in* P. B. A. 1895; *Oe. crassipellitum* West 1899, p. 55, Pl. 394, figs. 3–5; Hirn 1900, p. 215, Pl. XXXV, fig. 220; Collins 1909, p. 255; Heering 1914, p. 178, fig. 242; Tiffany 1926, p. 103, Pl. VIII, fig. 89; P. B. A. Nos. 72 and 716.

Idioandrosporous; oogonium 1–3, globose-obovoid to globose, pore superior; oospore ellipsoid-globose, ovoid, angular-globose (rarely globose), nearly filling the oogonium, spore wall smooth, thick; androsporangium 1–4; dwarf male straight or slightly curved, on or near the suffultory cell; antheridium exterior, 1–2; vegetative cell 25–36×65–200μ; oogonium 48–59×57–90μ; oospore 42–57×50–66μ; androsporangium 30–34×12–21μ; dwarf male stipe 14–16×60–70μ; antheridium 8–10×10–18μ.

United States: Massachusetts, Maine, Michigan, Pennsylvania, New Jersey, Minnesota, Connecticut, South Dakota, Iowa, Ohio, New York, Illinois, Mississippi; England, Denmark, France, Germany, Sweden.

This variety is one of the commonest of the nannandrous species of the genus. In fact, in comparison to it, the type seems rare. Characterized by the thick-walled oospore, globose-obovoid oogonia, and relatively long and straight vegetative cells. It differs from the species largely in its idioandrosporous habit.

142c. Var. **cataractum** (Wolle) Tiffany nov. comb.

(Pl. XLIX, fig. 477.)

Oe. cataractum Wolle 1887, p. 77, Pl. 85, figs. 10-12; *ibid.*, Hirn 1900, p. 308, Pl. XLII, fig. 264; *ibid.*, Collins 1909, p. 266.

Oogonium 1–2, often terminal, obovoid-globose or subglobose or broadly ovate, pore superior; oospore globose or obovoid-globose, nearly filling oogonium; androsporangium 2–6; dwarf male curved, on suffultory cell or below; vegetative cell 28–38×42–112μ; oogonium 55–60×60–75μ; oospore 50–55×50–60μ; androsporangium 26–30×10–15μ; dwarf male 10×65μ.

United States: Pennsylvania, Ohio.

From Wolle's description this plant is certainly very close to *Oe. crassiusculum*, as suggested by Hirn (1900). Wolle's

figure does not help much and his confusing statements regarding an interior and a unicellular antheridium probably mean that he did not attach much significance to this character. The Ohio material with short vegetative cells seemed close to *Oe. crassiusculum* in other characteristics. I have therefore placed Wolle's species as a variety of *crassiusculum*, with an emended description based on the Ohio specimens.

143. **Oe. multisporum** Wood.

(**Pl. XLVI, figs. 450 and 451.**)

1869, p. 141; *Androgynia multispora* Wood 1872, p. 196, Pl. 17, fig. 3; Hirn 1900, p. 232, Pl. XXXIX, fig. 239; Collins 1909, p. 257; Fritsch and Rich 1913, p. 76, fig. 1 A; P. B. A. No. 1784.

Dioecious, nannandrous; oogonium 1–3, subovoid or subglobose, pore superior; oospore globose, nearly filling oogonium, spore wall smooth; dwarf male a little curved or nearly erect, near or on oogonium, antheridium exterior, 1–4; vegetative cell 10–15×10–30μ; oogonium 24–35×27–33μ; oospore 27–30×24–30μ; dwarf male stipe 10–11×26–30μ; antheridium 7–9×7–9μ.

United States: Pennsylvania, Illinois; England.

143a. Var. **magnum** Ackley.

(**Pl. XLVI, fig. 452.**)

1929, p. 305, Pl. XXXVI, figs. 20–22.

Larger than the species; idioandrosporous; oogonium 1, subglobose, pore supramedian (rarely median); androsporangium 1–2; dwarf male on or near oogonium or scattered; vegetative cell 14–18×30–90μ; suffultory cell 17–21×28–90μ; oogonium 40–43×33–38μ; oospore 38–41×32–36μ; androsporangium 17–18×16–22μ; dwarf male stipe 12–14 (–20)×24–26 (–29)μ; antheridium 8–10 (–12)×8–10μ.

United States: Michigan (Muskegon Lake).

It is sometimes difficult to decipher the pore in the species proper. The plant is usually irregularly formed with numerous and often scattered dwarf males and frequently gives the appearance of not being mature. The variety is larger.

144. **Oe. irregulare** Wittrock.

(**Pl. XLVI, fig. 447.**)

1870, p. 128; 1874, p. 22; Hirn 1900, p. 202, Pl. XXXIII, fig. 207.

Dioecious, nannandrous; oogonium 1, globose or rarely subdepressed-globose, pore superior; oospore globose, completing oogonium, spore wall smooth; dwarf male erect, on or near oogonium, antheridium exterior, 1–4; vegetative cell 15–20×40–80μ; oogonium 37–45×36–47μ; oospore 36–42×34–41μ; dwarf male stipe 12–15×20–24μ; antheridium 10–12×6–8μ.

United States: Illinois, Ohio, Florida, Michigan; British Columbia; Denmark, Sweden.

144a. Var. **condensatum** (Hallas) Hirn.

(**Pl. XLVI, figs. 448 and 449.**)

1906, p. 17, Pl. III, fig. 15; *Oe. condensatum* Hallas 1905, p. 400, fig. 4.

Idioandrosporous; oogonium rarely in two's; oospore depressed-globose; androsporangium 1–13; vegetative cell 14–18×20–80μ; oogonium 35–46×28–38μ; oospore 32–44×25–36μ; androsporangium 12–14×7–21μ; dwarf male stipe 11–13×21–24μ; antheridium 9–10×7–12μ.

United States: Michigan; Denmark.

The species is characterized by erect dwarf males, globose oospores, and smooth spore walls. It is larger than *Oe. multisporum* (No. 143) and there is little tendency toward a cluster of dwarf males. The var. *condensatum* has depressed-globose oospores and the dwarf males sometimes appear more or less in clusters. In superficial appearance there is considerable resemblance between *Oe. multisporum* var. *magnum* (No. 143a) and *Oe. irregulare* var. *condensatum*.

145. **Oe. donnellii** Wolle; Hirn.

(**Pl. XLV, fig. 437.**)

Wolle 1880, p. 48; Wolle 1887, p. 85, Pl. 84, figs. 3-6; Hirn 1900, p. 206, Pl. XXXIV, fig. 211.

Dioecious, nannandrous, idioandrosporous; oogonium 1 (rarely 2), obovoid-globose, pore superior; oospore globose, not filling oogonium, outer layer of spore wall echinate, spirals 5–7, anastomosate; androsporangium 4–10; dwarf male a little curved, on suffultory cell or rarely on oogonium, antheridium exterior, 1–2–?; vegetative cell 41–59×54–175μ; oogonium 63–78×70–93μ; oospore (with spines) 60–70×60–70μ; androsporangium 40–45×10–12μ; dwarf male stipe 16–21×63–74μ; antheridium 14–15×8–22μ.

United States: Florida.

145a. Var. **wittrockianum** Hirn.

(**Pl. XLV, figs. 438 and 439.**)

1909, p. 207, Pl. XXXIV, fig. 212; *Oe. wittrockianum* Hirn 1896 *in* Wittr., Nordst, and Lagerh. Alg. Exs. No. 1251.

Smaller; spines a little smaller; vegetative cell (32–)35–45×70–135μ; oogonium 63–73×68–75μ; oospore (with spines) 55–66×56–68μ; androsporangium 30–38×11–26μ; dwarf male stipe 11–15×50–65μ; antheridium 9–10×20–23μ.

Brazil, Paraguay.

The species is characterized by the echinate oospore wall, the spines being arranged spirally. The variety *wittrockianum* is very similar to the type, having slightly more slender filaments and smaller spines.

146. **Oe. armigerum** Hirn.

(Pl. XLIII, fig. 415.)

1900, p. 203, Pl. XXXIII, fig. 208; (?) *Oe. echinatum* Wood *in* Wolle 1887, p. 86, Pl. 85, figs. 13-16.

Dioecious, nannandrous; oogonium 1, subglobose, pore superior; oospore globose, nearly filling oogonium, outer layer of spore wall echinate; dwarf male curved, on suffultory cell, stipe sometimes 2–4 celled; antheridium exterior, 1–?; vegetative cell 9–11×36–100μ; oogonium 29–33×32–35μ; oospore 26–29×26–29μ; dwarf male, lower cell 7–8×20–24μ, upper cell 4–6×21–30μ; antheridium 5–6×7–8μ.

Brazil.

Characterized by its echinate oospore wall with the spines not spirally arranged. It is smaller than either *Oe. echinatum* (No. 147) or *Oe. lindmanianum* (No. 148).

147. **Oe. echinatum** (Wood) Wittrock.

(Pl. XLV, fig. 436.)

Androgynia echinata Wood 1872, p. 198, Pl. 18, fig. 3; *Oe. echinatum* Wittr. 1878, p. 137; Hirn 1900, p. 204.

Dioecious, nannandrous; oogonium (?) 1, globose, usually depressed, pore superior; oospore globose, distending oogonium, outer layer of spore wall echinate; dwarf male suberect, near oogonium, (?) antheridium exterior, 1; vegetative cell 8–13×50–138μ; oogonium 35–36×35–36μ; oospore (without echinations) 25–26×25–26μ.

United States: Pennsylvania.

Wood's figure of the echinate oospore is the only record of this species, other than the description above.

148. **Oe. lindmanianum** Wittrock.

(Pl. XLV, figs. 434 and 435.)

In Wittr., Nordst., and Lagerh. Alg. Exs. No. 1216, 1896; Hirn 1900, p. 204, Pl. XXXIV, fig. 209.

Dioecious, nannandrous, idioandrosporous; oogonium 1, obovoid-globose or subglobose, pore superior; oospore globose or subglobose, quite filling oogonium; outer spore wall echinate; androsporangium to 7-seriate; dwarf male a little curved, on suffultory cell, antheridium exterior, 1; vegetative cell 22–30×40–120μ; oogonium 46–57×46–57μ; oospore (with spines) 45–56×45–54μ; androsporangium 22–28×17–27μ; dwarf male stipe 12–15×38–46μ; antheridium 6–8×11–16μ.

Paraguay.

Cf. *Oe. armigerum* (No. 146).

149. **Oe. cyathigerum** Wittrock.

(Pl. LI, figs. 484 and 485.)

1870, p. 131, Pl. 1, figs. 6 and 7; *Oe. cyathigerum* Wittr. var. *rumelica* Istvanffi 1890, p. 77; *Oe. ornatum* Hirn 1896, p. 3, fig. (p. 4); Hirn 1900, p. 252, Pl. XLIII, figs. 265 and 266; Heering 1914, p. 184, fig. 256; Tiffany 1926, p. 103, Pl. IX, figs. 104 and 105.

Dioecious, nannandrous, idioandrosporous; oogonium 1–3, subovoid or quadrangular-ellipsoid, pore superior; oospore same form as oogonium,

filling it, outer layer of spore wall smooth, median layer with 16–25 longitudinal, continuous, rarely anastomosing, often curved, ridges—inner layer smooth; basal cell elongate; terminal cell, often an oogonium, obtuse; dwarf male goblet-shaped, curved, on the suffultory cell or oogonium; antheridium interior; vegetative cell 21–30×40–300μ; suffultory cell 42–48×75–110μ; oogonium 57–66×70–100μ; oospore 51–62×60–75μ; androsporangium 23–30×12–30μ; dwarf male cell 12–15×50–58μ.

United States: Iowa, Illinois, Ohio, Mississippi, Michigan; Denmark, France, Germany, Sweden, Rumania, Switzerland, England.

149a. Form **americanum** Wolle.

1887, p. 77, Pl. 81, figs. 20-22; Hirn 1900, p. 256.

Smaller; dwarf male on oogonium; vegetative cell 17–21×22–62μ; oogonium 45–50×55–63μ; oospore 39–40×44–46μ; dwarf male 12–15×50–54μ.

United States: Pennsylvania.

149b. Form **ornatum** (Wittrock) Hirn.

(Pl. LI, figs. 488-490.)

1900, p. 254, Pl. XLIII, fig. 267; *Oe. cyathigerum* Wittr. var. *ornatum* Wittr. 1878, p. 134.

Idioandrosporous; elongated dwarf males; vegetative cell 21–30×60–270μ; suffultory cell 39–48×60–116μ; oogonium 56–65×69–102μ; oospore 54–60×65–83μ; androsporangium 21–27×13–27μ; dwarf male 12–16×60–75μ.

Mexico (Vera Cruz).

149c. Form **perfectum** Hirn.

(Pl. LI, figs. 486 and 487.)

1900, p. 254; Pl. XLIII, fig. 268; *Oe. cyathigerum* Wittr. *in* Borge 1896, p. 5.

Larger; androsporangium to 23-seriate; vegetative cell 22–35×65–350μ; suffultory cell 37–56×56–140μ; oogonium 65–81×72–111μ; oospore 61–78×65–85μ; androsporangium 21–30×15–30μ; dwarf male 12–16×55–69μ.

United States: Mississippi, Ohio; Brazil; Australia; India.

149d. Var. **ellipticum** Magnus and Wille.

(Pl. LII, fig. 493.)

In Wille 1884, p. 40, Pl. 2, fig. 67; Hirn 1900. p. 255, Pl. XLIV, fig. 271; Fritsch and Rich 1924, p. 320, fig. 4 A-C.

Oospore frequently not filling oogonium, quadrangular-ellipsoid or nearly ellipsoid or rarely subglobose; vegetative cell 19–30×30–120μ; suffultory cell 26–43×40–125μ; oogonium 50–63×68–94μ; oospore 48–57×45–66μ; dwarf male 15–18×43–55μ.

United States: Ohio; Uruguay, Brazil; South Africa.

149e. Var. **hormosporum** (West) Hirn.

(**Pl. LII, figs. 491 and 492.**)

1900, p. 255, Pl. XLIV, figs. 269 and 270; *Oe. hormosporum* West 1897, p. 5.

Oogonium and oospore smaller; oogonia 2–10 (rarely 1), androsporangium up to 15-seriate; vegetative cell 22–30×76–180μ; suffultory cell 35–45×52–112μ; oogonium 48–57×56–95μ; oospore 46–55×53–65μ; androsporangium 18–22×12–24μ; dwarf male 9–13×47–54μ.

Africa.

The species is readily identified among the nannandrous group by the irregular longitudinal ridges appearing on the median oospore wall. The suffultory cells are very much enlarged. The varieties and forms are separated largely on the basis of size. It differs from *Oe. wolleanum* (No. 150) in its smaller number of ribs. Fritsch and Rich (1924) record a form of *Oe. cyathigerum* with suffultory cell not always swollen and with frequently globose oospores. This is perhaps merely a slight variation of var. *ellipticum*.

150. **Oe. wolleanum** Wittrock.

(**Pl. L, figs. 479 and 480.**)

1878, p. 137; Wolle 1887, p. 82, Pl. 80, figs. 4 and 5; *Oe. aphophysatum* A. Br. *in* Rabenh. Alg. Sach. No. 291, 1853; *Oe. concatenatum* (Hass.) Kuetz. f. *luxurians* Breb. *in* Roumeg. Alg. Exs. Nos. 683 and 1062; Hirn 1900, p. 220, Pl. XXXVII, fig. 226.

Dioecious, nannandrous, gynandrosporous or idioandrosporous; oogonium 1–4, subobovoid or quadrangular-ellipsoid, pore superior, wall with raised longitudinal lines on the inner surface; oospore of same form as oogonium, quite filling it, outer layer of spore wall with 25–35 longitudinal ribs, rarely anastomosate, inner layer smooth; androsporangium 1–3, often subepigynous or scattered in the upper part of the filament; basal cell elongate; terminal cell, sometimes oogonium, short-acute or acuminate; dwarf male on suffultory cell, stipe slightly curved; antheridium exterior, 1–3; vegetative cell 21–30×65–235μ; suffultory cell 45–56×68–110μ; oogonium 58–68×69–89μ; oospore 56–66×65–83μ; androsporangium 21–30×18–25μ; dwarf male stipe 15–24×54–60μ; antheridium 9–14×7–11μ.

United States: Massachusetts, Connecticut, New Jersey, Iowa, Pennsylvania, Minnesota, Florida, Illinois; Brazil; India; France, Latvia, Germany; Australia; Greenland.

150a. Var. **concinnum** Hirn.

(**Pl. L, fig. 481.**)

1900, p. 222, Pl. XXXVII, fig. 228.

Smaller; oospore not quite filling oogonium; ribs of outer layer of spore wall finely crenulate; vegetative cell 19–27×80–180μ; suffultory cell 41–52×72–150μ; oogonium 54–63×63–93μ; oospore 52–61×62–74μ; dwarf male stipe 16–20×50–60μ; antheridium 10–13×10–15μ.

United States: Minnesota.

150b. Form **insigne** (Nordstedt) Hirn.

(Pl. L, figs. 482 and 483.)

1900, p. 222, Pl. XXXVII, fig. 227; *Oe. wolleanum* Wittr. var. *insigne* Nordst. *in* Wittr. and Nordst. Alg. Exs. No. 207, 1879.

Stouter; ribs on the oogonium and oospore 35–40; oogonium 1–10; androsporangium to 10-seriate; antheridium 1–4; vegetative cell 18–36×53–250μ; suffultory cell 57–66×100–150μ; oogonium 67–80×78–92μ; oospore 64–76×74–90μ; androsporangium 19–30×18–30μ; dwarf male stipe 18–24×54–68μ; antheridium 12–14×10–12μ.

United States: New Jersey; Sweden.

This species is characterized by regular, longitudinal ribs on the outer layer of the oospore wall. It differs from *Oe. cyathigerum* (No. 149) in this respect and also in having a larger number of ribs. Var. *concinnum* has crenulate ribs, and f. *insigne* differs in its slightly larger size and in the larger number of ribs on the oospore.

151. **Oe. concatenatum** (Hassall) Wittrock.

(Pl. LII, fig. 494.)

Vesiculifera concatenata Hass. 1845, p. 201, Pl. 51, fig. 3; *Oe. concatenatum* Wittr. 1874, p. 25; *Oe. apophysatum* Al. Br. *in* Pringsh. 1858, p. 71, Pl. 5, fig. 9; *Oe. apophysatum* Pringsh. *in* Wittr. 1872a, p. 22; *Oe. concatenatum* (Hass.) Wittr. var. *lagenarioides* Filarszky 1899, p. 65, Pl. 3; Hirn 1900, p. 223, Pl. XXXVIII, fig. 230; Heering 1914, p. 180, fig. 245; Tiffany 1926, p. 104, Pl. VIII, fig. 92.

Dioecious, nannandrous, gynandrosporous; oogonium 1–6, subovoid or quadrangular-ellipsoid, pore superior; oospore of same form as oogonium, nearly filling it, outer layer of spore wall smooth, middle layer with pits, more or less distinctly arranged in 30–35 longitudinal series, inner wall smooth; suffultory cell swollen; androsporangium 1–4; basal cell elongate; terminal cell obtuse; dwarf male curved, on suffultory cell; antheridium exterior, 1–4; vegetative cell 25–40×75–400μ; suffultory cell 50–62×88–155μ; oogonium 63–83×76–105μ; oospore 60–75×67–95μ; androsporangium 25–28×15–36μ; dwarf male stipe 17–25×50–75μ; antheridium 13–15×12–25μ.

United States: Illinois, Iowa, Massachusetts, New Jersey, Pennsylvania, New York, Michigan; Austria, England, Finland, Germany, Spain, Hungary, Sweden, Denmark; Alaska; British Columbia.

151a. Form **hutchinsiæ** (Wittrock) Hirn.

(Pl. LII, fig. 495.)

1900, p. 225, Pl. XXXVIII, fig. 231; *Oe. hutchinsiæ* Wittr. 1874, p. 42; Heering 1914, p. 180; Tiffany 1926, p. 104.

Form a little smaller, oospore more nearly globose, the pits of the middle layer of spore wall not arranged in evident longitudinal series; vegetative cells 26–35×75–210μ; suffultory cell 37–50×65–200μ; oogonium 52–75×67–95μ; oospore 50–73×55–77μ.

United States: Iowa; England, France, Spain.

151b. Var. **rectangulare** Rich.

(**Pl. LIII, figs. 496 and 497.**)

1925, p. 72, fig. 1.

Oospore quadrangular-ellipsoid, membrane thick, middle layer of spore wall with its pits in transverse and longitudinal rows (about 15 transverse rows); idioandrosporous; vegetative cell 32–36×75–400μ; suffultory cell 50×88–155μ; oogonium 56×76–105μ; oospore 48–56×67–95μ; androsporangium 27×15–36μ.

England.

Oe. concatenatum is unique among the poriferous, nannandrous forms of the genus for its prominently pitted oospore. F. *hutchinsiæ* and var. *rectangulare* are separable largely on the arrangement of the pits on the median layer of the oospore.

152. **Oe. huntii** Wood.

(**Pl. XLVIII, figs. 465-468.**)

1869, p. 333; Wittrock 1878, p. 136; *Androgynia huntii* Wood 1872, p. 197, Pl. 17, fig. 2; Hirn 1900, p. 208, Pl. XXXIV, fig. 213; Collins 1908, p. 57; P. B. A. No. 1471.

Dioecious, nannandrous; oogonium usually 1, subglobose or subobovoid-globose (rarely subhexagonal), pore inferior; oospore globose, not filling oogonium, outer spore wall with four raised spiral ribs; basal cell elongate; terminal cells tapering, setiferous (consisting of 10 or more superimposed long cylindrical cells, each smaller in diameter than the one below); dwarf male nearly straight, on suffultory cell, antheridium exterior, 1–2 (?); vegetative cell 15–25×36–82μ; oogonium 50–60×52–60μ; oospore 38–42×38–42μ; dwarf male stipe 11×52μ; antheridium 10×30μ.

United States: Massachusetts, Pennsylvania.

Fruiting material showing the 4 spiral ribs has been seen only by Wood. Collins (1908) records the species showing the peculiar tapering setiferous terminal cells (see description above). This is the only species in the nannandrous group having ribbed oospores and an inferior pore.

153. **Oe. hispidum** Nordstedt.

(**Pl. XLV, fig. 440.**)

In Wittr. 1870, p. 128, and 1874, p. 28; Hirn 1900, p. 210, Pl. XXXV, fig. 215.

Dioecious, nannandrous, gynandrosporous; oogonium 1, terminal, subellipsoid or ellipsoid-globose, pore inferior; oospore globose to globose-ellipsoid, not filling oogonium or rarely enlarging it, outer spore wall echinate; androsporangia 2; terminal cell obtuse; dwarf male a little curved, on suffultory cell, antheridium exterior, 1; vegetative cell 9–14×36–130μ; oogonium 35–44×42–56μ; oospore (with spines) 32–39×32–40μ; androsporangium 10–12×6–8μ; dwarf male stipe 7–8×17–18μ; antheridium 5–6×7–9μ.

France, Sweden.

The only nannandrous species with echinate oospores and inferior position of the oogonial pore.

154. **Oe. cleveanum** Wittrock.

(**Pl. XLVI, figs. 443 and 444.**)

1870, p. 128; 1872a, p. 22; 1874, p. 28; *Oe. echinospermum* Al. Br. *in* Pringsh. 1858, p. 70, Pl. 5, fig. 7; *Oe. berolinense* Wittr. 1872, p. 6; *Oe. cleveanum* Wittr. var. *arvensis* Istvanffi 1887, p. 242; Hirn 1900, p. 209, Pl. XXXV, fig. 214; *Oe. cleveanum* Wittr. f. *exoticum* Hirn 1900, p. 210 (*not* Hirn 1906, p. 33).

Dioecious, nannandrous, gynandrosporous; oogonium 1, subobovoid-globose or subglobose, pore inferior; oospore globose, filling oogonium, outer layer of spore wall dentate, teeth in 4–6 spiral rows, anastomosate; suffultory cell sometimes tumid; androsporangium 1–7; dwarf male a little curved, on suffultory cell, antheridium exterior, 1; vegetative cell (14–) 18–26×40–110μ; oogonium 45–60×48–63μ; oospore (with teeth) 44–57×45–59μ; androsporangium 18–22×9–18μ; dwarf male stipe 10–11×29–32μ; antheridium 5–9×12–16μ.

England, France, Germany, Hungary, Sweden; Brazil.

154a. Form **exoticum** Hirn.

1906, p. 33, (*not* 1900, p. 210); Schmidle 1901, p. 344.

Oogonium 1–3; vegetative cell 14–25×44–200μ; oogonium 39–46×40–47μ; oospore (with teeth) 38–44×38–44μ; dwarf male stipe 10–11×27–30μ; antheridium 6–7×11–13μ.

Caroline Islands.

Oe. cleveanum is characterized by the inferior position of the oogonial pore and the dentate oospore, the teeth being arranged somewhat spirally. The form *exoticum* as described by Hirn (1900) is so nearly identical with the species as to be untenable even as a form. The specimens from the Caroline Islands referred to f. *exoticum* by Schmidle (1901) and Hirn (1906) have distinctly smaller oogonia and oospores and are thus perfectly tenable.

155. **Oe. elegans** West and West.

(**Pl. LIII, figs. 498 and 499.**)

1902, p. 128, Pl. 17, figs. 6-7; Hirn 1906, p. 13, Pl. IV, fig. 22.

Dioecious, nannandrous; oogonium 1, depressed-globose, operculate, division median; oospore depressed-globose, quite filling oogonium, spore wall smooth; dwarf male small, unicellular, on oogonium; vegetative cell densely and minutely granulate, the deposits spirally arranged; vegetative cell 6–9×25–85μ; oogonium 27–31×25–26μ; oospore 25–28×18–19μ; dwarf male 5–6×8–9μ.

Ceylon.

The only nannandrous member of the genus with granulate vegetative cells. Cf. *Oe. minus* (No. 84).

156. **Oe. rigidium** Hirn.
(**Pl. LIII, figs. 506 and 507.**)

1900, p. 237, Pl. XL, fig. 244.

Dioecious, nannandrous, gynandrosporous; oogonium 1, obovoid-globose, operculate, division superior; oospore globose, nearly filling oogonium, spore wall smooth, often thick; androsporangium 1–2, epigynous, subepigynous or hypogynous; vegetative cell broadly capitellate; terminal cell obtuse; dwarf male curved, on oogonium, antheridium exterior, 1–?; vegetative cell 12–14×38–58μ; oogonium 35–39 (–42)×38–45μ; oospore (30–) 34–38×34–38μ; androsporangium 10–11×11–12μ; dwarf male stipe 7–9×18–22μ; antheridium 5–7×6–7μ.

Brazil; South Africa.

The only nannandrous species having the combination of superior position of the oogonial operculum, and capitellate vegetative cells.

157. **Oe. bengalense** Hirn.
(**Pl. LIII, figs. 504 and 505.**)

1900, p. 268, Pl. XLVI, fig. 287.

Dioecious, nannandrous, idioandrosporous; oogonium 1–4, subdepressed-globose to ovoid, operculate, division median, rather wide; oospore subdepressed-globose or globose; quite filling oogonium, spore wall smooth; androsporangium 1–4; vegetative cell capitellate; basal cell elongate; terminal cell, not rarely the oogonium, apically obtuse; dwarf male obovoid, unicellular, on oogonium; vegetative cell 14-19× 45–110μ; oogonium 46–54×44–54μ; oospore 43–48×43–48μ; androsporangium 14–15×13–18μ; dwarf male 12–13×16–18μ.

India: Bengal.

Cf. *Oe. indicum*, below.

158. **Oe. indicum** Hirn.
(**Pl. LIV, fig. 509.**)

1900, p. 269, Pl. XLVI, fig. 288.

Dioecious, nannandrous, gynandrosporous; oogonium 1–2, depressed-globose or depressed obovoid-globose, operculate, division median, narrow but distinct; oospore depressed-globose, completing oogonium, spore wall smooth; androsporangium 1–2–?, subepigynous; vegetative cell broadly capitellate; basal cell elongate; dwarf male obovoid, unicellular, on oogonium; vegetative cell 20–25×50–110μ; oogonium 57–64×48–53μ; oospore 55–61×43–50μ; androsporangium 19–20× 8–10μ; dwarf male 11–14×18μ.

India.

This species together with *Oe. bengalense* above combine the characters of capitellate vegetative cells and median position of a narrow operculum. *Oe. indicum* is the larger of the two. Cf. *Oe. areschougii* (No. 160), *Oe. brasiliense* (No. 159), and *Oe. confertum* (No. 161).

159. **Oe. brasiliense** Borge.

(**Pl. LIV, fig. 508.**)

1899, p. 4, Pl. 1, fig. 1; Hirn 1900, p. 272, Pl. XLVI, fig. 292.

Dioecious, nannandrous, idioandrosporous; oogonium 1–3, subdepressed-globose or subpyriform-globose, operculate, division median, broad; oospore subdepressed-globose, not quite filling oogonium, spore wall smooth; androsporangium to 5-seriate; vegetative cell capitellate; dwarf male obovoid, unicellular, on oogonium; vegetative cell 16–22×35–95μ; oogonium 53–63×52–59μ; oospore 48–53×45–50μ; androsporangium 15–16×11–14μ; dwarf male 10–12×14–19μ.

Brazil.

Characterized by its broad operculum and capitellate vegetative cells.

160. **Oe. areschougii** Wittrock.

(**Pl. LIII, fig. 500.**)

1870, p. 122, Pl. 1, figs. 1 and 2; 1874, p. 19, Pl. 1, figs. 10 and 11; Hirn 1900, p. 270, Pl. XLVI, fig. 289.

Dioecious, nannandrous, gynandrosporous; oogonium 1–6, subdepressed- or depressed pyriform-globose, operculate, division median, broad; oospore globose, rarely subdepressed-globose, not completing oogonium longitudinally, spore wall smooth; androsporangium 1–6, subepigynous or hypogynous or rarely scattered; vegetative cell capitellate; basal cell elongate; terminal cell, usually the oogonium, apically obtuse; dwarf male obovoid, unicellular, on oogonium; vegetative cell 8–13×35–75μ; oogonium 34–39×36–40μ; oospore 22–26×22–25μ; androsporangium 9–11×10–12μ; antheridium 6–7×13–15μ.

United States: New Jersey; Brazil; Finland, Germany, Sweden, Denmark; Greenland; Siberia.

160a. Var. **americanum** Tiffany.

(**Pl. LIII, fig. 501.**)

1927, p. 205, Pl. IX, figs. 8 and 9.

Idioandrosporous; oogonium smaller; androsporangium to 11-seriate; vegetative cell 8–12×40–80μ; oogonium 29–36×26–40μ; oospore 23–26×22–26μ; androsporangium 7–9×7–11μ.

United States: Illinois.

160b. Form **robustum** Hirn.

(**Pl. LIII, figs. 502 and 503.**)

1900, p. 271, Pl. XLVI, fig. 290; (?) *Oe. obtruncatum* var. *oblatum* Tilden, Amer. Algæ No. 3, 1894; *Oe. areschougii* f. *major* Collins 1912, p. 88.

Idioandrosporous; oospore larger; oogonium to 8-seriate; vegetative cell 12–17×36–120μ; oogonium 36–40×36–53μ; oospore 30–32×27–31μ; androsporangium 9–12×10–13μ; dwarf male 6–8×14–15μ.

England; (?) Minnesota (U. S.).

This species is characterized by its capitellate vegetative cells, wide operculum, small size, and small oospores in comparison with oogonia. Var. *americanum* differs from the species in being idioandrosporous; f. *robustum* in addition has larger oospores.

161. **Oe. confertum** Hirn.

(**Pl. LIV, fig. 510.**)

1900, p. 272, Pl. XLVI, fig. 291.

Dioecious, nannandrous, (?) idioandrosporous; oogonium 1–4, depressed-globose or depressed pyriform, operculate, division median, wide; oospore globose or subdepressed-globose, not filling oogonium longitudinally, spore wall smooth; vegetative cell capitellate; dwarf male obovoid, on oogonium; vegetative cell 19–26×66–105μ; oogonium 56–63×44–56μ; oospore 42–48×40–44μ; dwarf male 10–12×13–16μ.

Australia.

To be compared with *Oe. areschougii* (No. 160), which is smaller and has less depressed oogonia. It is also similar in appearance to the larger *Oe. perspicuum*, below.

162. **Oe. perspicuum** Hirn.

(**Pl. LIV, fig. 511.**)

1900, p. 273, Pl. XLVI, fig. 293; *Oe. dioicum* Carter *in* West and West 1901, p. 175, Pl. IV, fig. 42.

Dioecious, nannandrous; oogonium 1–8, depressed or subdepressed-globose, operculate, division median, broad; oospore globose or subglobose, not filling oogonium longitudinally, spore wall smooth; dwarf male obovoid, unicellular, on oogonium; vegetative cell (30–) 35–43× 95–175μ; oogonium 89–100×64–104μ; oospore 55–70×52–70μ; dwarf male 15–18×19–22μ.

Australia; Siam.

Cf. *Oe. confertum*, above.

163. **Oe. clavatum** Hallas.

(**Pl. LIV, figs. 512 and 513.**)

1905, p. 399, fig. 3; Hirn 1906, p. 11, Pl. IV, fig. 23.

Dioecious, nannandrous, gynandrosporous; oogonium 1–3, subpyriform to subdepressed-globose, operculate, division a little above medium; oospore subdepressed, depressed-globose, or globose, quite filling oogonium (rarely not), spore wall smooth; androsporangium 1–2, scattered; dwarf male obovoid, unicellular, on oogonium; vegetative cell capitellate or nearly clavate; basal cell subhemispherical; vegetative cell 2–9×5–80μ; oogonium 14–26×16–21μ; oospore 12–21×12–14μ; androsporangium 4–6×5–7μ; dwarf male 6×14–15μ.

United States: New York (Long Island); Denmark.

One of the smallest nannandrous species with capitellate or nearly clavate vegetative cells.

164. **Oe. oelandicum** Wittrock; Hirn.
(**Pl. LVI, fig. 539.**)

Wittrock 1874, p. 17; Hirn 1900, p. 273, Pl. XLVII, fig. 297.

Dioecious, nannandrous, gynandrosporous; oogonium 1–7, depressed-globose, with 12–16 longitudinal ridges, operculate, division supramedian, rather broad; oospore depressed-globose, nearly filling oogonium, spore wall smooth; androsporangium to 6-seriate; vegetative cell capitellate; terminal cell apically obtuse; dwarf male obovoid, unicellular, on oogonium; vegetative cell 10–15×25–125μ; oogonium 31–40×25–32μ; oospore 25–36×23–30μ; androsporangium 7–12×10–18μ; dwarf male 7–8×12–15μ.

United States: Michigan; British Columbia; Sweden.

164a. Form **minus** Borge.
(**Pl. LVI, fig. 540.**)

1911, p. 205, Pl. 2, fig. 10.

Smaller; vegetative cell 9–10×36–50μ; oogonium 27–30×19–25μ; dwarf male 6–7×11–12μ.

The species is characterized by its longitudinally ridged oogonia, supramedian operculum, and capitellate vegetative cells. It is smaller than the similarly appearing, larger *Oe. megaporum*, below. F. *minus* has shorter oogonia.

165. **Oe. megaporum** Wittrock.
(**Pl. LVI, fig. 543.**)

1872, p. 3, Pl. 1, figs. 5 and 6; Hirn 1900, p. 274, Pl. XLVII, figs. 298 and 299; *Oe. oelandicum* Wittr. var. *subpyriforme* Wittr. *in* Wittr., Nordst., and Lagerh. Alg. Exs. No. 1218, 1896.

Dioecious, nannandrous, idioandrosporous; oogonium 1–6, broadly pyriform, with 12–16 rounded longitudinal ridges, operculate, division supramedian and wide; oospore subdepressed-globose, not filling oogonium, spore wall smooth; androsporangium to 4-seriate; vegetative cell capitellate, basal cell elongate; terminal cell apically obtuse; dwarf male unicellular, broadly obovoid, on oogonium; vegetative cell 13–17×40–100μ; oogonium 37–42×40–45μ; oospore 31–35 (–38)×27–30μ; androsporangium 10–11×12–22μ; dwarf male 8–12×13–16μ.

United States: Michigan; Finland, Germany, Sweden.

Cf. *Oe. oelandicum* (No. 164).

166. **Oe. bahusiense** Nordstedt.
(**Pl. LV, figs. 530 and 531.**)

1877, p. 26, Pl. 3, figs. 7–11; Hirn 1900, p. 279, Pl. XLVIII, fig. 307.

Dioecious, nannandrous, gynandrosporous; oogonium 1 (rarely 2), depressed pyriform, with 9–12 longitudinal ridges appearing as a median whorl, operculate, division inframedian; oospore depressed-obovoid or depressed-globose, nearly filling oogonium, spore wall smooth; androsporangium to 4-seriate, scattered, often terminal; vegetative cell

capitellate; dwarf male unicellular, obovoid, small, on oogonium; vegetative cell 12–15×25–60μ; oogonium 30–36×22–29μ; oospore 23–28×20–24μ; androsporangium 10–13×5–7μ; dwarf male 5–6×8–9μ.

Sweden.

This species combines the inframedian position of the operculum, ridged oogonium, capitellate vegetative cell, and non-tumid suffultory cell. It differs from *Oe. platygynum*, below, in its larger dimensions.

167. **Oe. platygynum** Wittrock.

(Pl. LVI, fig. 544.)

1872, p. 1; 1874, p. 17, Pl. 1, figs. 5-9; *Oe. platygynum* Wittr. f: *major* West 1891, p. 109, Pl. 18, fig. 1; Hirn 1900, p. 276, Pl. XLVII, figs. 301 and 302; P. B. A. No. 1677.

Dioecious, nannandrous, gynandrosporous and idioandrosporous; oogonium 1–2, depressed obovoid, with 7–12 (more often 8) rounded projections arranged in a whorl around the middle, operculate, division inframedian; oospore depressed- or subdepressed-globose, not quite filling oogonium, spore wall smooth; suffultory cell sometimes tumid; androsporangium 1–3; vegetative cell evidently capitellate; terminal cell apically obtuse; dwarf male unicellular, obovoid, small, on oogonium; vegetative cell 5–11×14–50μ; oogonium 21–30×16–24μ; oospore 17–24×13–20μ; androsporangium 6–8×7–8μ; dwarf male 4–5×8–10μ.

United States: New Jersey, Pennsylvania, Florida, Minnesota; Brazil; England, Denmark, Finland, Germany, Ireland, Norway, Latvia, Sweden; Africa; Ceylon.

167a. Form **obtusum** Hirn.

(Pl. LVI, fig. 545.)

1900 p. 277, Pl. XLVII, fig. 303.

Idioandrosporous, oogonium a little less depressed, processes obtusely rounded; vegetative cell 6–10×14–50μ; oogonium 22–26×18–24μ; oospore 17–19×14–15μ; androsporangium 6–8×8–10μ; dwarf male 4–5×7–9μ.

England, Sweden.

167b. Var. **continuum** Nordstedt.

(Pl. LVI, fig. 546.)

1888, p. 12, Pl. 1, figs. 16 and 17; Hirn 1900, p. 278, Pl. XLVII, fig. 305.

Oogonium to 5-seriate, projections more truncately rounded; suffultory cell enlarged; vegetative cell 8×48μ; suffultory cell 12–14×25–40μ; oogonium 28–32×21–26μ; oospore 22×20μ; ? androsporangium 15–17×12μ.

New Zealand.

167c. Var. **novæ zelandiæ** Hirn.

(Pl. LVI, fig. 547.)

1900, p. 278, Pl. XLVII, fig. 304; *Oe. platygynum* Wittr. *forma* Nordst. 1888, p. 12, Pl. 1, figs. 14 and 15.

Gynandrosporous; oogonium subpyriform, projections obtuse or truncately rounded; vegetative cells very broadly capitellate, 6–9×20–50μ; oogonium 24–28×22–26μ; oospore 20–22×18–20μ; androsporangium 7–8×7–11μ.

New Zealand.

Cf. *Oe. bahusiense* (No. 166).

168. **Oe. longicolle** Nordstedt.

(Pl. LV, figs. 516 and 517.)

1878, p. 20, Pl. 2, figs. 11 and 12; Hirn 1900, p. 263, Pl. XLV, fig. 278.

Dioecious, nannandrous; oogonium 1–7, pyriform, often elongated longitudinally, operculate, division median and narrow; oospore subdepressed-globose or subglobose, inflating oogonium medianly, not filling it longitudinally, spore wall smooth; basal cell subhemispherical; dwarf male unicellular, obovoid, minute, on oogonium; vegetative cell 4–6×16–45μ; oogonium 13–16×16–32μ; oospore 12–15×10–16μ; dwarf male 2×4μ; basal cell 14×6μ.

Australia; Ceylon.

168a. Var. **senegalense** Nordstedt.

(Pl. LV, figs. 518 and 519.)

1880, p. 13, Pl. 1, fig. 23; (?) *Oe. delicatulum* Kuetz. *in* Wolle 1887, Pl. 81, figs. 12 and 13; Hirn 1900, p. 264, Pl. XLV, figs. 279 and 280. *Oe. longicolle* Nordst. var. *senegalense* Nordst. f. *afghanicum* Schaarsch. 1884, p. 249, Pl. 5, fig. 26, and *in* Hirn 1900, p. 264, Pl. XLV, fig. 281.

Larger; vegetative cell 5–8×12–40μ; oogonium 16–20×14–24μ; oospore 14–20×11–17μ; basal cell 13–14×5–7μ.

Africa; Brazil; Ceylon; Australia; Afghanistan; Burma.

The species is characterized by its small size, subhemispherical basal cell, nannandrous habit, and smooth oogonium. It is the smallest of similar species that follow: *Oe. rothii* (No. 169) and *Oe. decipiens* (No. 171).

169. **Oe. rothii** (Le Clerc) Pringsheim.

(Pl. LV, fig. 526.)

(?) *Prolifera rothii* Le Clerc 1817, p. 476, Pl. 23, fig. 8; *Oe. rothii* Pringsh. 1858, p. 69, Pl. 5, fig. 4; *Oe. cryptoporum* Wittr. var. *vulgare* Wittr. f. *abbreviata* Gutw. 1897, p. 126; *Oe. cryptoporum* Wittr. var. *subdepressum* Wittr. *in* Wittr. and Nordst. Alg. Exs. No. 152, 1878; Hirn 1900, p. 265, Pl. XLV, fig. 282; Collins, 1909, p. 262; P. B. A. No. 520.

Dioecious, nannandrous, gynandrosporous; oogonium 1–3, subdepressed-globose, operculate, division median, narrow; oospore depressed-globose, almost filling oogonium, spore wall smooth; androsporangium 1–4; subhypogynous, hypogynous, subepigynous, or scattered; vegetative cell 6–10×20–76μ; oogonium 20–27×16–27μ; oospore 17–25×14–20μ; androsporangium 6–8×5–10μ; dwarf male 4×11–12μ.

United States: Massachusetts; Austria, Denmark, England, Germany, Norway, Sweden.

Cf. *Oe. longicolle*, above.

170. **Oe. danicum** Hallas.

(Pl. LIV, fig. 515.)

1905, p. 404, fig. 10; Hirn 1906, p. 12, Pl. IV, fig. 24.

Dioecious, nannandrous, gynandrosporous; oogonium 1, pyriform or pyriform-globose, operculate, division supramedian; oospore globose or depressed-globose, filling oogonium or not, spore wall smooth; androsporangium 1–3, hypogynous or scattered; dwarf male obovoid, unicellular, on suffultory cell or scattered; vegetative cell 4–7×20–82μ; oogonium 21–23×23–35μ; oospore 19–20×15–20μ; androsporangium 4–7×7–12μ; dwarf male 6–7×14–16μ.

Denmark.

171. **Oe. decipiens** Wittrock.

(Pl. LV, fig. 520.)

1870, p. 126; *Oe. vesicatum* Link *in* De Bary 1856, p. 224, Pl. 5; *Oe. rothii* (Le Cl.) Pringsh. f. *major* West and West 1897, p. 5; Hirn 1900, p. 266, Pl. XLVI, figs. 283 and 284; Collins 1909, p. 262; Heering 1914, p. 188, fig. 258; Tiffany 1926, p. 104, Pl. VIII, fig. 88.

Dioecious, nannandrous, gynandrosporous; oogonium 1–3, subdepressed globose, operculate, division median, rather narrow; oospore subdepressed or depressed-globose, almost filling the oogonium, spore wall smooth; suffultory cell not swollen; androsporangium 1–6, subepigynous, hypogynous, or scattered; dwarf male unicellular, usually on the oogonium; vegetative cell 9–12×28–80μ; oogonium 30–38×27–40μ; oospore 25–34×23–28μ; androsporangium 9–10×8–15μ; dwarf male 6–7×13–15μ.

United States: Michigan, Iowa, New Jersey; France, Germany, Sweden, England; Africa.

171a. Form **dissimile** Hirn.

(Pl. LV, figs. 521 and 522.)

1900, p. 267, Pl. XLVI, fig. 285.

Gynandrosporous; vegetative cells evidently capitellate, 8–11×25–65μ; oogonium 28–35×23–38μ; oospore 23–34×21–30μ; androsporangium 8–9×6–10μ; dwarf male 5–6×11–14μ.

United States: Michigan; Brazil.

171b. Var. **africanum** Tiffany.

(Pl. LV, figs. 523 and 524.)

1929, p. 74; *Oe. decipiens* Wittr. forma *in* West and West 1897, p. 5, and *in* Hirn 1900, p. 267, Pl. XLVI, fig. 284.

Smaller and idioandrosporous; vegetative cell 8–13×25–60μ; oogonium 25–32×24–32μ; oospore 24–30×23–28μ; androsporangium 7–11×9–13μ; dwarf male 6–7×9–12μ.

Africa.

171c. Var. **bernardense** (Bates) Hirn.
(Pl. LV, fig. 525.)

1900, p. 268, Pl. XLVI, fig. 286; *Oe. bernardense* Bates 1886, p. 313; *Oe. londinense* Wittr. var. *compressum* West 1891, p. 110, Pl. 18, figs. 10-12.

Smaller; gynandrosporous; androsporangium to 8-seriate; vegetative cell 8–12×18–45μ; oogonium 25–31×21–32μ; oospore 21–29×17–24μ; androsporangium 7–11×5–11μ; dwarf male 6–7×10–12μ.

England, Spain.

The tendency of the *decipiens* group toward capitellate cells reaches a maximum in f. *dissimile*. The others are either not noticeably or only somewhat capitellate. The small size, nannandrous habit, and median operculum are also characteristic. F. *africanum* is idioandrosporous, while f. *bernardense is* gynandrosporous.

172. **Oe. macrospermum** West and West.
(Pl. LV, figs. 527 and 528.)

1897, p. 472, Pl. 7, figs. 6 and 7; Hirn 1900, p. 227, Pl. XXXVIII, fig. 232; *Oe. macrospermum* West and West f. *patagonicum* Borge and Hirn *in* Borge 1901, p. 9, Pl. 1, fig. 1, and *in* Hirn 1906, p. 18, Pl. III, fig. 18; Tiffany 1926, p. 105, Pl. VIII, figs. 93 and 94.

Dioecious, nannandrous, gynandrosporous; oogonium 1 (rarely 2), subdepressed to depressed-globose, operculate, division median, narrow; oospore subdepressed-globose, filling the oogonium, spore wall smooth; dwarf male slightly curved or straight, not infrequently at right angles to the filament, on suffultory cell or on oogonium or scattered; antheridium exterior, 1–4; basal cell elongate; androsporangium 1–?; vegetative cell 10–16×30–80μ; oogonium 39–46×34–44μ; oospore 36–44×32–42μ; dwarf male stipe 9–14×16–30μ; androsporangium 14–15×10–11μ; antheridium 7–10×6–16μ.

United States: Iowa, Michigan, Ohio; England, Latvia; Patagonia.

The above description as emended by Tiffany (1926) from material collected in Iowa includes f. *patagonicum* Borge and Hirn (Borge 1901). The species is characterized by its particularly straight vegetative cells, narrow median operculum, and dwarf males scattered and often at right angles to the filament.

173. **Oe. costatum** Transeau nov. sp.
(Pl. LVI, fig. 548.)

Dioecious, nannandrous, gynandrosporous; oogonium 1, depressed globose, with verticillate folds forming distinct pointed projections at the suture, operculate, division narrow, supramedian; oospore depressed-globose, filling oogonium, spore wall smooth; androsporangium hypogynous; vegetative cell usually capitellate; terminal cell with rounded apex; vegetative cells 12–15×50–70μ; oogonium 50–55×40–44μ; oospore 48–53×36–42μ; androsporangium 12–13×10–12μ.

United States: New York (Smithtown Pond and Fish Hatchery Pond, Long Island).

Distinguished by its depressed-globose oogonia with verticillate folds forming pointed projections at the suture. It is larger than *Oe. boreale* below and is further distinguished by the shape and form of the oogonium.

174. **Oe. boreale** Hirn.

(Pl. LVI, fig. 542.)

1900, p. 275, Pl. XLVII, fig. 300.

Dioecious, nannandrous; oogonium 1 (rarely 2), pyriform, wall thick and lamellose, medianly plicate, 16–19 verticillate folds, operculate, division supramedian; oospore subglobose (or subpyriform-globose), inflating oogonium, spore wall smooth; vegetative cell capitellate; dwarf male broadly obovoid, unicellular, on oogonium; vegetative cell 18–22×55–150μ; oogonium 58–65×67–78μ; oospore 48–53×48–53μ; dwarf male 14–16×15–20μ.

Finland.

Cf. *Oe. costatum*, above.

175. **Oe. mirandrium** Skuja.

(Pl. LIV, fig. 514.)

1927, p. 101, Pl. II, figs. 12 and 12a.

Dioecious, nannandrous, (?) idioandrosporous; oogonium 1 (rarely 2), subpyriform globose, operculate, division supramedian, or nearly superior; oospore globose, quite or not filling oogonium, spore wall smooth; dwarf male unicellular, ovoid, on oogonium; terminal cell obtuse; basal cell elongate; vegetative cell 13–20×28–90μ; suffultory cell 14–24×35–90μ; oogonium 40–43×38–43μ; oospore 35–42×35–42μ; dwarf male 9–26×11–35μ.

Latvia.

Characterized by the supramedian operculum, unicellular dwarf male, and smaller suffultory cell. It bears some resemblance to the macrandrous *Oe. pringsheimii* (No. 95.)

176. **Oe. contortum** Hallas.

(Pl. XLVIII, fig. 464.)

1905, p. 399, fig. 2; Hirn 1906, p. 11, Pl. IV, fig. 25.

Dioecious, nannandrous, gynandrosporous; oogonium 1 (rarely 2), depressed-globose (rarely pyriform), operculate, division inframedian; oospore depressed (rarely globose), quite filling oogonium, spore wall smooth; androsporangium 1–5, curved, hypogynous or rarely epigynous or scattered; dwarf male obovoid, unicellular, on oogonium; vegetative cell 5–7×20–60μ; oogonium 23–35×16–35μ; oospore 16–28×12–21μ; androsporangium 5–7×7–14μ; dwarf male 4×13μ.

Denmark.

The twisted appearance of the filaments, the inframedian operculum, and the non-filled oogonia are characteristic. It should be remarked that Hallas' original figure which Hirn copies gives every evidence of an inframedian "pore." The description however indicates an operculate oogonium. The curved filaments are similar to those of the monoecious *Oe. curvum* (No. 2). It should be compared with *Oe. platygynum* (No. 167).

177. **Oe. schmidlei** Gutwinski.

(Pl. LVIII, fig. 572.)

1896, p. 2, Pl. 1, fig. 2; Hirn 1900, p. 228, Pl. XXXVIII, fig. 234.

Dioecious, nannandrous; oogonium 1, obovoid-globose, operculate, division superior (? narrow); oospore globose, not filling oogonium, spore wall pitted, rather thick; dwarf male a little curved, on suffultory cell, antheridium exterior, 1?; vegetative cell 10×25–90μ; suffultory cell 22×44μ; oogonium 29×32–37μ; oospore 26×26μ; dwarf male stipe 5×27μ; antheridium 5–6×5–6μ.

Austria; British Columbia.

Gutwinski's figure leaves room for doubt as to the exact nature of the oospore wall. Hirn (1900) regards it as "membrana porifera" which I have interpreted as pitted. The record from British Columbia by Mr. G. H. Wailes gave no added data. In general appearance it resembles the larger and smooth spored *Oe. hians* (No. 180).

178. **Oe. longatum** Kuetzing.

(Pl. LVIII, fig. 563.)

1853, p. 11, Pl. 33, fig. 6; Wittr. 1874, p. 38; Nordst. 1877, p. 28; *Oe. crispulum* Wittr. and Nordst. *in* Wittr. 1872, p. 5; Hirn 1900, p. 239, Pl. XL, fig. 248; Heering 1914, p. 182, fig. 249; Tiffany 1926, p. 105, Pl. IX, fig. 106; P. B. A. No. 82.

Dioecious, nannandrous; oogonium 1–3, ovoid to ellipsoid, operculate, division superior; oospore ellipsoid about filling the oogonium, spore wall usually smooth, basal cell elongate; terminal cell obtuse; dwarf male on the oogonium; antheridium exterior, 1–?, curved; vegetative cells 4–7×10–35μ; oogonium 16–18×21–25μ; oospore 15–17×17–19μ; dwarf male stipe 5–6×10–15μ; antheridium 4–5×5–6μ.

United States: Iowa, Massachusetts, Pennsylvania; Austria, England, Finland, Germany, Sweden; British Columbia.

Cf. *Oe. rugulosum*, below.

179. **Oe. rugulosum** Nordstedt.

(Pl. LVIII, fig. 560.)

1877, p. 28, Pl. 3, figs. 12 and 13; *Oe. sp.* Borge 1896, p. 5, Pl. 1, fig. 4; Hirn 1900, p. 241, Pl. XL, figs. 249 and 250; Heering 1914, p. 182, fig. 250; Transeau 1917, p. 231; Tiffany 1926, p. 105, Pl. IX, fig. 96.

Dioecious, nannandrous; oogonium 1–2, obovoid or obovoid-ellipsoid, operculate, division superior; oospore ellipsoid, nearly filling oogonium

(or rarely globose-ellipsoid, not filling oogonium) spore wall sometimes crenulate; dwarf male on or near oogonium; antheridium exterior, 1–?, curved; vegetative cell 4–8×10–35μ; oogonium 16–20×22–29μ; oospore 15–18×19–23μ; antheridium 4–5×5–6μ; dwarf male 5–7×11–14μ.

United States: Iowa, Michigan, New York; Denmark, France, Sweden; Australia.

179a. Form **minutum** (Hansgirg) Hirn.

(Pl. LVIII, fig. 561.)

1900, p. 242, Pl. XL, fig. 251; *Oe. crispulum* Wittr. and Nordst. var. *minutum* Hansg. 1886, p. 44.

Smaller; median spore wall distinctly crenulate (Transeau); vegetative cell 3–7×12–40μ; oogonium 14–18×18–24μ; oospore 13–17×15–20μ.

United States: Illinois; Austria.

179b. Form **rotundatum** Hirn.

(Pl. LVIII, fig. 562.)

1900, p. 242, Pl. XL, fig. 252.

Oogonium a little larger and shorter; oospore globose-ellipsoid; vegetative cell 5–8×15–31μ; oogonium 19–23×20–26μ; oospore 18–22×18–23μ; dwarf male stipe 5–6×11–15μ; antheridium 4–6×4–6μ.

Germany.

This species is near *Oe. longatum* (No. 178) and is separable largely on the basis of the form of the oogonium and relative length of the oospore. Sometimes the oospore wall of *Oe. rugulosum* is crenulate. The latter is characteristic of f. *minutum*, which is smaller and has more obovoid oogonia. F. *rotundatum* has globose-ellipsoid oospores and slightly larger oogonia.

180. **Oe. hians** Nordstedt and Hirn.

(Pl. LVIII, figs. 570 and 571.)

In Hirn 1900, p. 227, Pl. XXXVIII, fig. 233.

Dioecious, nannandrous, gynandrosporous; oogonium 1–2, subovoid or globose, operculate, division superior, wide; oospore globose, quite filling oogonium, spore wall smooth, thick, and often lamellose; suffultory cell tumid; androsporangium 1–2, subepigynous; basal cell elongate; terminal cell apically obtuse; dwarf male curved, on suffultory cell, antheridium exterior, unicellular; vegetative cell 9–15×37–145μ; suffultory cell 26–33×40–80μ; oogonium 37–43×45–60μ; oospore 33–40×33–40μ; androsporangium 11–12×15–18μ; dwarf male stipe 7–9×32–35μ; antheridium 6–8×5–6μ.

United States: Iowa; Brazil.

Characterized by its swollen suffultory cells, wide operculum, and tendency toward capitellate vegetative cells.

181. **Oe. hoersholmiense** Hallas.

(Pl. LVII, fig. 559.)

1905, p. 400, fig. 5; Hirn 1906, p. 15, Pl. IV, fig. 21.

Dioecious, nannandrous, gynandrosporous; oogonium 1 (rarely 2), ellipsoid, operculate, division superior; oospore ellipsoid or globose, not filling oogonium, spore wall smooth; androsporangium 1–5, often hypogynous or scattered; basal cell elongate; terminal cell obtuse; dwarf male curved, on oogonium, antheridium exterior, 1–2; vegetative cell 7–12×44–160μ; oogonium 30–36×56–68μ; oospore 26–32×32–45μ; androsporangium 7–12×16–21μ; dwarf male stipe 9–12×30–35μ; antheridium 7–8×10–11μ; basal cell 3–14×16–50μ.

Denmark.

This species is perhaps near *Oe. ciliatum* (No. 185) from which it differs in its smaller size, longer vegetative cell, and obtuse terminal cell. The figure of Hallas would seem to indicate an operculum in a supreme position, although the description records "superior." I have included it in both positions in the key.

182. **Oe. laetevirens** Wittrock.

(Pl. LVII, fig. 558.)

In Zeller 1876, p. 427; Hirn 1900, p. 239, Pl. XL, fig. 247.

Dioecious, nannandrous; oogonium 1 (rarely 2), subobovoid-globose, operculate, division superior; oospore globose or subdepressed-globose, filling oogonium or enlarging it, spore wall smooth; dwarf male on oogonium, stipe a little curved, antheridium exterior, 1–?; vegetative cell 12–13×18–32μ; oogonium 30–34×32–36μ; oospore 28–32×27–29μ; dwarf male stipe 7–8×20–21μ; antheridium 6×5–7μ.

Brazil.

Cf. *Oe. macrandrium* (No. 184).

183. **Oe. pluviale** Nordstedt.

(Pl. XL, figs. 392 and 393.)

In Rabenh. Alg. Eur. No. 2257, 1871; Wittr. 1872, p. 7; *Oe. intermedium* Kuetz. *in* Rabenh. Alg. Sachs. No. 828, 1859; *Oe. montagnei* Fior.-Mazz. var. *submarinum* Wittr. *in* Wittr. and Nordst. Alg. Exs. No. 905, 1889; *Oe. fonticola* Al. Br. *in* Wolle 1887, p. 93, Pl. 75, figs. 4–6; (?) *Vesiculifera dissiliens* Hass. 1845, p. 202, Pl. 50, fig. 7; *Oe. diplandrium* Juranyi 1873, p. 27, Pl. 1–3; (?) *Oe. fonticola* Al. Br. var. *flavescens* Hansg. 1891, p. 305; *Oe. montagnei* Fior.-Mazz. var. *saxicolum* Wittr. 1876, p. 50, Pl. 13, figs. 29–31; Hirn 1900, p. 280, Pl. XLVIII, fig. 311; P. B. A. No. 1190.

Dioecious, nannandrous, idioandrosporous; oogonium 1 (very rarely 2–3), obovoid-globose or subglobose, operculate, division superior; oospore subglobose or subellipsoid-globose, almost filling oogonium, spore wall smooth; vegetative cell varying much in the same plant; basal cell elongate; terminal cell obtuse; androsporangium to 10-seriate; dwarf male broadly obovoid, unicellular, on oogonium; vegetative cell 22–29×20–55μ; androsporangial vegetative cell 18–27×18–27μ; oogonium 34–45×34–50μ; oospore 32–40×31–43μ; androsporangium 17–25×6–13μ; dwarf male 10×14–15μ.

United States: California; Austria, England, France, Spain, Germany, Hungary, Italy, Ireland, Switzerland, Sweden; Siam.

This species is the *Oe. diplandrium* Juranyi rather widely copied in morphological texts. It is characterized by its short vegetative cells, clustered unicellular dwarf males, and compact and numerous antheridia. It bears some resemblance to the imperfectly known *Oe. fonticola* (No. 208).

184. **Oe. macrandrium** Wittrock.

(**Pl. LVII, fig. 549.**)

1870, p. 130, Pl. 1, figs. 3-5; Hirn 1900, p. 233, Pl. XXXIX, fig. 240; Collins 1909, p. 258; Heering 1914, p. 180, fig. 248; Tiffany 1926, p. 106, Pl. IX, fig. 97.

Dioecious, nannandrous; oogonium 1–4, globose-ovoid, operculate, division superior; oospore globose, rarely ovoid-globose, not completely filling the oogonium, spore wall smooth; terminal cell obtuse or very shortly apiculate; dwarf male on or near the oogonium, stipe much curved, sometimes 2–3 celled; antheridium 1–7; vegetative cells 15–20 $\times$45–100μ; oogonium 36–42$\times$43–54μ; oospore 31–37$\times$33–39μ; dwarf male stipe 12–13$\times$24–33μ; antheridium 9–10$\times$7–10μ.

United States: Ohio, Iowa, Massachusetts, Pennsylvania; England, Finland, France, Germany, Denmark, Norway, Sweden, Switzerland.

184a. Form **acuminatum** Hirn.

(**Pl. LVII, fig. 550.**)

1900, p. 234, Pl. XXXIX, fig. 241.

Dwarf male apically broadly acute; vegetative cell 15–19$\times$30–80μ; oogonium 37–45$\times$43–55μ; oospore 35–40$\times$36–45μ; dwarf male stipe 11–15$\times$24–35μ; antheridium 9–13$\times$9–13μ.

Sweden.

184b. Form **aemulans** Hirn.

(**Pl. LVII, fig. 551.**)

1906, p. 43; *Oe. macrandrium* Wittr. var. *aemulans* Hirn 1900, p. 235, Pl. XXXIX, fig. 242; (?) *Oe. lundense* Wittr. *in* Wolle 1887, p. 79, Pl. 77, figs. 9 and 10.

Vegetative cell 10–15$\times$22–90μ; oogonium 28–40$\times$33–45μ; oospore 26–36$\times$26–36μ; dwarf male stipe 9–12$\times$20–25μ; antheridium 8–9$\times$8–10μ.

United States: Pennsylvania, California, Michigan, Illinois, Mississippi; Brazil.

184c. Form **lundense** (Wittrock) Hirn.

(**Pl. LVII, fig. 552.**)

1906, p. 42, Pl. III, fig. 19; *Oe. lundense* Wittr. 1872, p. 4, and 1874, p. 23; *Oe. lundense* Wittr. *in* Hirn 1900, p. 237, Pl. XL, fig. 245; *Oe. fioniæ* Hallas 1905, p. 401, fig. 6.

Oogonium subobovoid-globose; oospore wall sometimes thick; vegetative cell 13–21$\times$13–50μ; oogonium 31–40 (–45) $\times$34–43μ; oospore

29–36 (–40) ×29–36 (–40)μ; dwarf male stipe 10–15× (21–) 24–32μ; antheridium 8–10×6–9μ.

Finland, France, Denmark, Sweden.

184d. Var. **propinquum** (Wittrock) Hirn.
(**Pl. LVII, fig. 553.**)

1906, p. 42, Pl. IV, fig. 20; *Oe. propinquum* Wittr. 1870, p. 129, and *in* Hirn 1900, p. 236, Pl. XL, fig. 243; *Oe. eremitum* Hallas 1905, p. 403, fig. 8.

Smaller; oogonium 1–3; vegetative cell 8–14×18–70μ; oogonium 28–36×28–45μ; oospore 24–31×24–31μ; dwarf male stipe 11–14× 20–35μ; antheridium 7–9 (–12) ×6–8μ.

United States: Illinois, Alabama; Austria, France, Sweden, Denmark, Latvia.

184e. Var. **hohenackerii** (Wittrock) Tiffany.
(**Pl. LVII, figs. 554-556.**)

1929, p. 75; *Oe. hohenackerii* Wittr. 1874, p. 23, and *in* Hirn 1900, p. 238, Pl. XL, fig. 246; *Oe. tumidulum in* Hohenacker Alg. Exs. No. 404.

Vegetative cell 12–15×24–45μ; oogonium 29–33×30–35μ; oospore 27–31×28–31μ; androsporangium 11–13×10–14μ; dwarf male stipe 9–14×18–24μ; antheridium 5–6×5–8μ.

United States: Michigan, Ohio; India.

184f. Var. **scrobiculatum** Ackley.
(**Pl. LVII, fig. 557.**)

1929, p. 305, Pl. XXXVI, figs. 17–19.

Oogonium globose to subglobose; median layer of oospore wall scrobiculate; vegetative cell 9–11×27–60μ; oogonium 32–35×30–35μ; oospore 31–33×31–32μ; dwarf male stipe 12×10–18μ; antheridium 8×6–10μ.

United States: Michigan (Ox-bow of river near Holland).

The *macrandrium* group is perhaps one of the most interesting and variable in the genus. The species has rather an unfortunate name to be nannandrous. The group is readily recognized by its frequently seriate oogonia, its curved and twisted dwarf males resting on or near the oogonia and frequently clustered, and its relatively short vegetative cells. *Oe. laetevirens* (No. 182) is separable from the group largely on its smaller size. F. *lundense* has very short vegetative cells, and those of var. *hohenackerii* are slightly longer. Var. *scrobiculatum* is the only member of the group with scrobiculate oospores. The remaining forms and varieties are separable largely on the basis of size.

185. **Oe. ciliatum** (Hassall) Pringsheim.
(**Pl. LIX, fig. 583.**)

Vesiculifera ciliata Hass. 1845, p. 202, Pl. 52, fig. 2; *Oe. ciliatum* Pringsh. 1856, p. 227, Pl. I, figs. 1–10; Pringsh. 1858, p. 70, Pl. 4, figs. 1–14, and Pl. 5, fig. 8; *Oe. piliferum* Auerswald *in* Rabenh. Alg. Sachs. 1855; Hirn 1900, p. 243, Pl. XLI, fig. 253; Heering 1914, p. 183, fig. 252; Tiffany 1926, p. 106, Pl. IX, figs. 98 and 99.

Dioecious, nannandrous, gynandrosporous; oogonium 1–7, ovoid, to ovoid-ellipsoid (rarely nearly ellipsoid), operculate, division superior or nearly supreme; oospore ovoid to subellipsoid, rarely globose, nearly filling oogonium, spore wall smooth; androsporangium to 8-seriate, often subepigynous; basal cell elongate; terminal cell setiform; dwarf male curved, on oogonium; antheridium exterior, 1; vegetative cell 14–24×35–92μ; oogonium 43–50×55–72μ; oospore 40–47×44–57μ; androsporangium 14–20×10–20μ; dwarf male stipe 10–15×24–31μ; antheridium 8–10×10–11μ.

United States: Iowa, Ohio; England, Finland, Germany, Spain, Sweden, Latvia; British Columbia.

Characterized by its setiform terminal cells and ovoid to ovoid-ellipsoid oogonia. The division of the oogonium is quite often practically supreme rather than superior. It is near *Oe. wabashense* (No. 192); the latter has capitellate vegetative cells, supreme operculum, and smaller oogonia.

186. **Oe. spectabile** Hirn.
(**Pl. XLI, figs. 403-405.**)

1900, p. 284, Pl. XLIX, fig. 317.

Dioecious, nannandrous, idioandrosporous; oogonium 1, obovoid-ellipsoid or obovoid, operculate, division superior; oospore ellipsoid, nearly filling oogonium, spore wall smooth; androsporangium to 16-seriate, the androsporangial part of the filament often curved; basal cell elongate; dwarf male broadly obovoid, unicellular, on oogonium; vegetative cell 20–32×25–90μ; oogonium 42–50×63–72μ; oospore 40–48×55–62μ; androsporangium 19–27×11–19μ; dwarf male 11–14×16–21μ.

United States: Mississippi; Australia.

Characterized by the wide variation in cell diameter, the unicellular dwarf male, and the pronounced curve of the terminal part of the androsporangial filament. It is similar to *Oe. implexum* (below) which is smaller and has relatively more slender vegetative cells.

187. **Oe. implexum** Hirn.
(**Pl. XLI, figs. 400 and 401.**)

1900, p. 283, Pl. XLIX, fig. 316.

Dioecious, nannandrous, gynandrosporous; oogonium 1–3, sub-obovoid-ellipsoid, operculate, division superior; oospore ellipsoid, filling oogonium, spore wall smooth; androsporangium to 20-seriate

(filament containing androsporangia curved); dwarf male broadly obovoid, unicellular, on oogonium; vegetative cell 16–20×33–100μ; oogonium 38–45×50–75μ; oospore 36–42×47–60μ; androsporangium 16–20×13–25μ; dwarf male 12–14×13–15μ.

Australia.

Cf. *Oe. spectabile*, above.

188. **Oe. monile** Berkeley and Harvey.

(**Pl. LVIII, figs. 564 and 565.**)

In Hooker 1860, p. 342, Pl. 196, fig. B; Wittr. 1874, p. 40; (?) *Oe. birmanicum* Wittr. *in* Moebius 1892, p. 430, fig. 9B; Hirn 1900, p. 229, Pl. XXXVIII and XXXIX, fig. 235.

Dioecious, nannandrous; oogonium 1–8, subovoid or subglobose, operculate, division superior, very broad; oospore globose or subglobose, quite filling oogonium (except in length), spore wall of three layers: outer layer smooth, middle layer scrobiculate, inner layer smooth; vegetative cell sometimes capitellate; basal cell elongate; terminal cell obtuse; dwarf male a little curved, near oogonium, antheridium exterior, 1–?; vegetative cell 9–15×50–160μ; suffultory cell 21–29×40–57μ; oogonium 30–39×30–56μ; oospore 28–38×28–38μ; dwarf male stipe 9×25μ; antheridium 7×7μ.

United States: Massachusetts, Michigan; Australia; Brazil.

188a. Form **borgei** Hirn.

(**Pl. LVIII, fig. 567.**)

1900, p. 230, Pl. XXXIX, fig. 237.

Vegetative cell 14–20×45–100μ; suffultory cell 35–38×45–74μ; oogonium 40–50×40–60μ; oospore 39–45×39–48μ; dwarf male stipe 13–14×36–40μ; antheridium 9–11×8–10μ.

Australia.

188b. Var. **eminens** Hirn.

(**Pl. LVIII, figs. 568 and 569.**)

1900, p. 231, Pl. XXXIX, fig. 238.

Much larger; gynandrosporous, androsporangium subepigynous; dwarf male on suffultory cell, antheridium 1–2; vegetative cell 18–25×65–150μ; suffultory cell 38–41×48–72μ; oogonium 56–68×55–74μ; oospore 53–60×50–58μ; androsporangium 19–23×15–18μ; dwarf male stipe 18–19×40–48μ; antheridium 10–13×12–14μ.

Australia.

188c. Form **victoriense** G. S. West.

(**Pl. LVIII, fig. 566.**)

1909, p. 45, fig. 6 A and B.

Dwarf male a little longer and more narrow, on suffultory cell; vegetative cell 12–14×60–96μ; suffultory cell 27–28×68–83μ; oogonium 42–45×42–52μ; oospore 40–42×40–42μ; dwarf male stipe 6–8×38–44μ.

Victoria, Africa.

The species is characterized by its scrobiculate oospore, wide operculum, enlarged suffultory cell, and usually many-seriate oogonia. Var. *eminens* is much larger and f. *borgei* is considerably larger than the type; f. *victoriense* is near f. *borgei*, differing in the size of the oospore.

189. **Oe. obtruncatum** Wittrock.
(**Pl. LIX, fig. 577.**)

1874, p. 41; Hirn 1900, p. 284, Pl. XLIX, fig. 318.

Dioecious, nannandrous, gynandrosporous; oogonium 1–6, ellipsoid, or globose-ellipsoid, operculate, division supreme, operculum small and deciduous; oospore of same form as oogonium, nearly filling it, spore wall smooth; vegetative cell evidently capitellate; basal cell elongate; terminal cell (often the oogonium) apically obtuse; dwarf male oblong-pyriform, curved, unicellular, on oogonium; vegetative cell 18–22×56–110μ; oogonium 45–55×56–68μ; oospore 43–53×52–66μ; androsporangium 20×24μ; dwarf male stipe 17–20×36–40μ; antheridium 6–8×4–6μ.

United States: Ohio, Illinois; England; Brazil; India; Australia.

189a. Var. **completum** Hirn.
(**Pl. LIX, figs. 579-582.**)

1900, p. 285, Pl. L, fig. 319.

Oogonium larger; androsporangium 1–5, hypogynous or subepigynous or epigynous; terminal cell sometimes setiform; vegetative cell 18–22×66–150μ; oogonium 55–58×63–75μ; oospore 53–56×61–73μ; androsporangium 20–22×19–22μ.

Bengal.

189b. Var. **ellipsoideum** Wittrock.
(**Pl. LIX, fig. 578.**)

1878, p. 141; Hirn 1900, p. 286, Pl. L, fig. 320.

Oogonium longer, ellipsoid, 1–2, terminal; vegetative cell 17–23×54–110μ; oogonium 42–54×66–75μ.

Venezuela.

Oe. obtruncatum is characterized by the usually capitellate vegetative cells, supreme position of the operculum, unicellular nannandrium, and gynandrosporous habit. The two varieties *completum* and *ellipsoideum* are separable largely on the basis of differently sized oogonia. The species is much larger than the gynandrosporous *Oe. wabashense* (No. 192). It is perhaps nearest in general appearance to *Oe. praticolum* (No. 190) and *Oe. supremum* (No. 191), both of which are idioandrosporous and have larger oogonia.

190. **Oe. praticolum** Transeau.
(**Pl. LX, figs. 586-588.**)

1914, p. 298, Pl. XXIX, figs. 1-5; Tiffany 1926, p. 107, Pl. VII, figs. 82-84.

Dioecious, nannandrous, idioandrosporous; oogonium 1–7, ellipsoid to globose-ellipsoid, often terminal, sometimes scattered; wall sometimes rather thick, operculate, division supreme, lid small and deciduous; oospore ellipsoid to globose-ellipsoid, quite filling the oogonium, wall smooth, androsporangium 1–20; vegetative cell slightly capitellate; basal cell usually elongate; terminal cell apiculate or extended into a long hyaline seta; antheridium exterior, 1; vegetative cell, female 16–26×65–130μ; vegetative cell of androsporangial filament 14–22×56–110μ; oogonium 48–60×62–74μ; oospore 46–58×60–72μ; androsporangium 20–24×18–22μ; dwarf male stipe 8–14×21–28μ; antheridium 6–10×7–12μ.

United States: Illinois, Ohio, Iowa.

Cf. *Oe. obtruncatum* (No. 189).

191. **Oe. supremum** Tiffany.
(**Pl. LIX, figs. 573-576.**)

1924, p. 185, Pl. I, figs. 3 and 4, Pl. II, figs. 4 and 5; 1926, p. 107, Pl. VIII, figs. 90 and 91.

Dioecious, nannandrous, idioandrosporous; oogonium 1–4, globose or ellipsoid-globose, often terminal, operculate, division at the upper extremity of oogonium, lid often deciduous; oospore globose or ellipsoid-globose, filling oogonium, spore wall smooth; androsporangium 1–6; vegetative cell distinctly capitellate; basal cell elongate; dwarf male broadly obovoid, unicellular, on oogonium; vegetative cell 24–32×60–132μ; oogonium 66–78×72–90μ; oospore 60–66×66–84μ; androsporangium 26–28×30–40μ; dwarf male 20–24×24–26μ; basal cell 28–32×90–110μ.

United States: Iowa.

Cf. *Oe. obtruncatum* (No. 189).

192. **Oe. wabashense** Tiffany.
(**Pl. LX, figs. 584 and 585.**)

1927, p. 203, Pl. IX, figs. 3-5.

Dioecious, nannandrous, gynandrosporous; oogonium 2–3, ellipsoid or ovoid, often terminal, operculate, division supreme, lid often deciduous; oospore ellipsoid or ovoid (rarely globose), filling oogonium or not, spore wall smooth; androsporangium 1–3, subepigynous; vegetative cell capitellate; basal cell elongate; dwarf male on oogonium; antheridium 1–?; vegetative cell 12–20×36–64μ; oogonium 36–42×44–60μ; oospore 34–38×40–55μ; androsporangium 12–16×10–20μ; dwarf male stipe 12–16×24–40μ; antheridium 7–12×6–10μ; basal cell 18–20×40–64μ.

United States: Indiana, Ohio.

Cf. *Oe. ciliatum* (No. 185) and *Oe. obtruncatum* (No. 189).

193. **Oe. tentoriale** Nordstedt and Hirn.
(**Pl. LXI, fig. 597.**)
In Hirn 1900, p. 248, Pl. XLII, fig. 260.

Dioecious, nannandrous; oogonium 1, terminal, broadly ellipsoid or obovoid-globose, division supreme, lid small, deciduous, oogonium wall longitudinally ribbed on the inner surface, ribs often anastomosate; oospore quite filling oogonium, outer layer of the spore wall with 40–45 longitudinal, very finely crenulate ribs, closely filling in between the ribs of the oogonium, connected by delicate transverse lines, inner layer smooth; basal cell elongate; terminal cell obtuse; dwarf male suberect, on suffultory cell, antheridium exterior 1–?; vegetative cell 20–33 (–37) ×60–225μ; oogonium 66–82×73–88μ; dwarf male stipe 10–15×37–48μ; antheridium 9–12×7μ.

United States: Illinois; Brazil.

Cf. *Oe. acrosporum* (No. 195).

194. **Oe. michiganense** Tiffany.
(**Pl. LXI, figs. 594–596.**)
1927, p. 205, Pl. IX, figs. 10–12.

Dioecious, nannandrous, gynandrosporous; oogonium 1–7, globose to ellipsoid-globose (rarely subglobose), operculate, division at the upper extremity of the oogonium; oospore globose, filling the oogonium or not, outer layer of spore wall smooth, middle layer with 12–24 crenulate, sometimes anastomosing, longitudinal ribs, inner layer smooth; suffultory cell enlarged; vegetative cell broadly capitellate; basal cell elongate; terminal cell, occasionally oogonium, apically obtuse; dwarf male, a little curved, on suffultory cell, antheridium interior; vegetative cell 12–24×80–160μ; suffultory cell 32–48×64–80μ; oogonium 50–64×50–80μ; oospores 44–60×44–60μ; androsporangium 16–20×16–20μ; dwarf male 14–20×40–56μ; basal cell 18–20×70–100μ.

United States: Michigan.

The only nannandrous member of the genus possessing a capitellate vegetative cell, a supreme operculum, and longitudinally ribbed oospores.

195. **Oe. acrosporum** De Bary.
(**Pl. LX, fig. 589.**)

1854, p. 47 *et seq.*, Pl. 3, figs. 1–12; *Oe. acrosporum* De Bary f. *connectens* Wittr. *in* Wittr. and Nordst. Exs. No. 1101, 1893, *in* P. B. A. No. 409, 1898, *in* Hirn 1900, p. 245, Pl. XLI, fig. 255; Hirn 1900, p. 244, Pl. XLI, fig. 254; Collins 1909, p. 259; Heering 1914, p. 183, fig. 253; Tiffany 1926, p. 107, Pl. IX, fig. 103.

Dioecious, nannandrous, gynandrosporous (or idioandrosporous); oogonium 1, terminal, ellipsoid, operculate, division supreme, operculum small and deciduous; wall of oogonium with longitudinal, sometimes anastomosing, ridges on the inner surface; oospore quite filling the oogonium, outer layer of spore wall with 23–30 longitudinal ridges, closely fitting in between the ridges of the oogonium, inner smooth; basal cell elongate; terminal cell obtuse; androsporangia 1–2, hypo-

gynous; dwarf male curved, on the suffultory cell, stipe sometimes 2–3 celled, upper cells long, antheridium exterior, 1–2; vegetative cell 12–21×40–125μ; suffultory cell 16–25×26–76μ; oogonium 35–48×50–63μ; androsporangium 16–21×12–15μ; dwarf male stipe, upper cell 6–8×55–71μ; lower cell 9–12×30–38μ; antheridium 6–8×9–15μ

United States: Ohio, Illinois, Iowa, Michigan, New York, Massachusetts; Austria, England, Finland, France, Germany, Norway, Sweden; Brazil; Manchuria; Madagascar; British Columbia.

195a. Form **boreale** (Wolle) Hirn.

(**Pl. LX, fig. 590.**)

1900, p. 245, Pl. XLI, fig. 256; *Oe. acrosporium* De Bary var. *boreale* Wolle 1887, p. 84, Pl. 79, figs. 10 and 11.

Filaments few-celled; vegetative cell 14–16×45–80μ.

United States: Pennsylvania, New Jersey.

It is very doubtful if this form of the genus is tenable. The plant described by Wolle seems to have had fewer cells to the filament than the species proper. From data at hand regarding other species, it appears this variability in the number of the cells is largely a matter of environmental conditions. There are some species in the genus, however, that are never found except with very few cells to a filament. The form is retained until more definite data can be secured regarding its variations. If it is normally few celled, Wolle's varietal position must be maintained.

195b. Var. **bathmidosporum** (Nordstedt) Hirn.

(**Pl. LX, fig. 592.**)

1900, p. 246, Pl. XLII, fig. 259; *Oe. bathmidosporum* Nordst. 1878, p. 179; *Oe. acrosporum* De Bary *in* Gutw. 1897, p. 8; *Oe. acrospermum* De Bary in P. B. A. No. 163, 1896.

Smaller; ribs fewer, 11–17, evidently crenulate; dwarf male stipe unicellular; vegetative cell 12–17×35–125μ; suffultory cell 15–22×40–110μ; oogonium 30–40×40–54μ; dwarf male stipe 9–11×30–34μ; antheridium 8–10×9–12μ.

United States: Massachusetts; Austria, Sweden; Brazil.

195c. Var. **floridense** Wolle.

(**Pl. LX, fig. 593.**)

1887, p. 83, Pl. 85, figs. 1 and 2; Hirn 1900, p. 246, Pl. XLI, fig. 258.

Smaller with elongate vegetative cell and more tumid suffultory cell; dwarf male stipe 2–3 celled; vegetative cell 7–8×36–85μ; oogonium 33–35×45–50μ.

United States: Florida.

The only record is that of Wolle.

195d. Var. **majusculum** Nordstedt.

(**Pl. LX, fig. 591.**)

1878a, p. 21, Pl. 2, figs. 17–18; Hirn 1900, p. 246, Pl. XLI, fig. 257.

Smaller; vegetative cell 14–21×50–165μ; suffultory cell 18–28× 42–65μ; oogonium 44–56×54–70μ.

Australia.

Oe. acrosporum is readily identified by its single terminal oogonium and by the dovetailing of the longitudinal ridges of the inner surface of the oogonium and outer surface of the oospore. The varieties and form (see note under each) are separable largely on the basis of number of ribs and size of cells. The species is easily distinguished from *Oe. tentoriale* (No. 193) by its smaller number of longitudinal ribs on the oospore, by its more slender cells, and differently shaped oogonia.

Species Imperfectly Known.

The following members of the genus are recorded with varying degrees of certainty regarding their validity. A few are unquestionably readily recognized even though a complete description is not available or possible at the present status of our knowledge. Some are very near other species, differing in one or more characters, but lacking sufficient completeness of description to warrant definite placement in the genus. Others are included purely as a matter of record. Wherever possible, the species is included in the key in its probably proper position, with the idea of calling it to the attention of the student of the genus and thereby aid in its identification if collected. Appropriate remarks occur in connection with the description of each species.

196. **Oe. tapeinosporum** Wittrock.

(**Pl. XXXIV, fig. 314.**)

1874, p. 36; 1878, p. 140; De Toni 1889, p. 76; *Oe. tapeinosporum* var. *Angolense* West and West 1897, p. 5; Hirn 1900, p. 297, Pl. XXIII, fig. 117; Heering 1914, p. 224, fig. 344; Tiffany 1926, p. 96, Pl. VII, fig. 81.

Oogonium 1–2, depressed-globose, operculate, division median, distinct; oospore depressed-globose, not (rarely nearly) filling oogonium, spore wall smooth; basal cell subhemispherical; terminal cell obtuse; vegetative cell (2–) 3–5×10–40μ; oogonium 15–19× (14–) 17–23μ; oospore 13–16×8–14μ; basal cell 12–14×5–7μ.

United States: Iowa; England, Germany; Columbia; Africa; India.

This species is rather readily distinguished by its conspicuous operculum and small size. No antheridia have been observed thus far. The Iowa material combined the characters of the type and the variety *Angolense*, and the latter thus becomes untenable. The species is perhaps dioecious, macrandrous.

197. **Oe. angustissimum** West and West.
(**Pl. XXV, fig. 220.**)

1897, p. 6; Hirn 1900, p. 314, Pl. L, fig. 321.

(?) Monoecious; oogonium 2, transversely inflated; oospore transversely elliptical and inflating oogonium, wall smooth; filament irregularly flexed and very narrow; vegetative cell 1.8–2×13–28μ; oogonium 9.5×10.5–14.5μ; oospore 9.5×6.5μ.

Africa.

As far as is known, this is the smallest species of Oedogonium. Cf. *Oe. inconspicuum* (No. 198) and *Oe. tapeinosporum* (No. 196).

198. **Oe. inconspicuum** Hirn.
(**Pl. XXXIV, fig. 313.**)

1895, p. 23, Pl. 1, fig. 8; 1900, p. 296, Pl. XXIII, fig. 116; (?) *Oe. minutissimum* Grun. *in* Hansgirg 1905, p. 436.

(? Dioecious, macrandrous) Oogonium 1 (rarely 2–3), depressed- or subpyriform-globose, operculate, division median, narrow; oospore depressed-globose, filling the inflated part of oogonium, spore wall smooth; vegetative cell 3–5×20–34μ; oogonium 13–18× (13–) 17–23μ; oospore 12–17×8–12μ.

Columbia; Finland, Austria, Sweden.

In common with most of the smaller sized species of the genus, *Oe. inconspicuum* is found attached to other algæ or to submerged macrophytes. Cf. *Oe. angustissimum* above and *Oe. tapeinosporum* (No. 196).

199. **Oe. tenuissimum** Hansgirg.

1888a, p. 398; 1888, p. 222; Hirn 1900, p. 315.

(?) Monoecious; filament irregularly curved; oogonium 1, subpyriform, pore median; oospore globose–ellipsoid, not filling oogonium; vegetative cell 2.3–6×9–25μ; oogonium 9–18×14–23μ; oospore 15μ in diameter.

Austria.

Characterized by its median pore and elongated oogonium; cf. *Oe. sexangulare* (No. 135) and *Oe. pusillum* (No. 200).

200. **Oe. pusillum** Kirchner.
(**Pl. XXXIV, fig. 316.**)

1878, p. 59; (?) *Oe. excisum* Wittr. and Lund. *in* Nordst. 1880, p. 13; *Oe. africanum* Lagerh. 1893, p. 155; *Oe. Klebahnii* Lemm. 1893, p. 509, and 1895, p. 28, figs. 4 and 5; *ibid. in* De Wildemann 1896, p. 66, Pl. 5, figs. 2–7; *Oe. africanum* Lagerh. *in* Lemm. 1896, p. 502, Pl. 5, figs. 3–20; Hirn 1900, p. 299, Pl. XXIV, fig. 125; Collins 1912, p. 88; Heering 1914, p. 224, fig. 345; Tiffany 1926, p. 95, Pl. VII, fig. 80.

Oogonium 1 (rarely 2), subbiconic-ellipsoid or subbiconic-globose, seen from above circular, margin even, operculate, division wide; oospore ellipsoid or globose, generally constricted at the middle, not quite filling oogonium, spore wall smooth; basal cell subhemispherical; terminal cell obtuse or obtusely conical; vegetative cell 3–6×10–60μ; oogonium 14–16×15–25μ; oospore 11–13×13–15μ; basal cell 7–8×7–8μ.

United States: Iowa, Illinois; Austria, France, Germany; Africa; Brazil; Sumatra.

This species is usually very readily recognized by its medianly constricted oospore, and whether eventually found to be monoecious or dioecious, it is a distinct species.

201. **Oe. selandiæ** Hallas.
(**Pl. XXXVIII, fig. 359.**)

1905, p. 496, fig. 14; Hirn 1906, p. 20, Pl. III, fig. 11.

(?) Monoecious; oogonium 1–2, oblong (or angular-oblong), operculate, division superior; oospore oblong-ellipsoid or obovoid, completely filling oogonium or not; vegetative cell 3–5×13–40μ; oogonium 9–14×27–30μ; oospore 7–12×16–25μ.

Denmark.

To be compared with *Oe. gracillimum* (No. 114) and with *Oe. rugulosum* (No. 179).

202. **Oe. sancti thomæ** Wittrock and Cleve.
(**Pl. XXXVIII, fig. 360.**)

In Witt. 1874, p. 40; 1878, p. 141; Hirn 1900, p. 304, Pl. XXIX, fig. 173; Collins 1909, p. 265.

Oogonium 1–3, pyriform, operculate, division superior; oospore pyriform-obovoid, not quite filling oogonium, spore wall smooth; basal cell subhemispherical; terminal cell very slender, subhyaline; vegetative cell 7–15×16–88μ; oogonium 28–33×36–50μ; oospore 25–30×28–35μ; basal cell 14–23×8–12μ.

United States: Mississippi, Ohio; West Indies (St. Thomas).

Material from Mississippi and Ohio have been referred to this species, although antheridia were not observed. It is perhaps dioecious, macrandrous.

203. **Oe. fusus** Hallas.

(Pl. XXXIV, fig. 311.)

1905, p. 407, fig. 15; Hirn 1906, p. 14, Pl. IV, fig. 26.

(?) Dioecious; oogonium 1, ellipsoid, operculate, division median; oospore globose, not filling oogonium, spore wall smooth; vegetative cell 2–3×10–23μ; oogonium 14–15×31–35μ; oospore 12×12μ.

Denmark.

Characterized by its small size and ellipsoid oogonium with globose oospore. Cf. *Oe. inconspicuum* (No. 198) and *Oe. pusillum* (No. 200).

204. **Oe. rhodosporum** (Welwitsch) Wittrock.

(Pl. XL, figs. 388 and 389.)

1874, p. 34; De Toni 1889, p. 72; Hirn 1900, p. 305, Pl. XXXI, fig. 193.

Dioecious (? macrandrous or nannandrous); oogonium 1–3, obovoid to globose obovoid, operculate, division superior; oospore same form as oogonium, nearly or quite filling oogonium, spore wall smooth; antheridium (? androsporangium) 1–6; vegetative cell 16–23×20–66μ; oogonium 35–44×45–54μ; oospore 33–41×38–48μ; antheridium (? androsporangium) 16–19×9–17μ.

France, Portugal.

To be compared with *Oe. pluviale* (No. 183) and with the two following species.

205. **Oe. vesicatum** (Lyngbye) Wittrock.

(Pl. XL, figs. 386 and 387.)

Conferva vesicata Lyng. 1819, p. 140, Pl. 47, fig. D1; *Oe. vesicatum* Wittr. 1874, p. 39; Hirn 1900, p. 306, Pl. XXXI, fig. 194.

Dioecious, oogonium 1, obovoid or globose-obovoid, operculate, division superior; oospore same form as oogonium which it nearly fills, spore wall smooth; antheridium (? androsporangium) 1–4; vegetative cell, female 17–23×22–74μ; male (? androsporangial) 16–21×28–63μ; oogonium 40–45×49–60μ; oospore 35–42×40–48μ; antheridium (? androsporangium) 16-18×11–16μ.

Denmark.

Cf. *Oe. rhodosporum* above and *Oe. montagnei* below.

206. **Oe montagnei** Fiorini-Mazzanti.

(Pl. XL, figs. 390 and 391.)

1860, p. 259, Pl. 1, figs. 1, 2 and 5; Wittrock 1874, p. 41; Hirn 1900, p. 307, Pl. XXXI, fig. 195.

Oogonium 1–2, obovoid or globose-obovoid, operculate, division superior; oospore of same form as oogonium, filling it or nearly so, spore wall smooth; vegetative cell 18–26×20–110μ; oogonium 40–52× 48–65μ; oospore 38–47×43–52μ.

Italy.

Cf. *Oe. rhodosporum* (No. 204) and *Oe. vesicatum* (No. 205).

207. **Oe. flexuosum** Hirn.

(**Pl. XL, fig. 394.**)

1900, p. 313, Pl. XLVIII, fig. 310.

Oogonium 1, obovoid or obovoid-globose, operculate, division superior; oospore same form as oogonium and filling it, spore wall smooth; filament irregularly curved; vegetative cell 15–18×12–32μ; oogonium 29–34×29–43μ; oospore 27–32×27–37μ.

Ireland.

Characterized by its curved filaments and short cells. Cf. *Oe. fonticola* (No. 208) and *Oe. implexum* (No. 187).

208. **Oe. fonticola** Al. Braun.

(**Pl. XLI, fig. 402.**)

In Kuetz. 1849, p. 368, and 1858, p. 13, Pl. 40, fig. 2; *Oe. rhodosporum* (Welw.) Wittr. 1876, p. 47; Hirn 1900, p. 313, Pl. XLIX, fig. 315; Heering 1914, p. 225, fig. 341; Tiffany 1926, p. 106.

Dioecious; oogonium 1–2, obovoid or globose-obovoid, operculate, division superior; oospore obovoid-ellipsoid or subglobose, nearly or quite filling oogonium, spore wall smooth; vegetative cell 16–32× 12–70μ; oogonium 36–43 (–45) ×43–56μ; oospore 34–41 (–43) ×40–49μ.

United States: Iowa, Indiana, Mississippi; Austria, Italy, Spain, Germany, England.

Cf. *Oe. implexum* (No. 187), *Oe. flexuosum* (No. 207), and *Oe. pluviale* (No. 183).

West (1912) records the presence of very small apparently male filaments of *Oe. fonticola*, indicating a condition intermediate between "truly dioecious macrandrous species and those with large nannandria." If these are really male filaments, the species becomes dioecious, macrandrous. Until the data are more complete, *Oe. fonticola* must remain in the imperfectly known division of the genus.

209. **Oe. oryzæ** Wittrock.

(**Pl. XXI, fig. 190.**)

1876, p. 51, Pl. 13, figs. 32 and 33; Hirn 1900, p. 294, Pl. XXII, fig. 113.

Oogonium 1–2, scarcely tumid, subobovoid or subcylindric, pore superior; oospore of same form as oogonium, nearly filling it or sometimes enlarging it, spore wall smooth; basal cell elongate; terminal cell acuminate; vegetative cell 24–39×36–120μ; suffultory cell 45× 56–90μ; single or upper series of oogonium 45–55×65–95μ; lower series of oogonium 43–53×45–57μ; oospore 41–51× (44–) 60–80μ.

United States: Mississippi; Italy.

209a. Var. **seriosporum** (Lagerheim) Hirn.

(Pl. XXI, figs. 191 and 192.)

1900, p. 294, Pl. XXII, fig. 114; *Oe. seriosporum* Lagerh. 1888, p. 590.

More variable, oogonium sometimes 2–5, lower series of oogonium subcylindric or cylindric-globose; vegetative cell 24–42 (–54) ×38–120μ; oogonium, single or upper series, 48–60×60–99μ, lower series 42–54× (35–) 43–52μ; oospore 40–56×40–75μ.

Germany.

Characterized by the variation in the size of the oogonia and the vegetative cells on the same plant, the species is somewhat near *Oe. mexicanum* (No. 44). The variety is even more variable than the species, and its oogonia are more seriate.

210. **Oe. virceburgense** Hirn.

(Pl. XXXVI, fig. 336.)

1896, p. 8; 1900, p. 301, Pl. XXIV, fig. 128; 1906, p. 54.

Oogonium 1–8, subpyriform- to subdepressed-globose, operculate, division a little above median; oospore subdepressed- or depressed-globose, quite filling oogonium, spore wall smooth; vegetative cell often broadly capitellate; basal cell half round; vegetative cell 4–6×13–45μ; oogonium 15–20×15–23μ; oospore 14–19×14–17μ.

Austria, Germany, Hungary.

To be compared with the slightly larger *Oe. spurium* (below) and with *Oe. petri* (No. 90).

211. **Oe. spurium** Hirn.

(Pl. XXXVI, fig. 333.)

1900, p. 301, Pl. XXIV, fig. 131.

Oogonium single, subdepressed- or depressed-globose, operculate, division supramedian; oospore of the same form as oogonium, nearly or completely filling it, spore wall smooth; vegetative cell capitellate; basal cell elongate; terminal cell apically obtuse or truncate-obtuse; vegetative cell 9–13×20–55μ; oogonium 26–29×23–28μ; oospore 24-28× 21–24μ.

United States: Ohio; Brazil.

Cf. *Oe. virceburgense* above. It also has considerable resemblance to the longer celled filaments of *Oe. sphaerandrium* (No. 105).

212. **Oe. velatum** Hallas.

(Pl. XLI, figs. 398 and 399.)

1905, p. 405, fig. 11; Hirn 1906, p. 23, Pl. IV, fig. 27.

Oogonium single, ellipsoid-globose, operculate, division superior; oospore globose, not filling oogonium, middle layer of spore wall echinate; vegetative cell 3–20×25–400μ; oogonium 43×68μ; oospore 35×35μ.

Denmark.

The cell diameter is extremely variable. The echinate appearance of the oospore is questioned by Hirn (1906), who thinks the oospore may be parasitized.

213. **Oe. pilosporum** West.
(**Pl. XL, fig. 395.**)

1891, p. 109, Pl. 18, fig. 3; Hirn 1900, p. 318, Pl. L, fig. 325.

Oogonium single, oblong-ellipsoid, somewhat narrowed at the upper extremity; oospore subglobose, spore wall thick and outer layer densely pilose, the hairs short; vegetative cell 11–12×55–70μ; oogonium 23×48μ; oospore (without hairs) 19×21μ; oospore wall 2μ thick.

Spain.

The above dimensions and description are copied gingerly by Hirn (1900). From West's figure one is inclined to agree with Hirn that the "oospore" may be nothing more than a fungal parasite within the oogonium.

214. **Oe. hoehnei** Borge.
(**Pl. XXVIII, fig. 251.**)

1925, p. 12, Pl. I, fig. 11.

(?) Dioecious, macrandrous; oogonium single, ellipsoid, pore superior; oospore globose, not filling oogonium in length, outer spore wall smooth, middle wall areolate; vegetative cell 43–44×148–240μ; oogonium 66–72×99–108μ; oospore 63–65×63–65μ.

Paraguay.

This species has spore markings similar to those of *Oe. areolatum* (No. 59).

215. **Oe. giganteum** Kuetzing; Wittrock.
(**Pl. XXIX, fig. 260.**)

Kuetz. 1845, p. 200; 1853, p. 12, Pl. 37, fig. 2; Wittr. 1874, p. 42; Hirn 1900, p. 295, Pl. XXIII, fig. 115.

(?) Dioecious, macrandrous; oogonium 1, cylindric-obovoid, pore superior; oospore cylindric-ellipsoid or subellipsoid, nearly filling oogonium, spore wall in three layers: outer smooth, middle layer with 25–30 longitudinal rows of pits, inner layer smooth; vegetative cell 30–50×60–225μ; suffultory cell 40–60×60–210μ; oogonium 53–69×67–106μ; oospore 51–65×65–103μ.

United States: Ohio; Austria, England, Denmark, Germany, Sweden.

This species is rather readily identified by its large size and by the longitudinal rows of distinct pits in the middle layer of the oospore wall. It is separable from *Oe. capense* (No. 216) by its larger size. The arrangement of pits and general appearance are somewhat similar to the nannandrous *Oe. concatenatum*

(No. 151). It is doubtless a distinct species, no matter what its final description may be.

216. **Oe. capense** Nordstedt and Hirn.
(**Pl. XXIX, fig. 257.**)

In Hirn 1900, p. 293, Pl. XV, fig. 88.

Oogonium 1–3, obovoid to ellipsoid, pore superior; oospore of same form as oogonium and filling it, spore wall in three layers: outer smooth, middle pitted, with pits in 25–30 longitudinal rows, inner layer smooth; basal cell elongate; vegetative cell 13–17×40–100μ; oogonium 35–38×53–58μ; oospore 33–35×46–48μ.

Africa.

This species is perhaps dioecious, macrandrous, although antheridia are unreported. Cf. *Oe. giganteum* above.

217. **Oe. moniliforme** Wittrock.
(**Pl. XII, fig. 114.**)

1874, p. 40; Hirn 1900, p. 288, Pl. V, fig. 28.

Oogonium 1–5, pyriform to globose-obovoid or subglose, pore supramedian; oospore globose or subdepressed-globose, not filling oogonium, middle layer of spore wall scrobiculate; terminal cell apically obtuse; vegetative cell 9–11×30–54μ; oogonium 23–28×28–35μ; oospore 22–27×22–26μ.

United States: Michigan, Ohio; Sweden.

The small size of this species together with its definitely scrobiculate spore wall makes it readily identifiable, even though antheridia have not been so far observed.

218. **Oe. inerme** Hirn.
(**Pl. XI, fig. 110.**)

1900, p. 287, Pl. II, fig. 10.

(?) Dioecious, macrandrous; oogonium single, subdepressed- or subpyriform-globose, pore median, rimiform and narrow; oospore depressed- or subdepressed-globose, not filling oogonium, spore wall smooth; vegetative cell 12–14×56–96μ; oogonium 37–39×34–45μ; oospore 33–38×28–32μ.

England, France, Germany.

218a. Var. **mentiens** Hirn.
(**Pl. XI, fig. 111.**)

1900, p. 287, Pl. II, fig. 11.

Smaller; oogonium depressed- to pyriform-globose; oospore sometimes nearly globose; vegetative cell 9–11×37–90μ; oogonium 28–32×33–45μ; oospore 27–29×25–28μ.

France.

The species is to be compared with *Oe. sociale* (No. 6), *Oe. rufescens* (No. 4), and *Oe. laeve* (No. 1). Var. *mentiens* is smaller.

219. **Oe. sol** Hirn.

(**Pl. XXXIII, fig. 286.**)

1900, p. 303, Pl. XXVIII, fig. 164.

Oogonium single, globose, operculate, division superior; oospore globose, completely filling oogonium, spore wall of three layers: outer smooth, middle with 35–45 granulate ribs sometimes anastomosate, inner smooth; vegetative cell 13–15×65–110μ; oogonium 46–55× 46–55μ; oospore 44–53×44–53μ.

Brazil.

If found to be dioecious, macrandrous, it is near *Oe. tumidulum* (No. 73) and should perhaps be considered a variety of it.

220. **Oe. urceolatum** Nordstedt and Hirn.

(**Pl. XXVII, figs. 238 and 239.**)

In Hirn 1900, p. 293, Pl. XIV, fig. 81.

Oogonium 1, obpyriform (rarely oblong-ellipsoid or subellipsoid), pore superior; oospore globose-ellipsoid or ellipsoid, not filling oogonium lengthwise, inflating lower part of oogonium, spore wall in three layers: outer smooth, middle with 15–20 entire, longitudinal ribs, sometimes anastomosate and often spirally curved, inner layer smooth; basal cell elongate; vegetative cell 24–30×120–210μ; oogonium 58–70×100–125μ; oospore 54–60×58–70μ.

Brazil.

To be compared with the monoecious *Oe. paulense* (No. 52) and with the dioecious *Oe. boscii* (No. 55).

221. **Oe. londinense** Wittrock.

1874, p. 39; Cooke 1884, p. 170, Pl. 65, fig. 4; Hirn 1900, p. 317.

Oogonium 1–2, globose, operculate, division median; oospore globose, quite filling oogonium; (?) antheridium 1–2, hypogynous; vegetative cell 10–15×15–75μ; oogonium 33–35×33–43μ; oospore 27–32×27–32μ; (?) antheridium 12×10–11μ.

England; (?) New Jersey.

This species is very uncertain and Cooke's figure helps none. It has very much the appearance of *Oe. areschougii* (No. 160) except for Wittrock's suspicion that it is monoecious. Quite likely Wittrock was wrong, and the "antheridia" are in reality androsporangia.

222. **Oe. consociatum** Collins and Hervey.

(**Pl. XL, fig. 396.**)

1917, p. 37, Pl. I, figs. 1–4; Collins 1918, p. 65; P. B. A. No. 2068.

Dioecious, ? macrandrous; oogonium single, globose to depressed-globose, operculate, division median to superior, narrow but distinct; oospore globose to depressed-globose, filling oogonium, spore wall smooth; basal cell depressed-globose; vegetative cell, more or less

distinctly clavate, 6–12 (–20) ×6–50μ; oogonium 28–26×28μ; oospore 26×24–26μ; basal cell 20–24×12–16μ.

Bermuda.

Characterized by its frequently short and clavate vegetative cells and depressed-globose basal cells. Its general appearance is near that of *Oe. vesicatum* (No. 205), *Oe. montagnei* (No. 206), and *Oe. pluviale* (No. 183). Its resemblance to *Oe. inversum* (No. 77), noted by Collins and Hervey, seems to the writer quite far-fetched. The so-called "stellate clusters" of young plants may be merely the development of numerous zoospores accidentally lodged in one mass.

223. **Oe. lageniforme** Hirn.

(Pl. XX, fig. 187.)

1900, p. 291, Pl. XIII, fig. 68.

(?) Dioecious, macrandrous; oogonium 1, obpyriform (in section sometimes trinodulose), pore superior; oospore globose to ellipsoid, occupying the lower part of the oogonium, spore wall smooth; vegetative cell 11–13×45–90μ; oogonium 33–36×48–63μ; oospore 29–31×31–38μ.

Brazil.

In spite of the incomplete description this species is readily recognized by its inferiorly inflated oogonium and its relatively smaller oospore. It bears some resemblance to the monoecious *Oe. pseudoboscii* (No. 27).

224. **Oe. poecilosporum** Nordstedt and Hirn.

(Pl. XXXIV, fig. 305.)

In Hirn 1900, p. 298, Pl. XXIII, fig. 124.

Oogonium 1–2, ellipsoid to depressed-globose (sometimes globose or subglobose), operculate, division median, broad; oospore of same form as oogonium, which it nearly fills, spore wall smooth; terminal cell apically obtuse; vegetative cell 6–8×20–47μ; oogonium 24–28×25–38μ; oospore 23–26×21–28μ.

Africa.

Compare with *Oe. gunnii* (No. 101) and *Oe. psaegmatosporum* (No. 83).

225. **Oe. inflatum** Hallas.

(Pl. XXI, figs. 193 and 194.)

1905, p. 408, fig. 16; Hirn 1906, p. 16, Pl. I, fig. 1.

(?) Dioecious; oogonium 1–2, often terminal, subglobose or ellipsoid-globose, poriferous, pore variable between supramedian and nearly

superior; oospore globose, not filling oogonium, spore wall smooth; basal cell elongate; vegetative cell of considerable variation in diameter, the terminal cell often narrow and produced into a long hyaline seta; vegetative cell 6–27×12–480μ; oogonium 37–49×54–76μ; oospore 28–35×28–35μ.

Denmark.

Cf. *Oe. tyrolicum* (No. 14) and *Oe. urbicum* (No. 11). The chief characteristics of *Oe. inflatum* are the variable position of the pore, the considerable variation in size of the vegetative cell, and the long, narrow hyaline setæ.

226. **Oe. warmingianum** Wittrock.

(**Pl. XV, fig. 148.**)

1878, p. 140; Hirn 1900, p. 290, Pl. XII, fig. 65.

Oogonium single, ellipsoid-ovoid, pore superior; oospore ellipsoid-globose, not filling oogonium in length, spore wall smooth; (? antheridium subepigynous); vegetative cell 8–9×32–63μ; oogonium 35×53μ; oospore 30×33μ.

Brazil.

It is impossible to determine with any degree of certainty the position of this species in the genus because of the very inadequate description.

227. **Oe. calvum** Wittrock.

(**Pl. XXXIV, figs. 309 and 310.**)

1874, p. 37; *Oe. vesicatum* Link *in* Rabenhorst Alg. Europe 1873; Hirn 1900, p. 316, Pl. L, fig. 323.

Oogonium 1–5, subdepressed-globose, operculate, division median; vegetative cell 7–9×22–40μ; oogonium 27–30×25–30μ.

India.

Cf. *Oe. poecilosporum* (No. 224), *Oe. latiusculum* (No. 81), and *Oe. pratense* (No. 80).

228. **Oe. inclusum** Hirn.

(**Pl. XL, fig. 397.**)

1895, p. 21, Pl. 1, fig. 4; 1900, p. 318, Pl. L, fig. 324; Fremy and Meslin 1926, p. 124, fig. 8.

Oogonium 1, suboblong-ellipsoid, wall thickened; oospore ellipsoid or suboblong-ellipsoid, not completing oogonium or sometimes enlarging it, spore wall slightly rugulose; basal cell elongate; vegetative cell 8–12×33–150μ; oogonium 24–30×48–55μ; oospore 18–23×38–48μ.

Finland, France.

229. **Oe. plicatulum** Wittrock.

(**Pl. LVI, fig. 535.**)

1874, p. 38; Hirn 1900, p. 310, Pl. XLVII, fig. 296; *Oe. rothii* Breb. *in* Rabenh. Alg. Eur. 2347, 1873.

Oogonium 1–3, subpyriform-globose, medianly plicate, with 12–17 longitudinal ridges, operculate, division supramedian; oospore subdepressed- to subpyriform-globose, nearly filling oogonium, spore wall smooth; terminal cell apically obtuse; vegetative cell 7–11×16–65μ; oogonium 23–28×24–29μ; oospore 21–25×21–25μ.

India.

To be compared with *Oe. oelandicum* (No. 164), *Oe. megaporum* (No. 165), and *Oe. crenulatum* (No. 233).

230. **Oe. lagerstedtii** Wittrock.

(**Pl. LVI, figs. 536-538.**)

1874, p. 38; Hirn 1900, p. 311, Pl. XLVII, fig. 306.

Oogonium 1–4, depressed-obovoid, medianly plicate, with 7–11 longitudinal ridges, operculate, division inframedian; oospore depressed-globose or subglobose, not filling oogonium, spore wall smooth; vegetative cell 5–8×10–48μ; oogonium 16–23×13–17μ; oospore 13–16×11–14μ.

Finland, Sweden.

Cf. *Oe. platygynum* (No. 167).

231. **Oe. uleanum** Hirn.

(**Pl. LV, fig. 529.**)

1900, p. 311, Pl. XLVIII, fig. 308; *Oe. sp.* Moebius 1895, p. 174, Pl. 2, figs. 11 and 12.

Oogonium 1–2, subpyriform, medianly plicate, with 7–9 longitudinal ridges, operculate, division inframedian; oospore globose or subglobose, not filling oogonium, spore wall smooth; vegetative cell 8–10×40–80μ; oogonium 23–29×24–39μ; oospore 18–22×18–25μ.

Brazil.

Cf. *Oe. platygynum* (No. 167) and *Oe. lagerstedtii* above.

232. **Oe. pulchrum** Nordstedt and Hirn.

(**Pl. LVI, fig. 541.**)

In Hirn 1900, p. 312, Pl. XLVIII, fig. 309.

(?) Dioecious-nannandrous; oogonium 1, depressed-pyriform, medianly plicate, with 7–10 longitudinal ridges, operculate, division inframedian; oospore globose or subglobose, not filling oogonium, spore wall smooth; (?) androsporangium 1–4, subepigynous or subhypogynous or rarely hypogynous; vegetative cell capitellate; terminal cell (often an oogonium) apically obtuse, vegetative cell 6–9×20–52μ; suffultory cell 9–12×15–36μ; oogonium 23–26×19–26μ; oospore 18–23×16–22μ; (?) androsporangium 7–8×7–8μ.

Brazil.

Cf. *Oe. bahusiense* (No. 166) and *Oe. platygynum* (No. 167).

233. **Oe. crenulatum** Wittrock.

(Pl. LVI, figs. 532 and 533.)

1876, p. 49, Pl. 13, figs. 25-27; Hirn 1900, p. 309, Pl. XLVII, fig. 294.

Oogonium 1, broadly pyriform-globose or transversely ellipsoid, medianly plicate, with about 13 longitudinal ridges, operculate, division median, narrow but distinct; oospore depressed-globose, inflating oogonium, spore wall smooth; vegetative cell 6–8×30–55μ; oogonium 25–27×26–28μ; oospore 22–23×15–17μ.

Italy.

233a. Var. **gracilius** (Nordstedt) Hirn.

(Pl. LVI, fig. 534.)

1900, p. 309, Pl. XLVII, fig. 295; *Oe. crenulatum* Wittr. f. *gracilior* Nordst. 1888, p. 12.

Smaller; vegetative cell 4–5×13–40μ; oogonium 16–18×16–21μ; oospore 15–16×12–13μ.

New Zealand.

Cf. *Oe. plicatulum* (No. 229), from which it is distinguished by its median position of the operculum.

234. **Oe. saxatile** Hansgirg.

1901, p. 1; Hirn 1906, p. 20.

In 1888 Hansgirg described *Oe. rufescens* var. *saxatile* as having an orange-red color and with these dimensions: vegetative cell 7–9(–12)×15–70μ; oogonium 18–24×24–36μ. Hirn (1900) considered this as a synonym of *Oe. rufescens* (No. 4). In 1901 Hansgirg, apparently feeling the variety to be distinct, gave it specific rank as *Oe. saxatile*, adding nothing to its description. It was found in several localities in Austria in a vegetative state on moist rock. *Oe. saxatile* may be distinct, but its description is at present too incomplete to warrant its retention as a distinct species, except as a matter of record. Vegetative cells red in color have been noted in a very few species of Bulbochaete, e. g., *B. sanguinea* (No. 50).

235. **Oe. reticulatum** West and West.

1902, p. 129; Hirn 1906, p. 19.

Vegetative cell elongate; oogonium ovoid-globose; oospore globose, not filling oogonium, spore wall areolate; vegetative cell 7–8×62–100μ; oogonium 37×41μ; oospore 25×25μ.

Ceylon.

To be compared with *Oe. arcyosporum* (No. 58) and *Oe. areolatum* (No. 59).

236. **Oe. reinschii** Roy.

(**Pl. XLI, fig. 406.**)

In Cooke 1884, p. 160, Pl. 57, fig. 23; *Cymatonema sp.* Reinsch 1875, p. xi, Pl. 6, fig. 1 (incorrectly *Cymatopleura*, p. 77); *Oe. sterile* Hansg. 1888, p. 43 and 260; Hirn 1900, p. 319, Pl. L, fig. 326; Lewis and Taylor 1928, p. 193, text figs. 3 and 4.

Vegetative cell subhexagonal or subellipsoid, sometimes nearly cylindrical; basal cell subhemispherical; apical cell obtuse; vegetative cell 6–9 (–11) ×8–24μ; basal cell 8–9×5–6μ.

United States: Michigan, Florida, New York, Massachusetts; Brazil, Paraguay; Austria, England, France, Germany, Scotland, Sweden.

This species, though as yet never found in fruit, is readily recognized by its peculiar vegetative cells. Among the typically hexagonal and ellispoid cells nearly always can be found regularly cylindrical cells.

TABLE III.

Alphabetical list of synonyms. The numbers indicate the species of BULBOCHAETE in the text considered synonymous, or under which they are discussed. If the number is preceded by a question mark, the synonym is considered very doubtful and cannot be definitely authenticated.

BULBOCHAETE	No.
anomala Pringsh.	?46
brebissonii Kuetz. f.	? 9a
canbyii Wood	?23
crenulata Pringsh. v. *plena* Wittr.	11
crenulata Pringsh. v. *supramediana* Wittr.	12
dumosa Wood	38a
elachistandria Wittr.	?12
elachistandria Wittr.	?14
ellipsospora West	?27
gracilis Pringsh.	6b
ignota Wood	?37
intermedia Pringsh.	20
intermedia DeBary f. *americana* Hirn.	12
intermedia DeBary f. *supramediana* (Wittr.) Hirn.	12
intermedia DeBary v. *depressa* Hirn.	12a
minor Al. Br.	41a
minor Al. Br.	44
mirabilis Wittr. v. *lapponica* Wittr. and Lund.	6
mirabilis Wittr. v. *immersa* Wittr.	6a
nana Wittr.	? 2
nana Wittr. v. *subbasispora* Wittr.	1
pachyderma Reinsch	?46
pringsheimiana Archer	?46
pygmaea Wittr.	34
pygmaea a. *major* Pringsh.	38a
pygmaea b. *minor* Pringsh.	34
rectangularis Wittr. v. *lundellii* Wittr.	36
rectangularis Wittr. v. *tenuis* Wittr.	35
rectangularis Wittr. v. *norvegica* Wittr.	35
reticulata Nordst.	46a
reticulata Nordst. v. *minor* Lemm.	38a
rhadinospora Wittr.	?36
setigera Agardh	23
setigera (Roth) Agardh	27
setigera v. *canbyii* Wood	?23
setigera (Roth) Agardh v. *punctulata* Nordst.	26
speciosa Wittr.	46
subsimplex Wittr.	38a
tenuis (Wittr.) Hirn v. *norvegica* (Wittr.) Hirn.	35
tumida Wittr.	9
varians Wittr. v. *antiqua* Nordst.	40a
varians Wittr. v. *alpina* Wittr. and Lund.	38a
CONFERVA	
setigera Roth	23

TABLE IV.

Alphabetical list of synonyms for the genus OEDOGONIUM. The numbers indicate the species or varieties in the text considered synonymous, or under which they are discussed. If the number is preceded by a question mark, the synonym is considered very doubtful and cannot be definitely authenticated.

OEDOGONIUM	No.	OEDOGONIUM	No.
acrosporum f. *connectens* Wittr.	195	*crispum* v. *uruguayense* f. *proprium* Hirn.	109e
acrosporum v. *boreale* Wolle	195a	*crispum* f. *vernale* (Hass. Wittr.) Hirn.	109
africanum Lagerh.	200	*cryptoporum* v. *vulgare* f. *abbreviata* Gutw.	169
alternans Kirch.	113	*cryptoporum* v. *subdepressum* Wittr.	169
amplum Magn. and Wille	49a	*cyathigerum* v. *ornatum* Wittr.	149b
angulosum Hallas.	135a	*cyathigerum* v. *rumelica* Istan.	149
apiculatum Wolle	? 57	*debaryanum* Chmiel.	37a
apophysatum Al. Br.	138	*delicatulum* Kuetz.	?168a
apophysatum Al. Br.	150	*diandronites* Carter.	? 25
apophysatum Al. Br.	151	*dioicum* Petrov.	37
apophysatum Pringsh.	151	*echinatum* Wittr.	147
archerianum Cooke.	? 53b	*eremitum* Hallas.	184d
arechavaletæ Wittr.	142a	*euganeorum* Wittr.	95b
areschougii f. *major* Collins.	160b	*exiguum* Elfv.	4a
bathmidosporum Nordst.	195b	*fioniæ* Hallas.	184c
bernardense Bates.	171c	*flavescens* Wittr.	133
berolinense Wittr.	154	*flavescens* v. *gynandrosporum* Hirn.	133
birmanicum Wittr.	138	*fonticola* v. *flavescens* Hansg.	?183
birmanicum Wittr.	?188	*gemelliparum* Pringsh.	45a
borisianum Wittr.	138	*gemelliparum* v. *majus* Wittr.	48
calcareum v. *gaditanum* Lewin.	132	*grande* v. *aequatoriale* f. *hortense* Wittr.	45b
calosporum Hirn.	57c	*grande* f. *robusta* Hirn.	45d
candollei (Le Cl.) Breb.	24	*grande* v. *robustum* (Hirn) Tiffany.	45d
capillare Kuetz.	35	*hafniense* Hallas.	132a
capillare v. *flavescens*	35	*hexagonum* Kuetz.	135
capilliforme v. *australe* f. *diversum* Hirn.	37d	*hispanicum* Lewin.	109
capilliforme v. *australe* f. *uberosporum* Hirn.	37c	*hohenackerii* Wittr.	184e
carbonicum Wittr.	15c	*hormosporum* West.	149e
cardiacum Wittr.	15	*huillense* West.	118
cataractum Wolle.	142c	*hutchinsiæ* Wittr.	151a
ciliare De Not.	95b	*insignis* v. *minus* Hirn.	74a
ciliatum Pringsh.	185	*intermedium* Kuetz.	183
cleveanum v. *arvensis* Istv.	154	*inversum* v. *subclusum* Wittr.	77
cleveanum f. *exoticum* Hirn.	154	*inversum* f. *subclusum* (Wittr.) Hirn.	77
concatenatum Wittr.	151	*kjellmanii* Wittr.	54
concatenatum f. *luxurians* Breb.	150	*klebahnii* Lemm.	200
concatenatum v. *lagenarioides* Filar.	151	*lagerheimii* Wittr.	109c
condensatum Hallas.	144a	*landsboroughi* Wittr.	48
crassipellitum West.	142b	*landsboroughi* v. *gemelliparum* (Pringsh.) Wittr.	45a
crassum Wittr.	49	*landsboroughi* v. *robustum* Wittr.	48a
crenulatum f. *gracilior* Nordst.	233a		
crispulum Wittr. and Nordst.	178		
crispulum v. *minutum* Hansg.	179a		
crispum v. *elongatum* Wittr.	109		
crispum f. *gracilis* Wittr.	109e		
crispum v. *granulosum* Nordst.	109a		

TABLE IV—(Continued).

OEDOGONIUM	No.
londinense v. *compressum* West.	171c
longicolle v. *senegalense* f. *afghanicum* Schaarsch	166a
lorentzii Magn. and Wille	37b
lundellii Wittr	4b
lundense Wittr	184c
lundense Wittr	?184b
macrandrium v. *aemulans* Hirn.	184b
macrospremum f. *patagonicum* Borge and Hirn	172
maximum West	41a
monandronites Carter	? 25
montagnei v. *submarinum* Wittr	183
montagnei v. *saxicolum* Wittr.	183
monticchii Fior.-Mazz	77
neglectum Hirn	27
nordstedtii Wittr	95b
oblongum v. *majus* Nordst	116a
obtruncatum v. *oblatum* Tilden.	?160b
ochroleucum Kuetz	6
oelandicum v. *subpyriforme* Wittr	165
ornatum Hirn	149
pachydermatosporum Nordst	95
pachydermatosporum Nordst	95b
paludosum Wittr	53
paludosum (Hass.) Kuetz	26
piliferum Wittr	86
piliferum Auersw	185
platygynum f. *major* West	167
polymorphum Wolle	10
princeps Wittr	38
pringsheimiana Archer	? 53b
pringsheimii v. *nordstedtii* f. *pachydermatosporum* (Nordst.) Hirn	95
pringsheimii v. *nordstedtii* f. *euganeorum* (Wittr.) Hirn	95b
pringsheimii v. *varians* Nordst.	95b
propinquum Wittr	184d
punctato-striatum v. *minor* Wittr	84
pyrulum v. *obesum* Wittr	108
rhodosporum (Welw.) Wittr	208
rivulare Al. Br	42
rivulare v. *major* Wolle	49a
rostellatum Pringsh	109
rostellatum Pringsh	109b
rothii Breb	4b
rothii Pringsh	169
rothii f. *major* West	171
rufescens f. *exiguum* (Elv.) Hirn.	4a
rufescens subsp. *lundellii* (Wittr.) Hirn	4b
rufescens subsp. *lundellii* f. *elongatum* Hirn	4b
seriosporum Lagerh	209a
setigerum Vaup	138
spetsbergense Wittr	? 3a
sphaericum Hallas	116b
spinospermum Reinsch	?136
spirogranulatum Schm	84
stagnale Kuetz	35
stagnale Kuetz	35a
stagnale v. *variabilis* Lewin	40
sterile Hansg	236
subpisanum Lewin	99
subcapitellatum Hirn	105
tapeinosporum v. *angolense* West and West	196
trichosporum Itzigs	? 9
tumidulum Pringsh	11
tumidulum (Roth)	29
tumidulum Kuetz	48
undulatum Al. Br	119
undulatum v. *interrupte-incisum* Schroed	119
undulatum v. *moebuisii* Schmid.	119
undulatum v. *senegalense* Nordst	119b
urbicum v. *oviforme* Lewin	30
vaucherii Braun	? 25
vaucherii Al. Br.; Wittr. f. *insulare* Hirn	25
vernale Wittr	109
vernale Wittr	12
vesicatum Link	171
vesicatum Link	227
vesicatum Wittr	205
vesicatum v. *flavescens* Kuetz	109b
vesicatum v. *fuscescens* Dupray	135
wittrockianum Hirn	145a
wolleanum v. *insigne* Nordst	150b

ANDROGYNIA	No.
echinata Wood	147
huntii Wood	152
mirabilis Wood	?138
multispora Wood	143

CONFERVA	No.
capillare L	35
tumidula Eng. Bot	73
undulata Breb	119
vesicata Ag	55
vesicata Lyng	205

TABLE IV—(Continued).

CYMATONEMA	No.
confervaceum Kuetz.	119

PRINGSHEIMIA	No.
inaequalis Wood	? 15

PROLIFERA	No.
borisiana Le Cl.	138
boscii Le Cl.	? 55
rivularis Le Cl.	? 42
rothii Le Cl.	?169
vaucherii Le Cl.	? 25

VESICULIFERA	No.
aurea Hass.	138
borissii Hass.	138
candollei Hass.	?109
capillaris Hass.	38
cardiaca Hass.	15
ciliata Hass.	185
compressa Hass.	? 5
concatenata Hass.	151
crispa Hass.	109
crassa Hass.	? 49
dissiliens Hass.	?183
flavescens Hass.	?133
landsboroughi Hass.	48
paludosa Hass.	? 53
princeps Hass.	38
pulchella Hass.	15b
vernalis Hass.	?109

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INDEX*

BULBOCHAETE

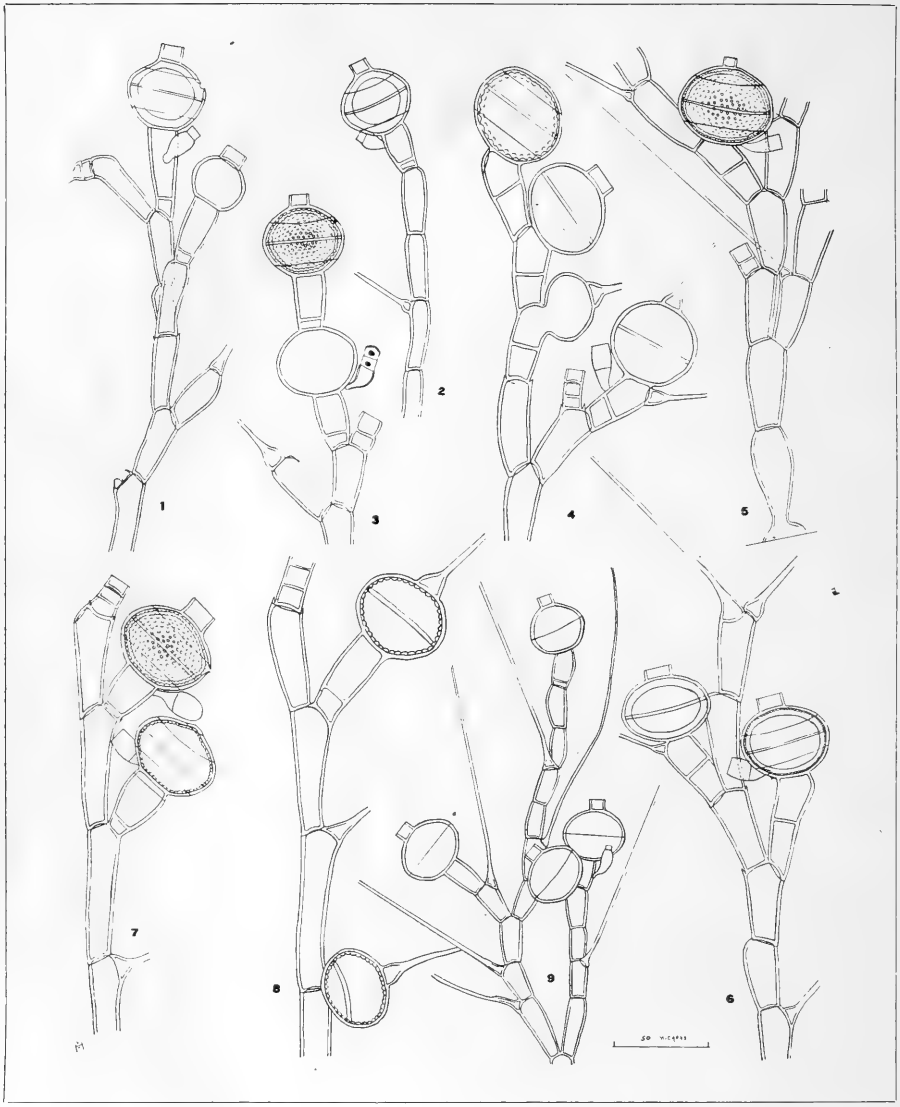
OEDOCLADIUM

*New species, varieties, and forms or new combinations are indicated by an asterisk.

OEDOGONIUM

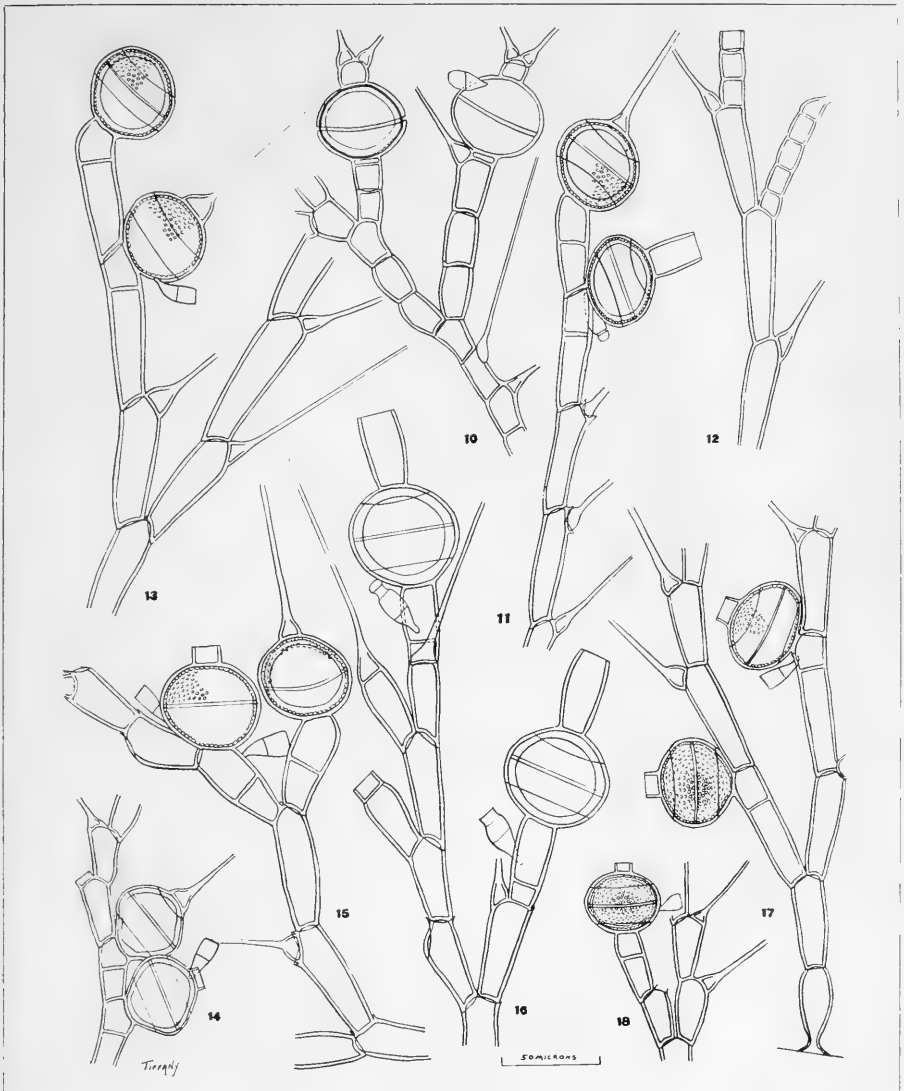
PLATES

PLATE I.



Page

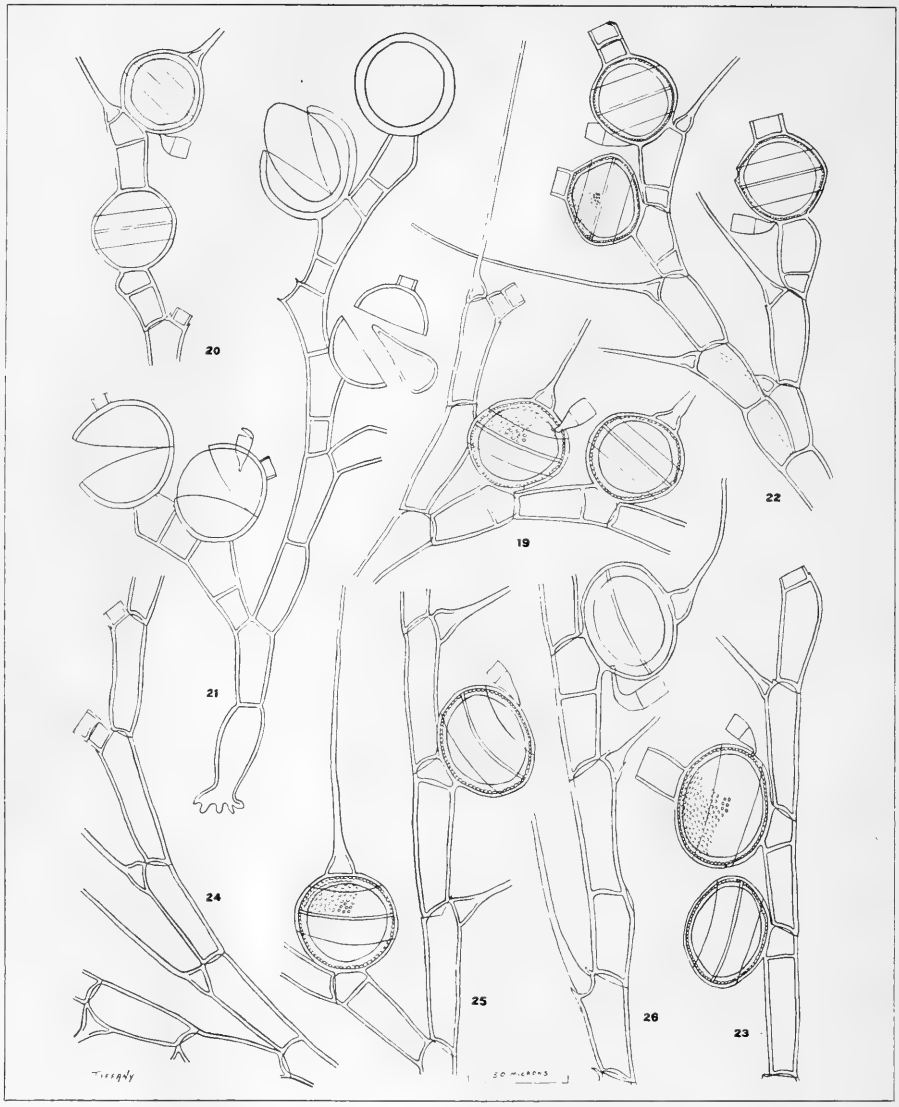
Fig. 1. **Bulbochaete elatior** Pringsheim. (Redrawn from Hirn)..... 32
Fig. 2. **B. elatior** f. **pumila** Hirn. (Redrawn from Hirn)..... 33
Fig. 3. **B. elatior** v. **scrobiculata** Tiffany..... 33
Fig. 4. **B. crenulata** Pringsheim. (Redrawn from Hirn)..... 34
Fig. 5. **B. intermedia** De Bary..... 35
Fig. 6. **B. intermedia** v. **depressa** Wittrock..... 35
Fig. 7. **B. brebissonii** Kuetzing. (After Hirn)..... 33
Fig. 8. **B. furberae** Collins. (After Lewis, in Collins 1918a)..... 34
Fig. 9. **B. minuta** West and West. (After G. S. West)..... 33



Page

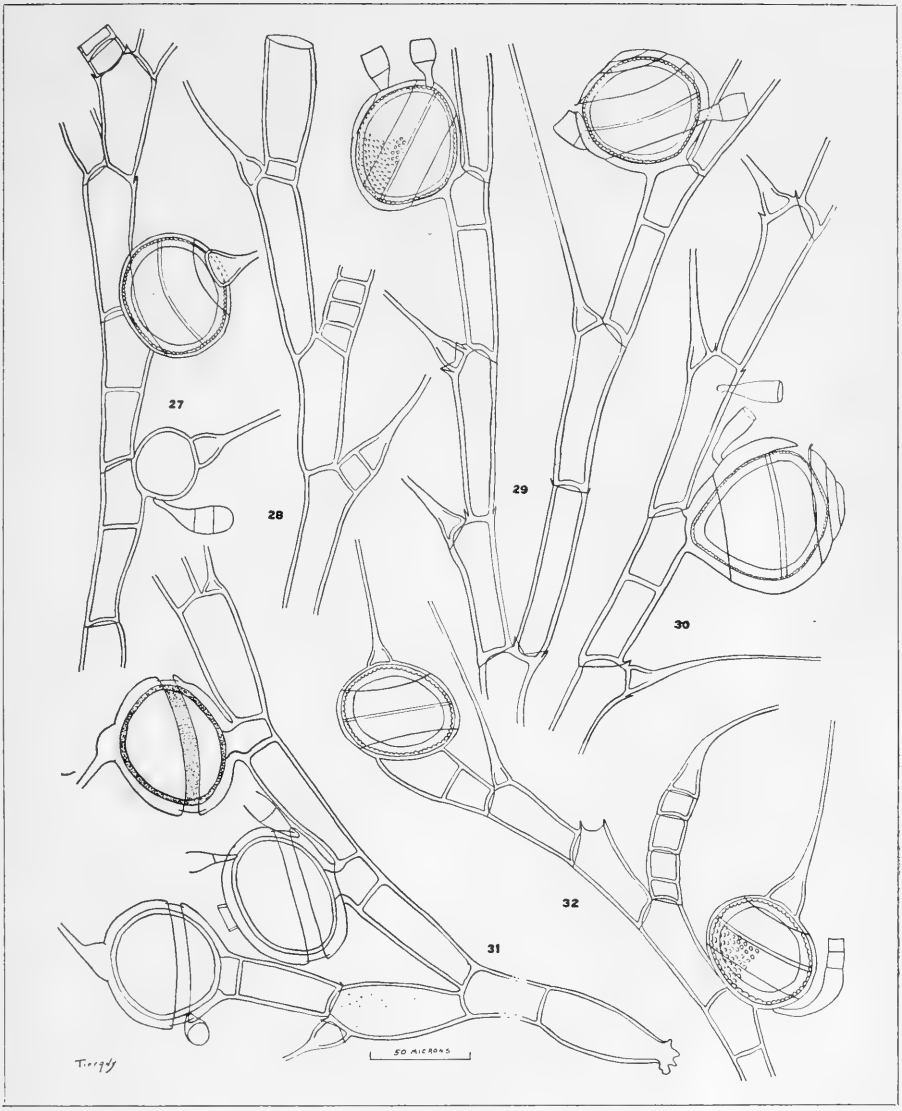
Fig. 10. **Bulbochaete borealis** Wittrock. (Redrawn from Hirn)..... 37
Fig. 11. **B. polyandria** Cleve, with oogonia..... 38
Fig. 12. **B. polyandria** Cleve, with androsporangia. (After Wittrock)..... 38
Fig. 13. **B. polyandria** f. **notabilis** Hirn. (Redrawn from Hirn)..... 38
Fig. 14. **B. angulosa** Wittrock and Lundell. (Redrawn from Hirn)..... 36
Fig. 15. **B. subintermedia** Elfving. (Redrawn from Hirn)..... 36
Fig. 16. **B. diamesandria** Nordstedt and Hirn. (Redrawn from Hirn)..... 38
Fig. 17. **B. nordstedtii** Wittrock..... 37
Fig. 18. **B. nordstedtii** f. **suberecta** Collins..... 37

PLATE III.



Page

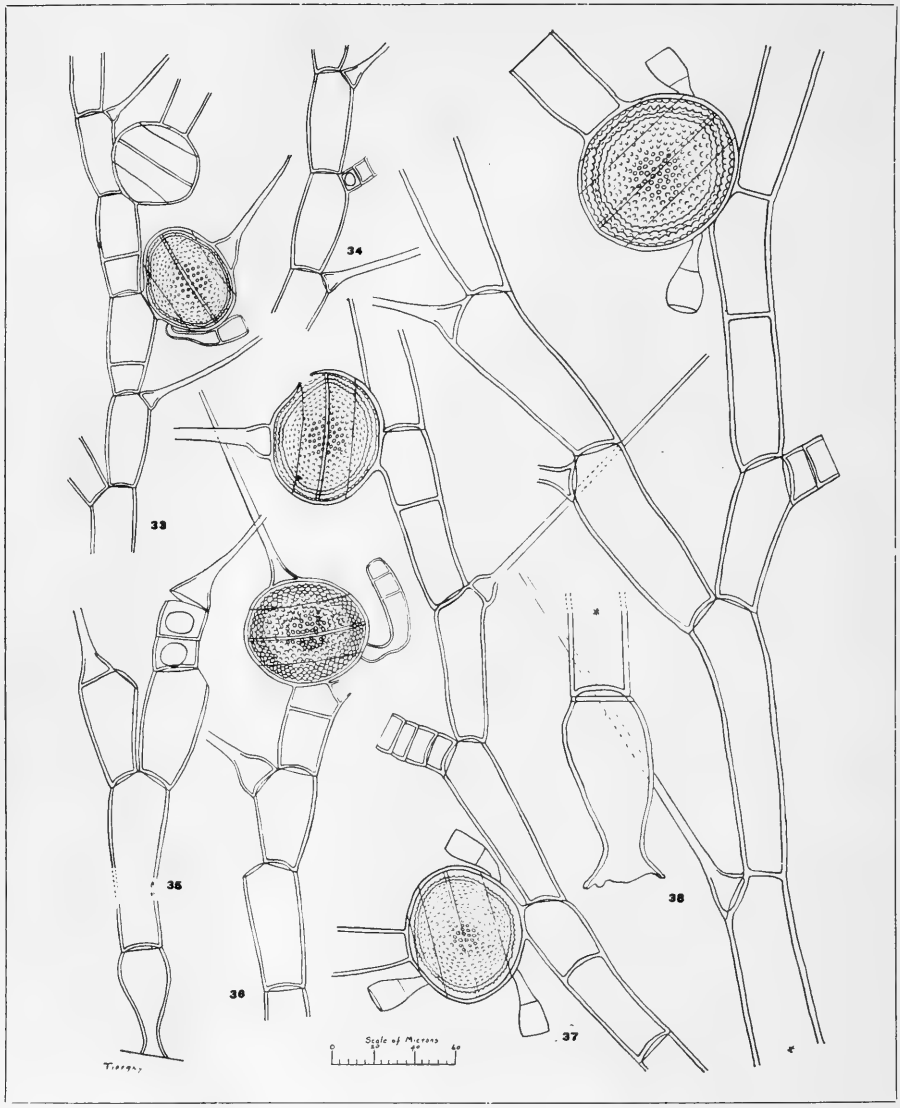
Fig. 19. **Bulbochaete sessilis** Wittrock. (Redrawn from Hirn)..... 39
Fig. 20. **B. sessilis** f. **glabra** Hirn. (Redrawn from Hirn)..... 39
Fig. 21. **B. elachistandria** Wittrock. (Redrawn from Pringsheim)..... 39
Fig. 22. **B. quadrata** Wittrock. (Redrawn from Hirn)..... 42
Fig. 23. **B. dispar** Wittrock. (Redrawn from Hirn)..... 40
Figs. 24 and 25. **B. dispar** v. **ripartiana** Wittrock. (After Hirn)..... 41
Fig. 26. **B. obliqua** Lundell. (After Hirn)..... 39



Page

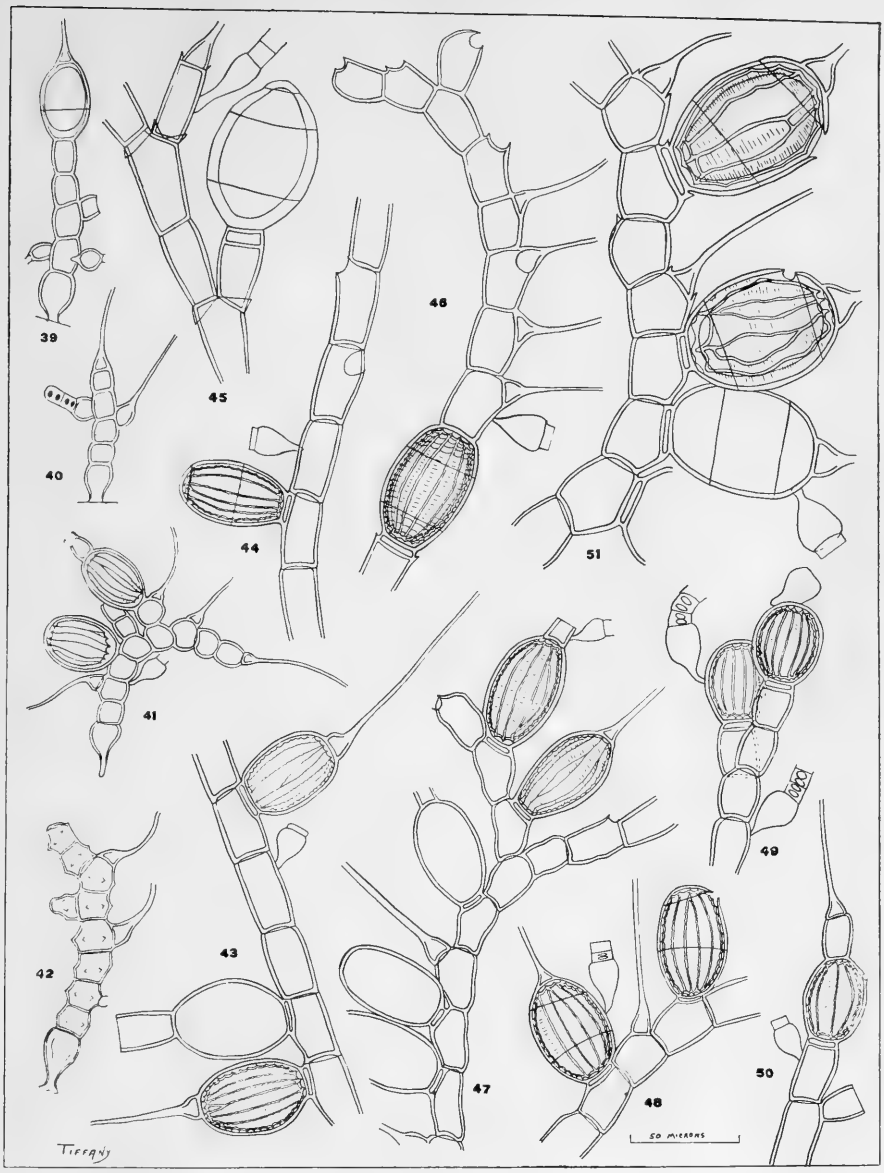
Fig. 27. **Bulbochaete valida** Wittrock. (Redrawn from Hirn)..... 42
Fig. 28. **B. crassiuscula** Nordstedt, with androsporangia. (After Nordstedt).. 41
Fig. 29. **B. crassiuscula** Nordstedt, with oogonia. (After Hirn)..... 41
Fig. 30. **B. pyrulum** Lundell. (Redrawn from Hirn)..... 43
Fig. 31. **B. punctulata** (Nordstedt) Hirn. (After Nordstedt)..... 41
Fig. 32. **B. crassa** Pringsheim..... 41

PLATE V.



Page

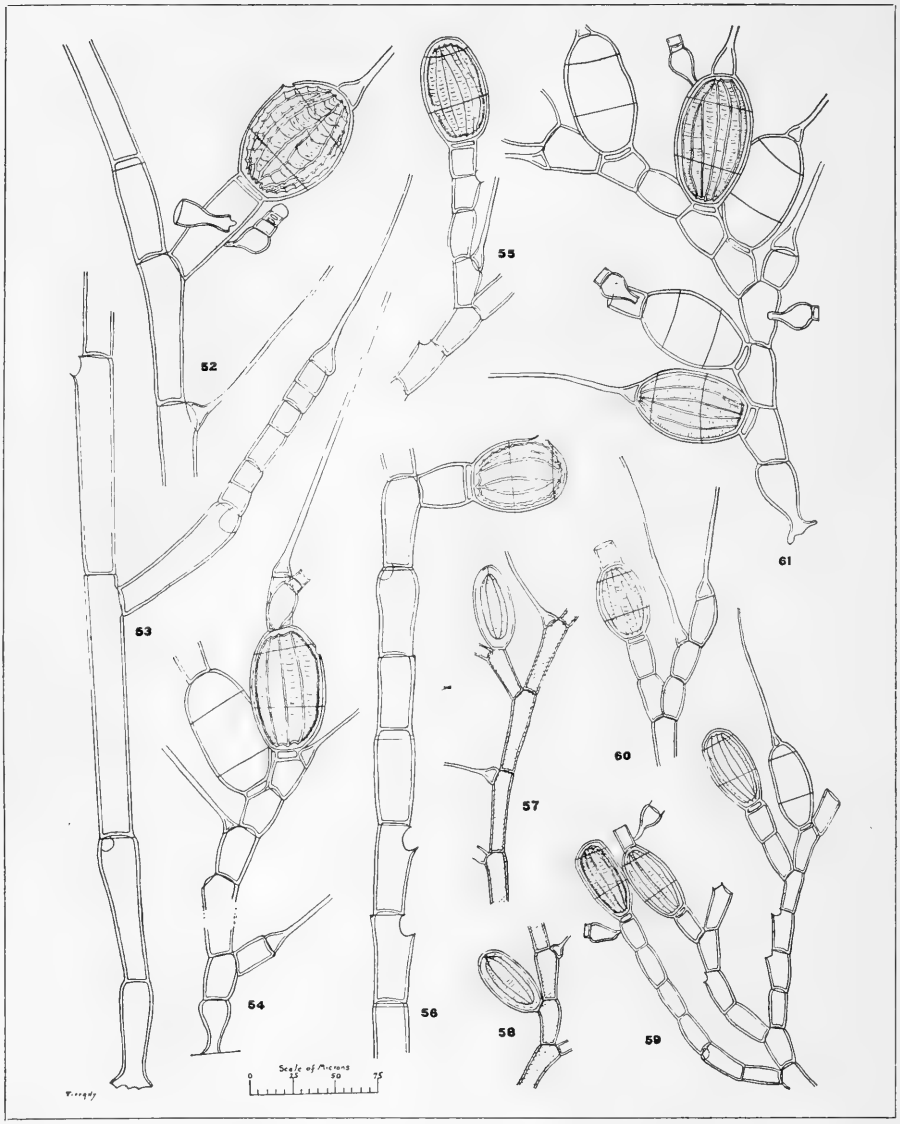
Figs. 33 and 34. **Bulbochaete congener** Hirn..... 42
Figs. 35 and 36. **B. gigantea** Pringsheim..... 38
Fig. 37. **B. setigera** (Roth) Agardh..... 40
Fig. 38. **B. alabamensis** Transeau and Brown..... 40



Page

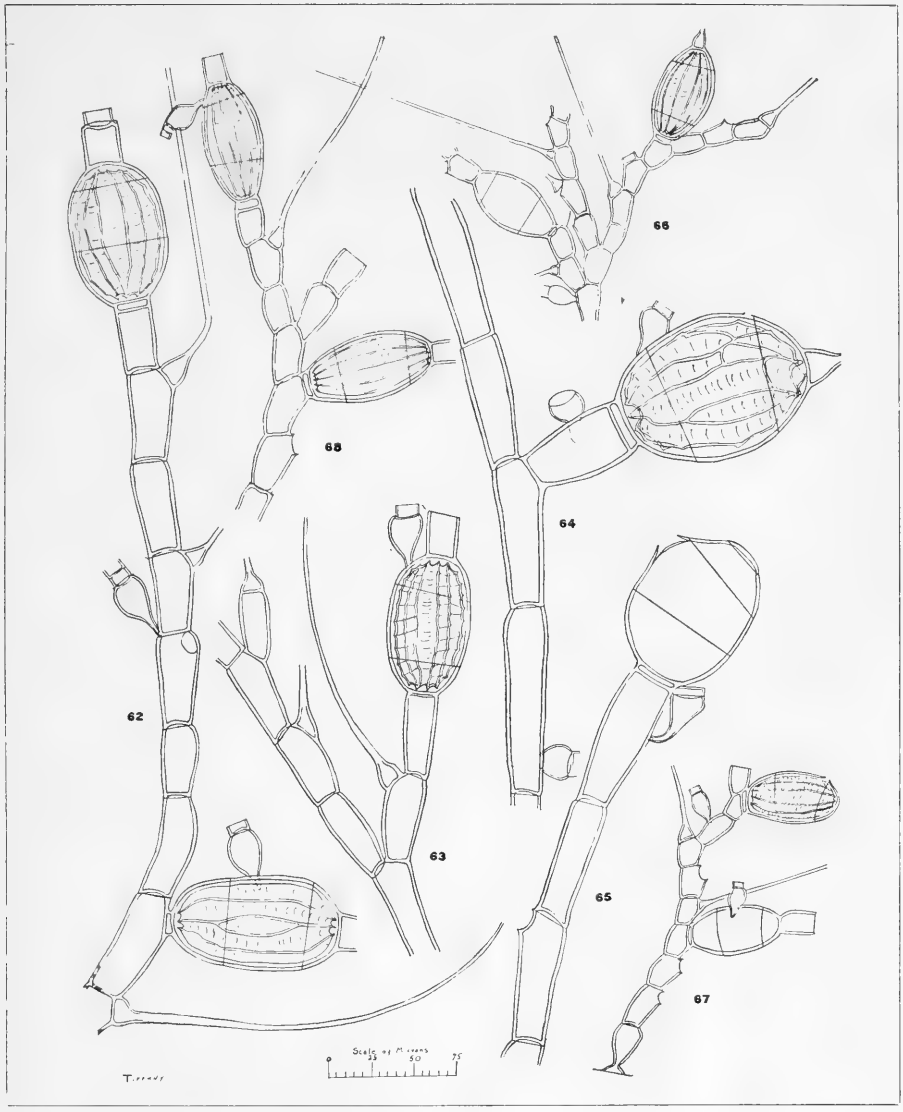
Figs. 39 and 40. **Bulbochaete doliiformis** Borge. (Redrawn from Borge)..... 43
Fig. 41. **B. pygmaea** Pringsheim..... 43
Fig. 42. **B. horrida** Nordstedt. (Redrawn from Hirn)..... 50
Fig. 43. **B. rectangularis** Wittrock..... 45
Fig. 44. **B. rectangularis** v. **hiloensis** Nordstedt. (After Hirn)..... 45
Fig. 45. **B. anomala** Pringsheim. (After Pringsheim)..... 48
Fig. 46. **B. lagoensis** Wittrock. (Redrawn from Hirn)..... 46
Fig. 47. **B. repanda** Wittrock..... 44
Fig. 48. **B. varians** Wittrock..... 45
Fig. 49. **B. varians** v. **subsimplex** (Wittrock) Hirn..... 45
Fig. 50. **B. varians** v. **hawaiensis** Nordstedt..... 46
Fig. 51. **B. denticulata** Wittrock. (Redrawn from Hirn)..... 48

PLATE VII.



Page

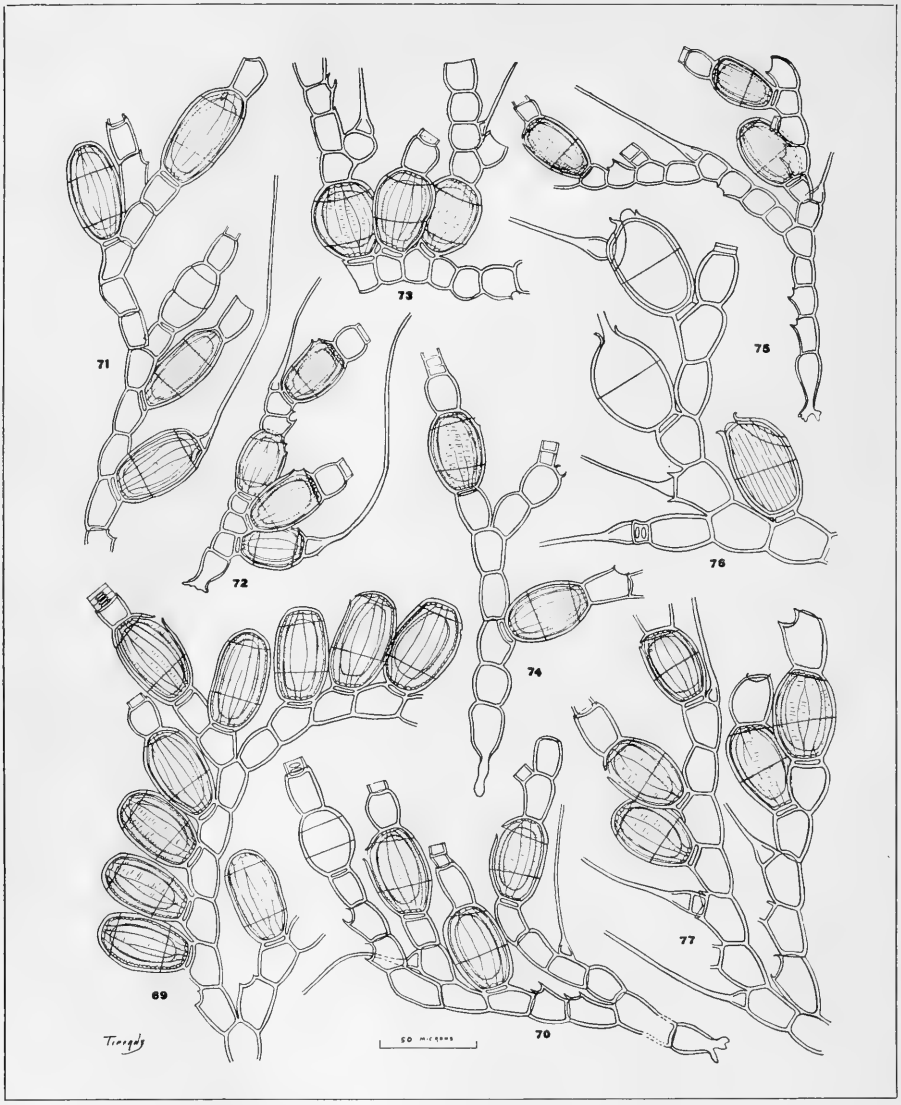
Figs. 52 and 53. **Bulbochaete bullardi** Transeau and Tiffany..... 47
Fig. 54. **B. minor** Al. Braun; Wittrock..... 47
Fig. 55. **B. minor** v. **germanica** Hirn. (After Hirn)..... 47
Fig. 56. **B. brevifulta** Wittrock. (Redrawn from Hirn)..... 50
Figs. 57 and 58. **B. spirogranulata** West and West. (Redrawn from G. S. West) 49
Fig. 59. **B. tenuis** (Wittrock) Hirn. (Redrawn from Hirn)..... 43
Fig. 60. **B. tenuis** v. **norvegica** (Wittrock) Hirn. (Redrawn from Hirn)..... 44
Fig. 61. **B. affinis** Hirn. (Redrawn from Hirn)..... 48



Page

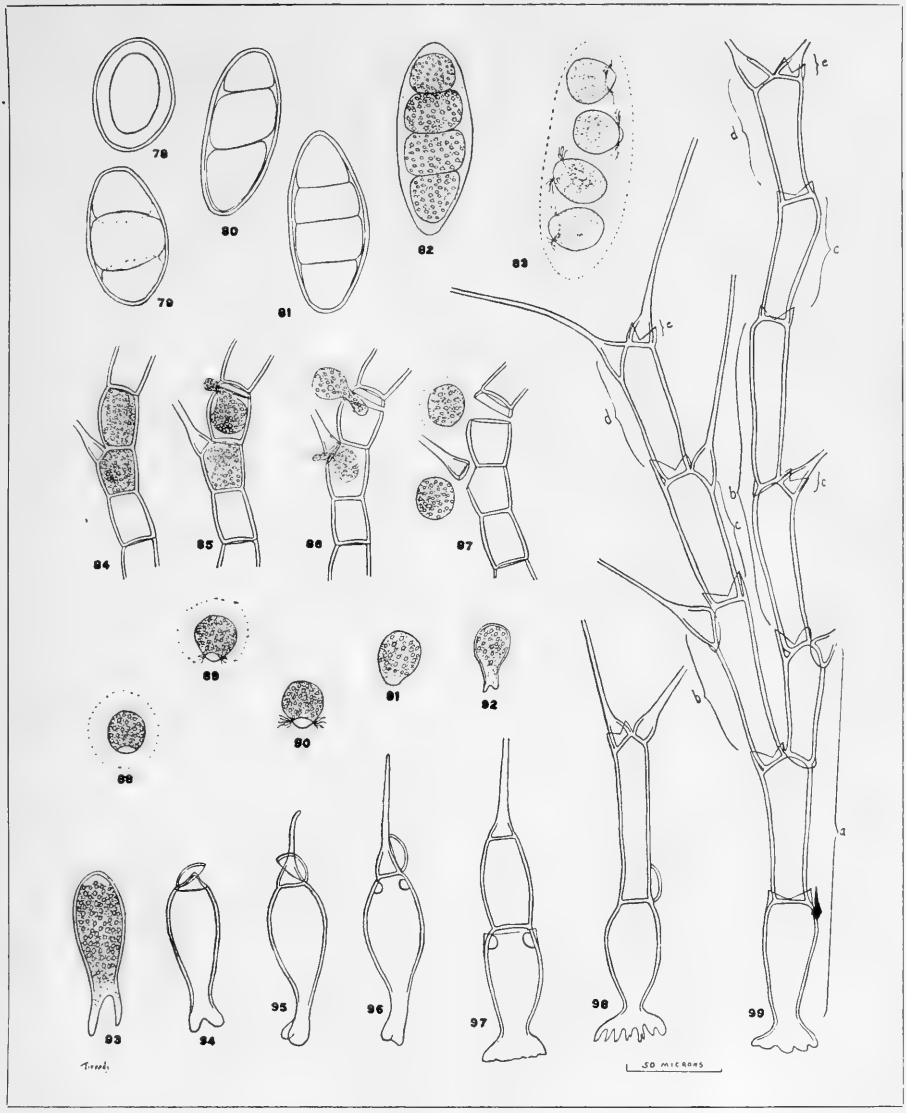
Fig. 62. **Bulbochaete insignis** Pringsheim 48
Fig. 63. **B. insignis** v. **reticulata** (Nordstedt) Hirn. (After Hirn) 49
Fig. 64. **B. imperialis** Wittrock. (Redrawn from Hirn) 49
Fig. 65. **B. imperialis** v. **regalis** Wittrock. (Redrawn from Hirn) 49
Fig. 66. **B. rhadinospora** Wittrock. (After Hirn) 46
Fig. 67. **B. rhadinospora** f. **antiqua** (Nordstedt) Hirn. (After Hirn) 46
Fig. 68. **B. rhadinospora** v. **litoralis** Hirn. (After Hirn) 47

PLATE IX.



Page

Fig. 69. **Bulbochaete mirabilis** Wittrock. (Redrawn from Hirn)..... 32
Fig. 70. **B. mirabilis** f. **immersa** (Wittrock) Hirn. (Redrawn from Hirn)..... 32
Fig. 71. **B. mirabilis** v. **gracilis** (Pringsheim) Hirn. (Redrawn from Hirn).... 32
Fig. 72. **B. monile** Wittrock and Lundell. (Redrawn from Hirn)..... 30
Fig. 73. **B. monile** v. **robusta** Hirn. (Redrawn from Hirn)..... 30
Fig. 74. **B. basispora** Wittrock and Lundell..... 31
Fig. 75. **B. nana** Wittrock. (Redrawn from Hirn)..... 30
Fig. 76. **B. megastoma** Wittrock and Lundell. (After Wittrock)..... 31
Fig. 77. **B. debaryana** Wittrock and Lundell. (Redrawn from Hirn)..... 31



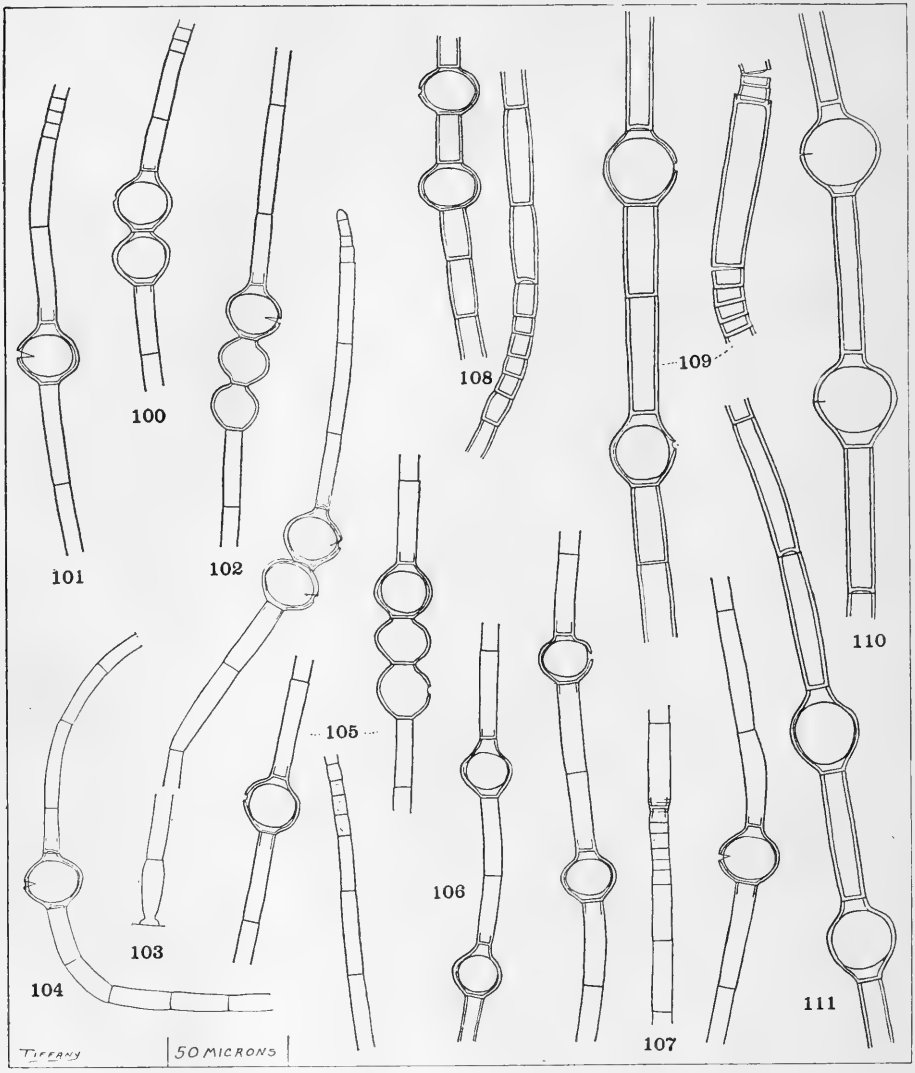
Figs. 78–83. Germination of oospore of **B. elachistandria** Wittrock. (After Pringsheim)

Figs. 84–92. Development and germination of zoospores of **B. varians** Wittrock v. **subsimplex** (Wittrock) Hirn.

Figs. 93–98. Development of bristle and first cell division of a germinated zoospore of **B. setigera** (Roth) Agardh. (After Pringsheim).

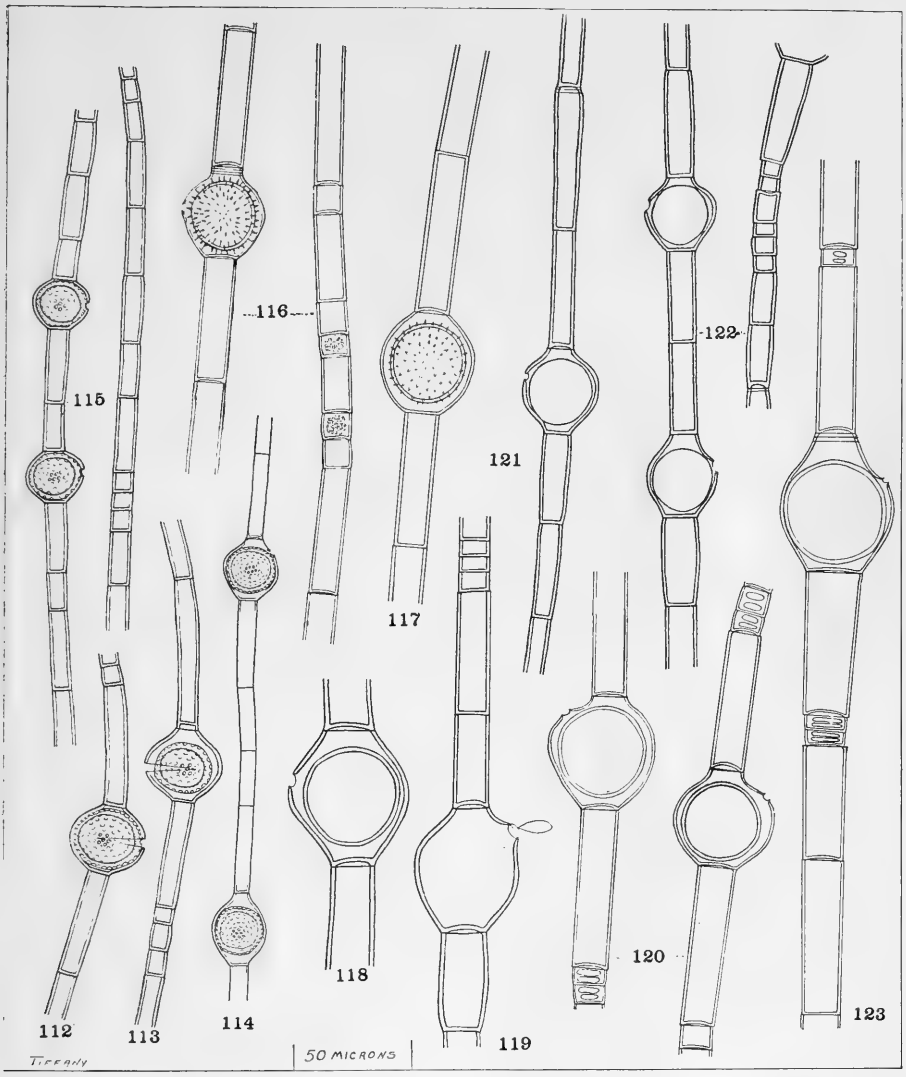
Fig. 99. A young plant of **B. setigera** (Roth) Agardh showing manner of branching: **a**, Primary filament developed from zoospore. **b**, Branch of the first order. **c**, **d**, **e**, Branches of the second, third, and fourth order, respectively. (Modified from Pringsheim).

PLATE XI.



Page

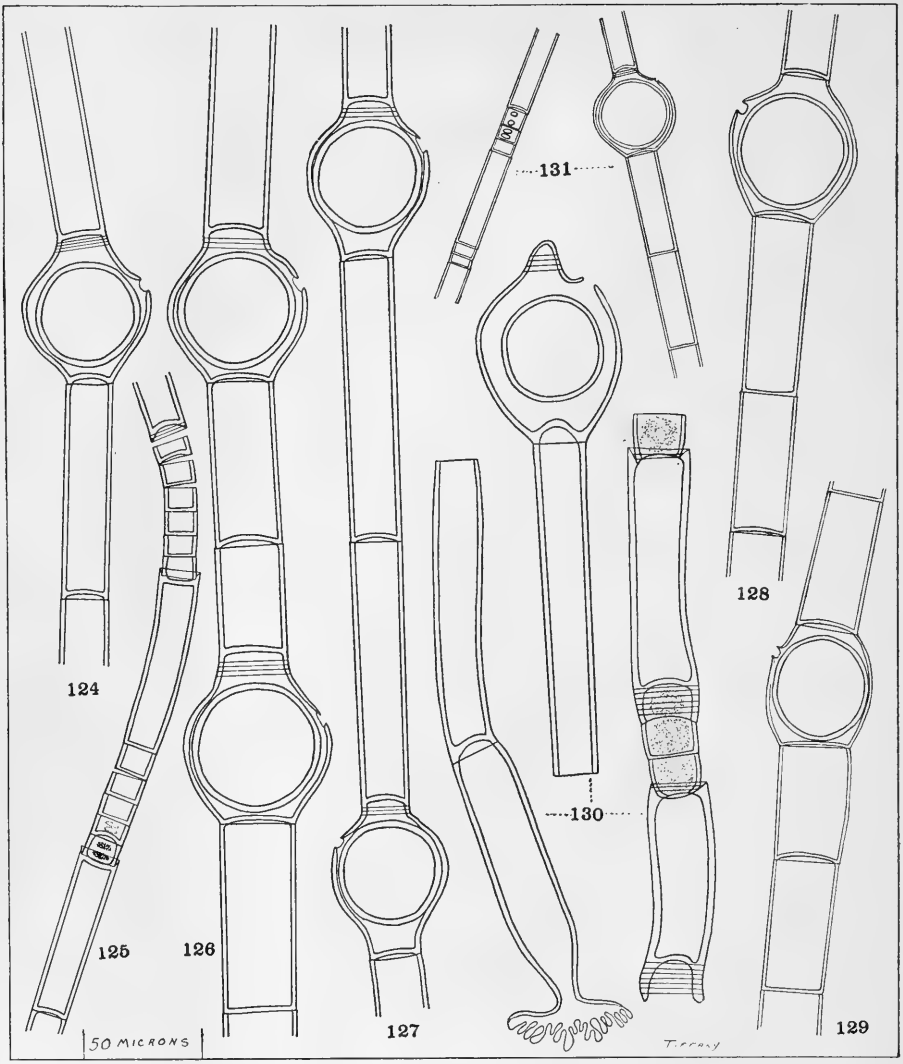
Fig. 100. **Oedogonium laeve** Wittr. 65
Fig. 101. **Oe. cryptoporum** Wittr. 65
Fig. 102. **Oe. cryptoporum** v. **vulgare** Wittr. (Redrawn from Hirn) 66
Figs. 103 and 104. **Oe. curvum** Pringsh. 65
Fig. 105. **Oe. rufescens** Wittr. (Redrawn from Hirn) 66
Fig. 106. **Oe. rufescens** v. **exiguum** (Elfv.) Tiffany 66
Fig. 107. **Oe. rufescens** v. **lundellii** (Wittr.) Tiffany. (Redrawn from Hirn) .. 66
Fig. 108. **Oe. calcareum** Cleve. (Redrawn from Hirn) 67
Fig. 109. **Oe. sociale** Wittr. (Redrawn from Hirn) 67
Fig. 110. **Oe. inerme** Hirn. (Redrawn from Hirn) 166
Fig. 111. **Oe. inerme** v. **mentiens** Hirn. (Redrawn from Hirn) 166

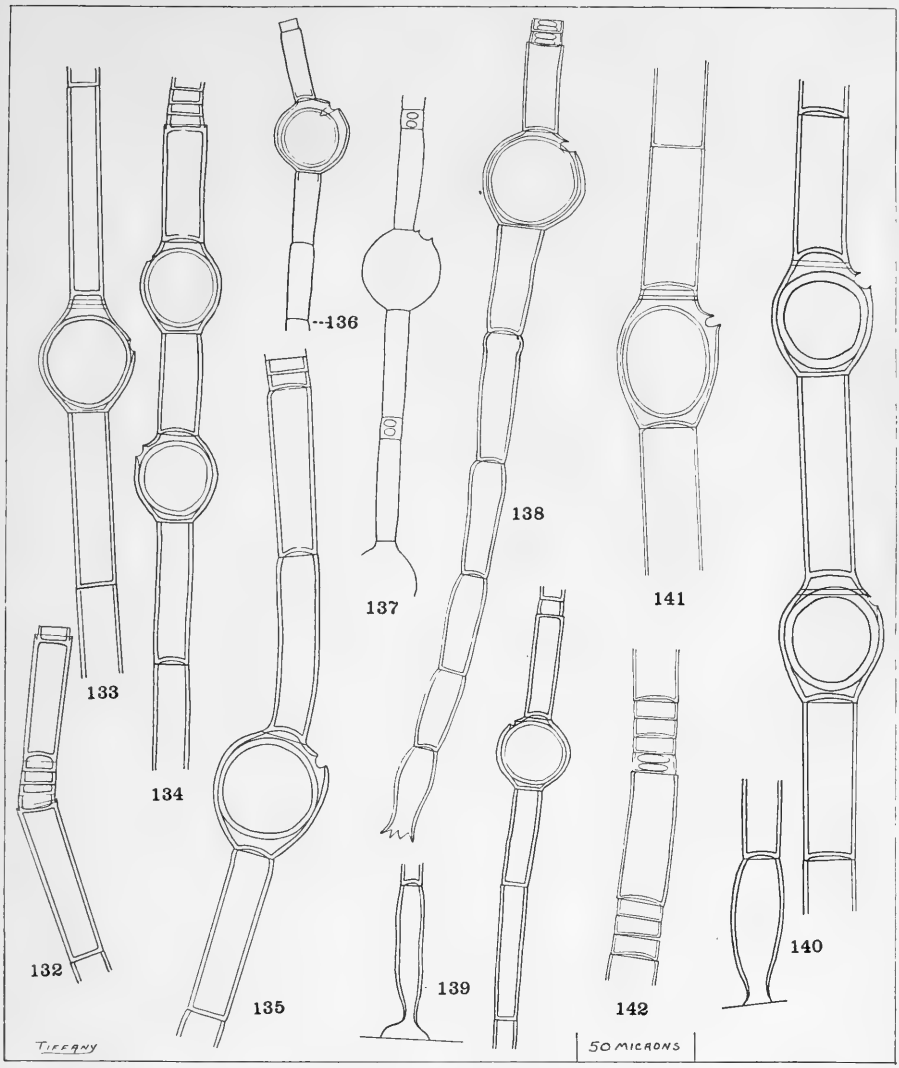


Page

Figs. 112 and 113. **Oedogonium cymatosporum** Wittr. and Nordst. (Redrawn from Hirn) 67
Fig. 114. **Oe. moniliforme** Wittr. 166
Fig. 115. **Oe. magnusii** Wittr. (Redrawn from Hirn) 68
Fig. 116. **Oe. suecicum** Wittr. 68
Fig. 117. **Oe. suecicum** f. **australe** G. S. West. (Redrawn from West) 68
Figs. 118 and 119. **Oe. urbicum** Wittr. (Redrawn from Pringsheim) 69
Fig. 120. **Oe. varians** Wittr. and Lund 69
Fig. 121. **Oe. obsoletum** Wittr. (Redrawn from Hirn) 69
Fig. 122. **Oe. plusiosporum** Wittr. (Redrawn from Hirn) 70
Fig. 123. **Oe. tyrolicum** Wittr 70

PLATE XIII.

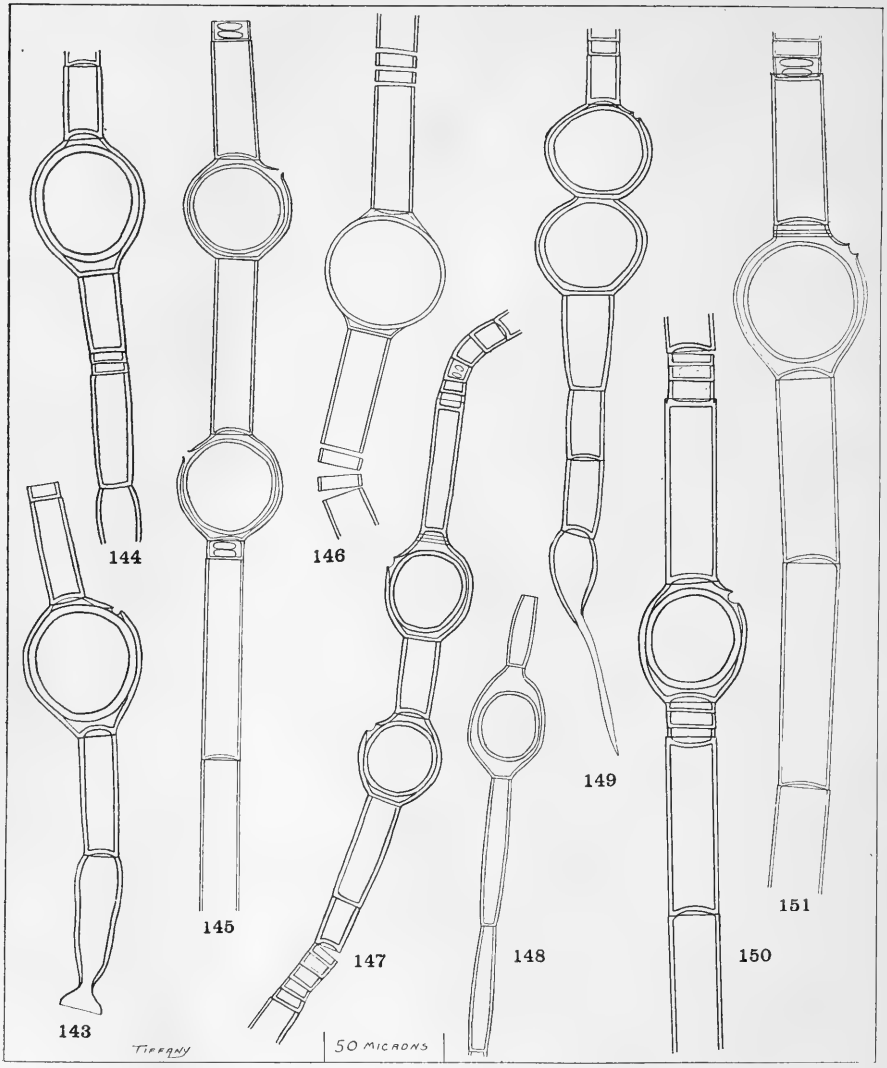




Page

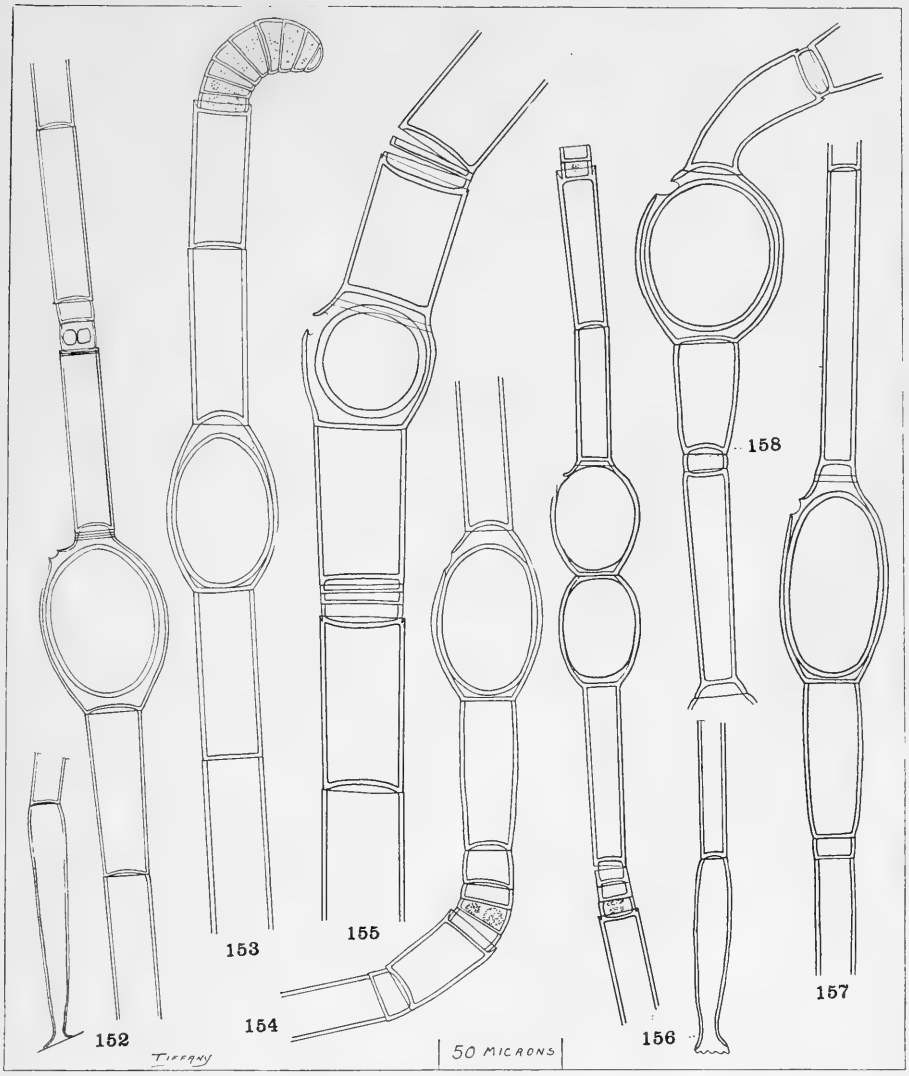
Figs. 132 and 133. **Oedogonium lautumniarum** Wittr. (Redrawn from Hirn).. 72
Fig. 134. **Oe. intermedium** Wittr..... 72
Fig. 135. **Oe. intermedium** v. **fennicum** Tiffany..... 73
Fig. 136. **Oe. hirnii** Gutw. (Redrawn from W. and G. S. West)..... 73
Fig. 137. **Oe. hirnii** Gutw. (Redrawn from Gutwinski)..... 73
Fig. 138. **Oe. hirnii** v. **africanum** G. S. West..... 73
Fig. 139. **Oe. globosum** Nordst. (Redrawn from Hirn)..... 74
Fig. 140. **Oe. plagiostomum** Wittr. (Redrawn from Hirn)..... 80
Figs. 141 and 142. **Oe. plagiostomum** v. **gracilius** Wittr..... 81

PLATE XV.



Page

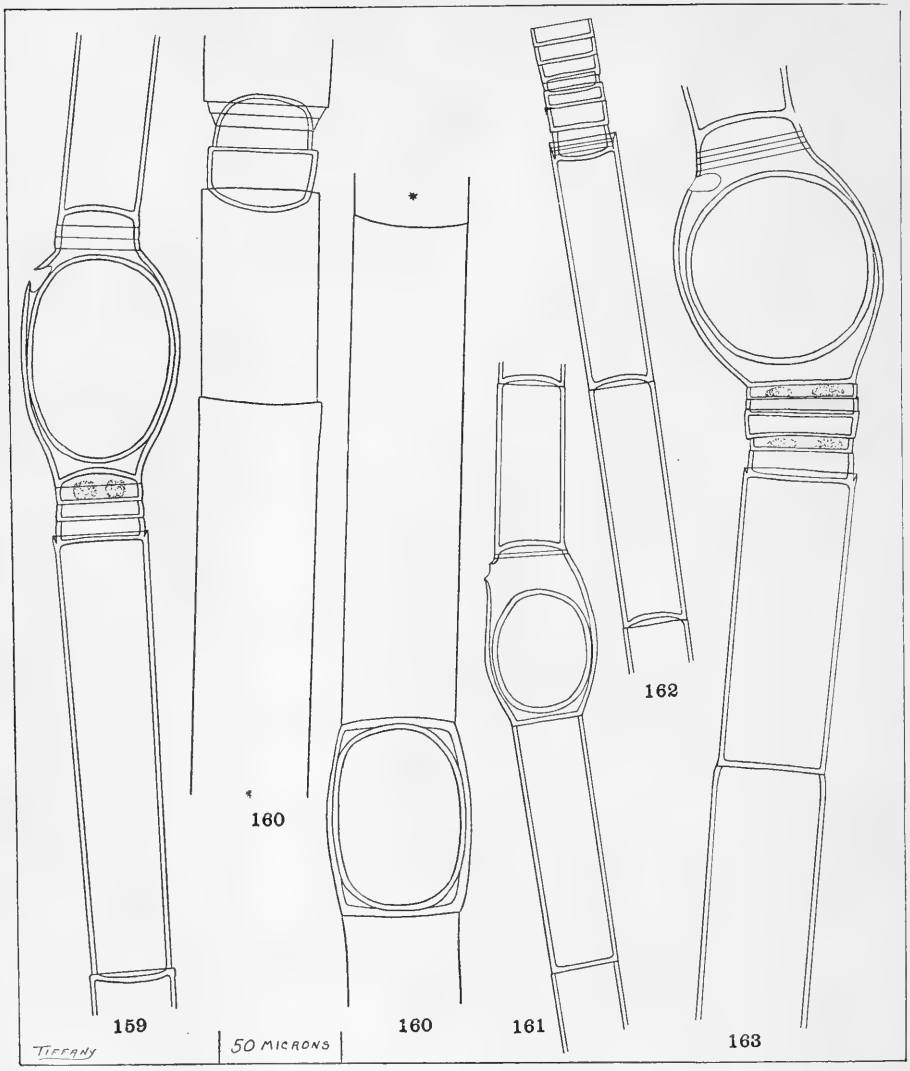
Figs. 143 and 144. **Oedogonium zigzag** Cleve. (Redrawn from Hirn)..... 74
Fig. 145. **Oe. fragile** Wittr..... 75
Fig. 146. **Oe. fragile** v. **robustum** (W. and W.) Tiffany. (Redrawn from West)..... 75
Fig. 147. **Oe. fragile** v. **abyssinicum** Hirn. (Redrawn from Hirn)..... 75
Fig. 148. **Oe. warmingianum** Wittr. (Redrawn from Hirn).....169
Fig. 149. **Oe. curtum** Wittr. and Lund. (Redrawn from Hirn)..... 74
Figs. 150 and 151. **Oe. vaucherii** (Le Cl.) A. Br.; Wittr..... 76



Page

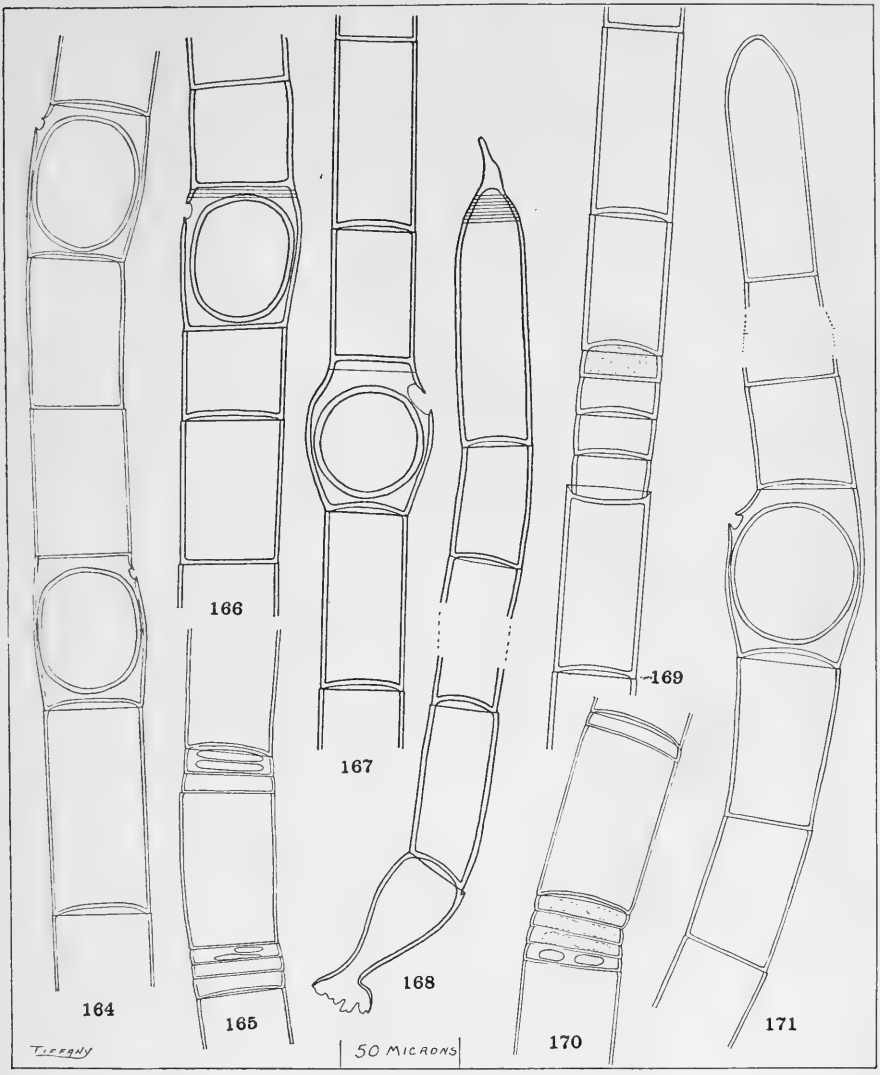
Fig. 152. **Oedogonium oviforme** (Lewin) Hirn..... 78
Figs. 153 and 154. **Oe. sodiroanum** Lagerh..... 77
Fig. 155. **Oe. geniculatum** Hirn..... 78
Fig. 156. **Oe. richterianum** Lemm. (Redrawn from Hirn)..... 76
Fig. 157. **Oe. upsaliense** Wittr..... 77
Fig. 158. **Oe. upsaliense** v. **fennicum** Hirn. (Redrawn from Hirn)..... 78

PLATE XVII.



Page

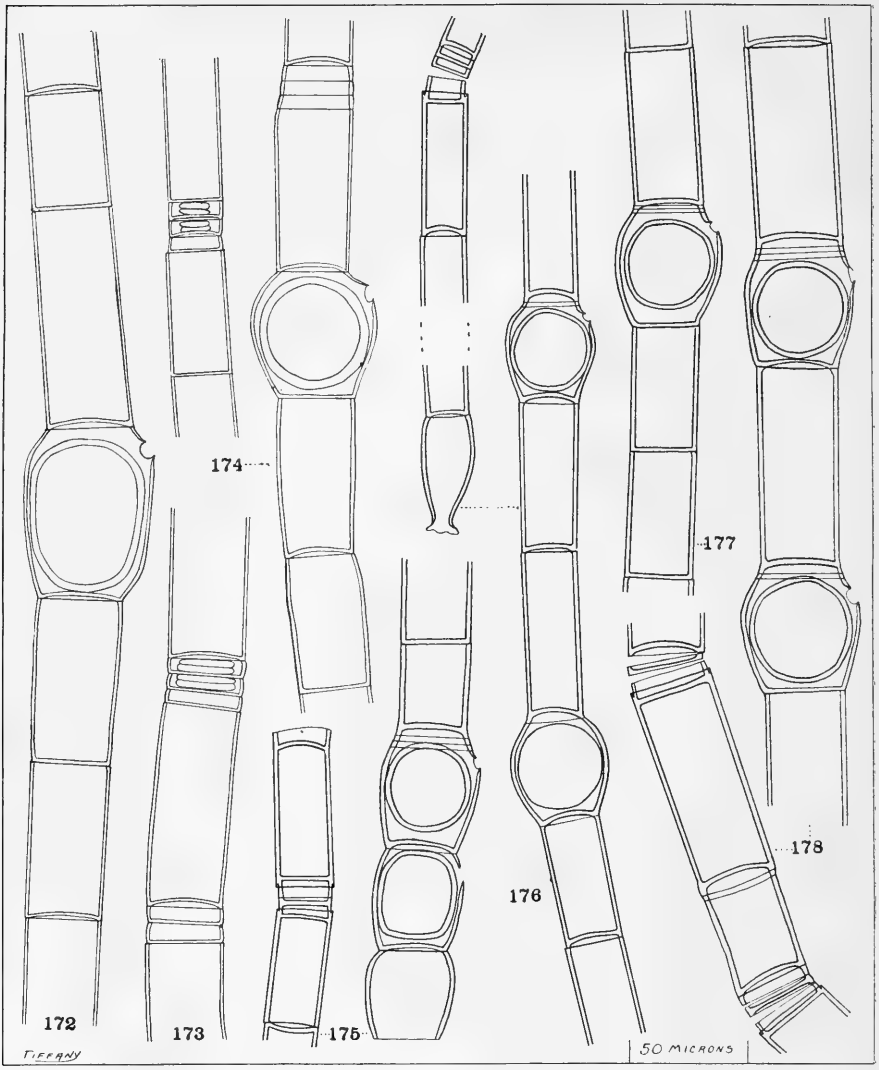
Fig. 159. **Oedogonium martinicense** Hirn. (Redrawn from Hirn)..... 79
Fig. 160. **Oe. suboctangulare** West and West. (Redrawn from West)..... 79
Figs. 161 and 162. **Oe. biforme** Nordst. (Redrawn from Hirn)..... 83
Fig. 163. **Oe. kurzii** Zeller. (Redrawn from Hirn)..... 79



Page

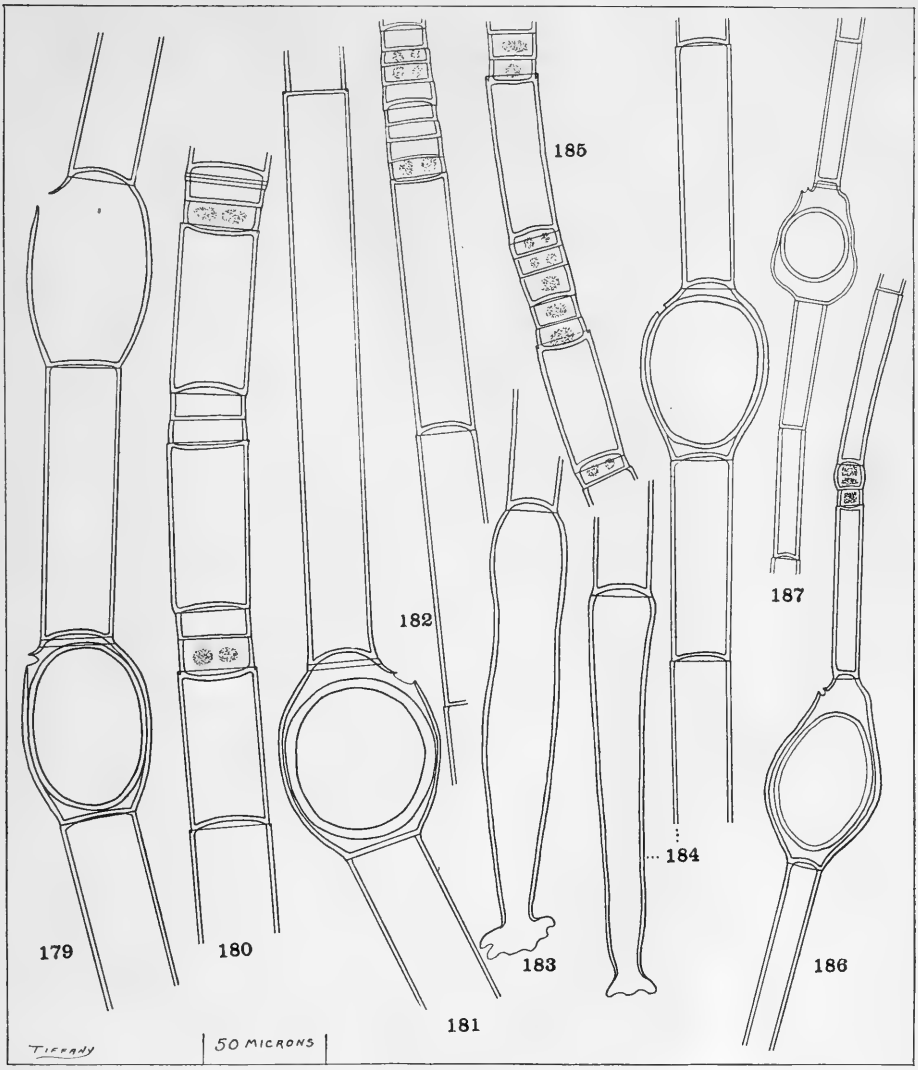
Figs. 164 and 165. **Oedogonium capillare** (L.) Kuetz..... 80
Fig. 166. **Oe. capillare** f. **stagnale** (Kuetz.; Wittr.) Hirn. (Redrawn from Hirn)..... 80
Figs. 167–169. **Oe. princeps** (Hass.) Wittr..... 82
Figs. 170 and 171. **Oe. anomalum** Hirn..... 83

PLATE XIX.



Page

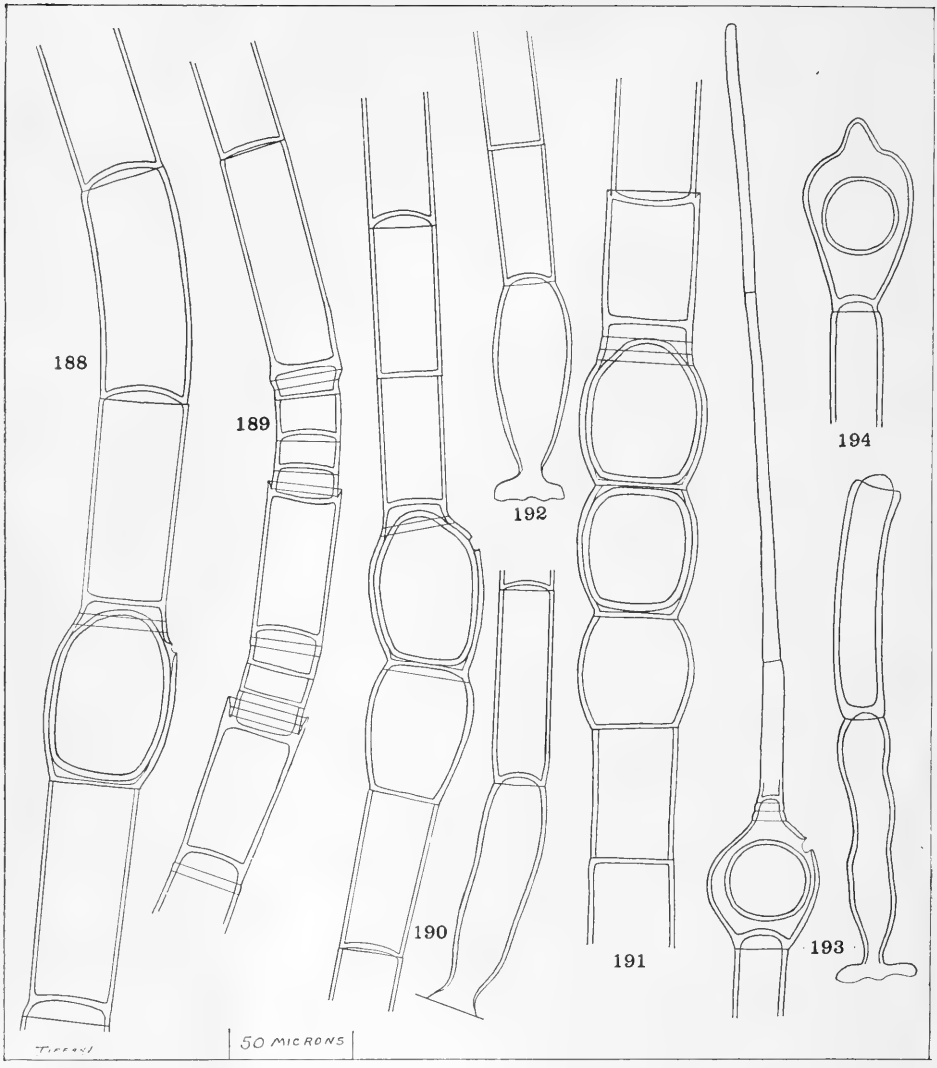
Figs. 172 and 173. **Oe. capilliforme** Kuetz.; Wittr..... 81
Fig. 174. **Oe. capilliforme** f. **debaryanum** (Chmiel.) Hirn..... 81
Fig. 175. **Oe. capilliforme** f. **lorentzii** (M. & W.) Hirn. (Redrawn from Hirn).. 81
Figs. 176 and 177. **Oe. capilliforme** v. **australe** Wittr..... 82
Fig. 178. **Oe. capilliforme** v. **diversum** (Hirn) Tiffany. (Redrawn from Hirn)..... 82



Page

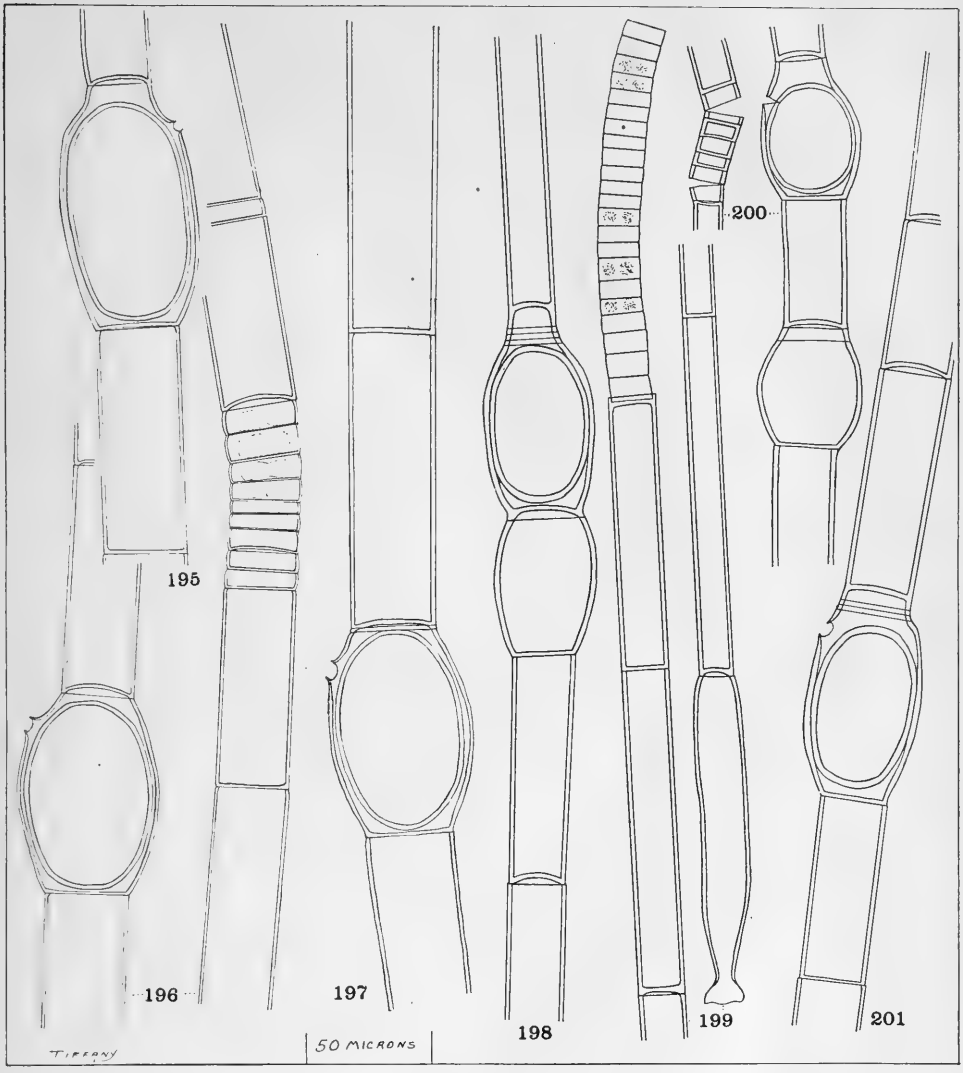
Figs. 179 and 180. **Oedogonium pachyandrium** Wittr. (Redrawn from Hirn).. 84
Figs. 181–183. **Oe. subrectum** Hirn. (Redrawn from Hirn)..... 87
Figs. 184 and 185. **Oe. oboviforme** Wittr. (Redrawn from Hirn)..... 86
Fig. 186. **Oe. pseudoboscii** Hirn. (Redrawn from Silfvenius)..... 76
Fig. 187. **Oe. lageniforme** Hirn. (Redrawn from Hirn).....168

PLATE XXI.



Page

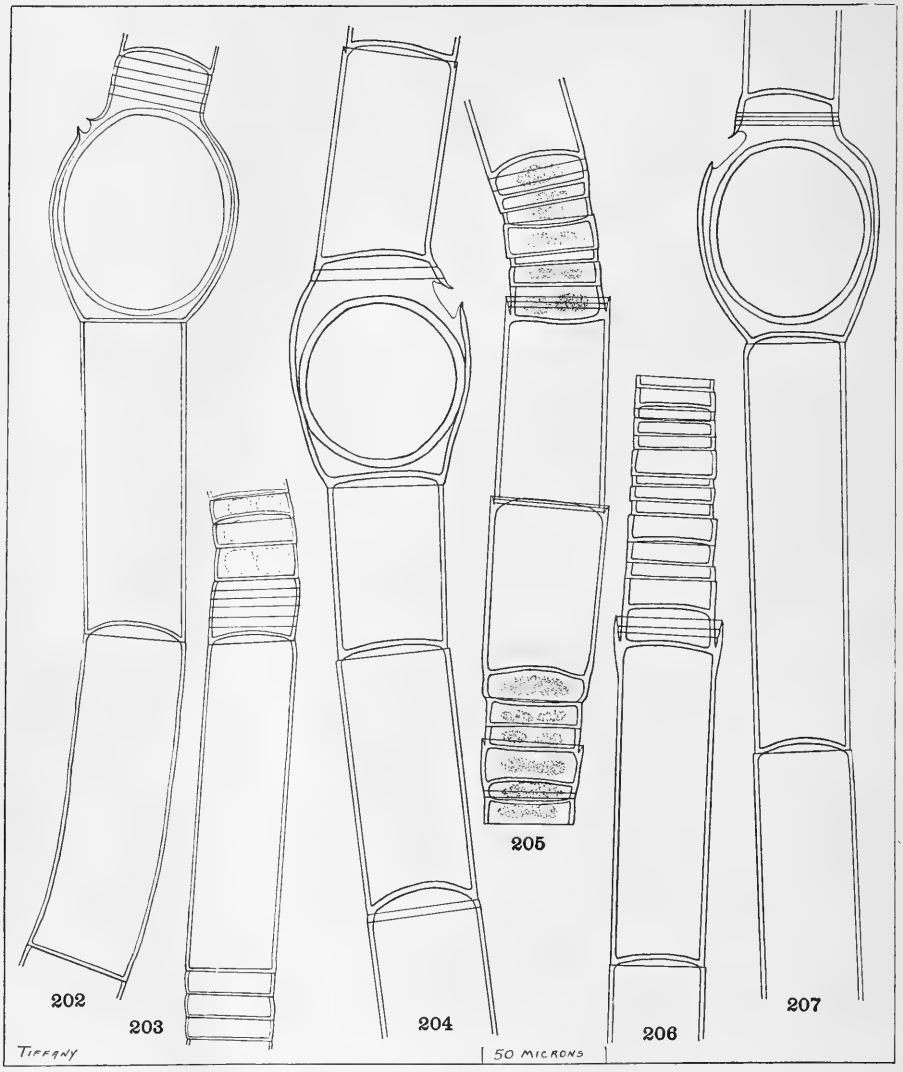
Figs. 188 and 189. **Oe. mexicanum** Wittr. (Redrawn from Hirn)..... 85
Fig. 190. **Oe. oryzae** Wittr. (Redrawn from Hirn).....163
Figs. 191 and 192. **Oe. oryzae** v. **seriosporum** (Lagerh.) Hirn. (Redrawn from Hirn).....164
Figs. 193 and 194. **Oe. inflatum** Hallas. (Redrawn from Hallas).....168



Page

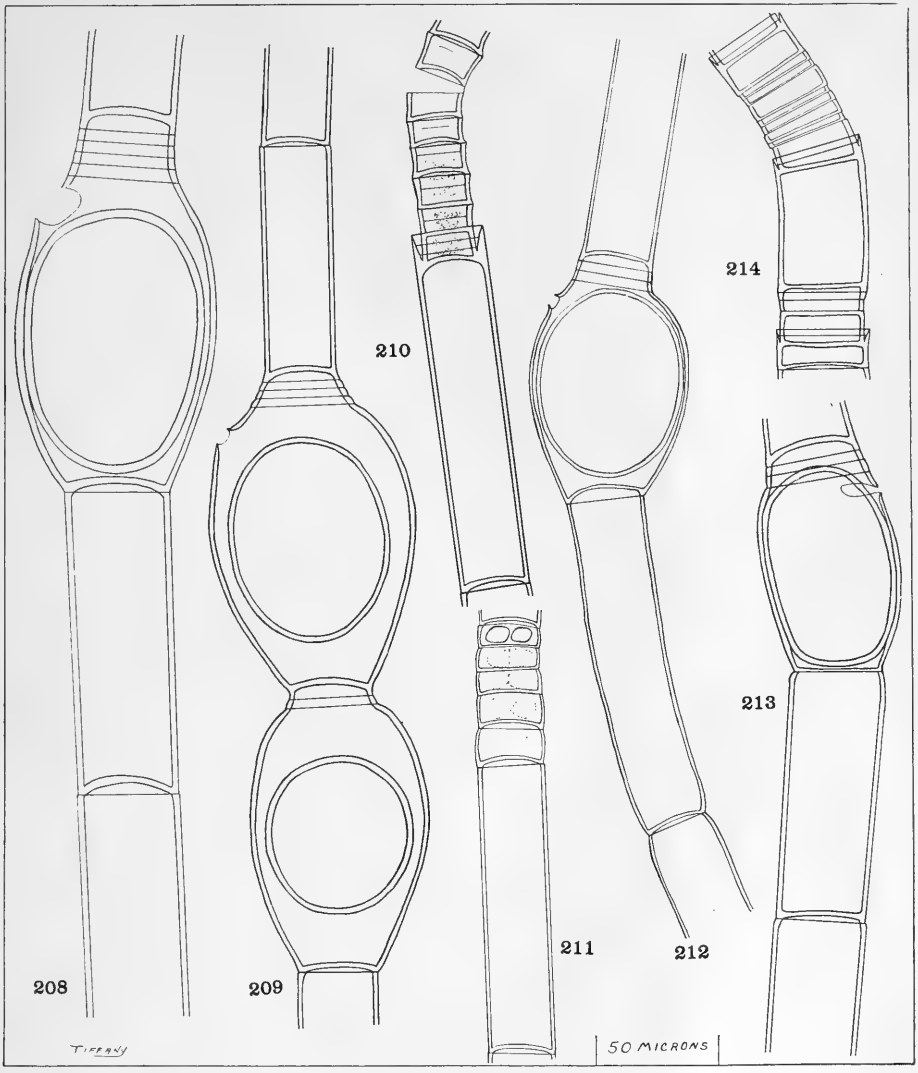
Figs. 195 and 196. **Oedogonium grande** Kuetz.; Wittr..... 85
Fig. 197. **Oe. grande** v. **majus** Hansg..... 86
Figs. 198 and 199. **Oe. grande** v. **angustum** Hirn. (Redrawn from Hirn)..... 86
Fig. 200. **Oe. grande** f. **gemelliparum** (Pringsh.) Hirn. (Redrawn from Hirn)..... 85
Fig. 201. **Oe. grande** v. **aequatoriale** Wittr. (Redrawn from Hirn)..... 85

PLATE XXIII.



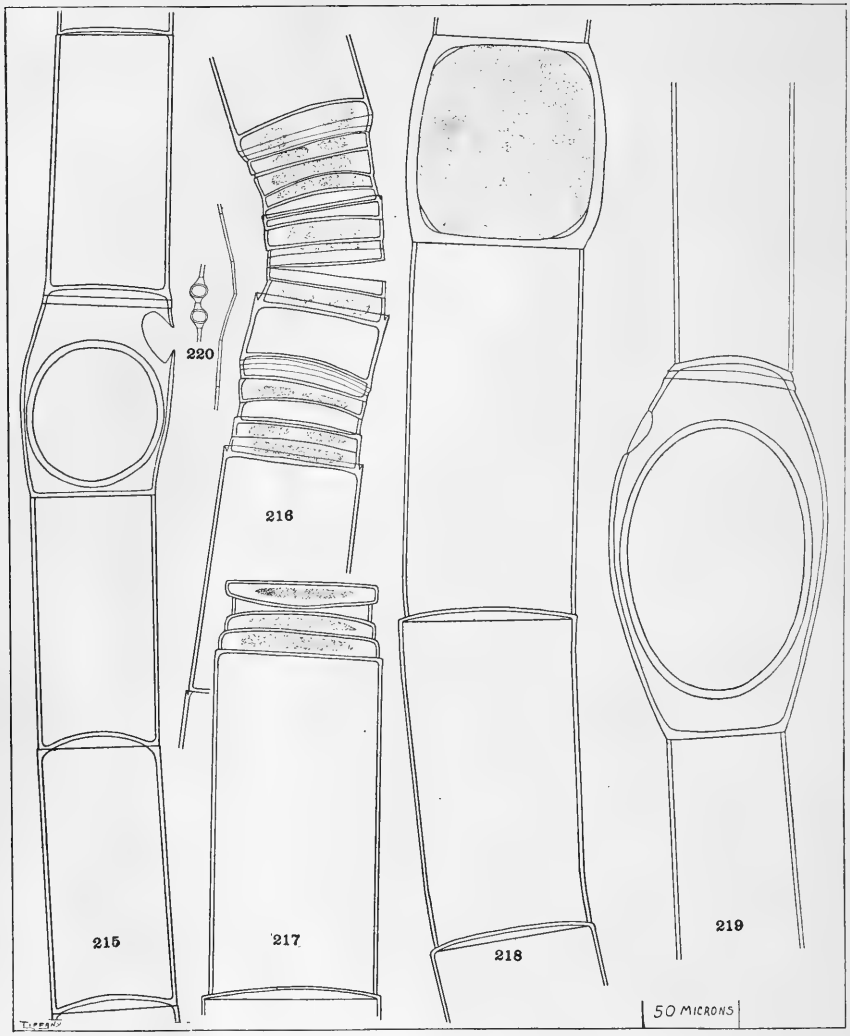
Page

Figs. 202 and 203. **Oedogonium crassum** (Hass.) Wittr..... 88
Figs. 204 and 205. **Oe. crassum** f. **amplum** (M. & W.) Hirn. (Redrawn from Hirn)..... 88
Figs. 206 and 207. **Oe. crassum** v. **subtumidum** Hirn. (Redrawn from Hirn).. 88



Page

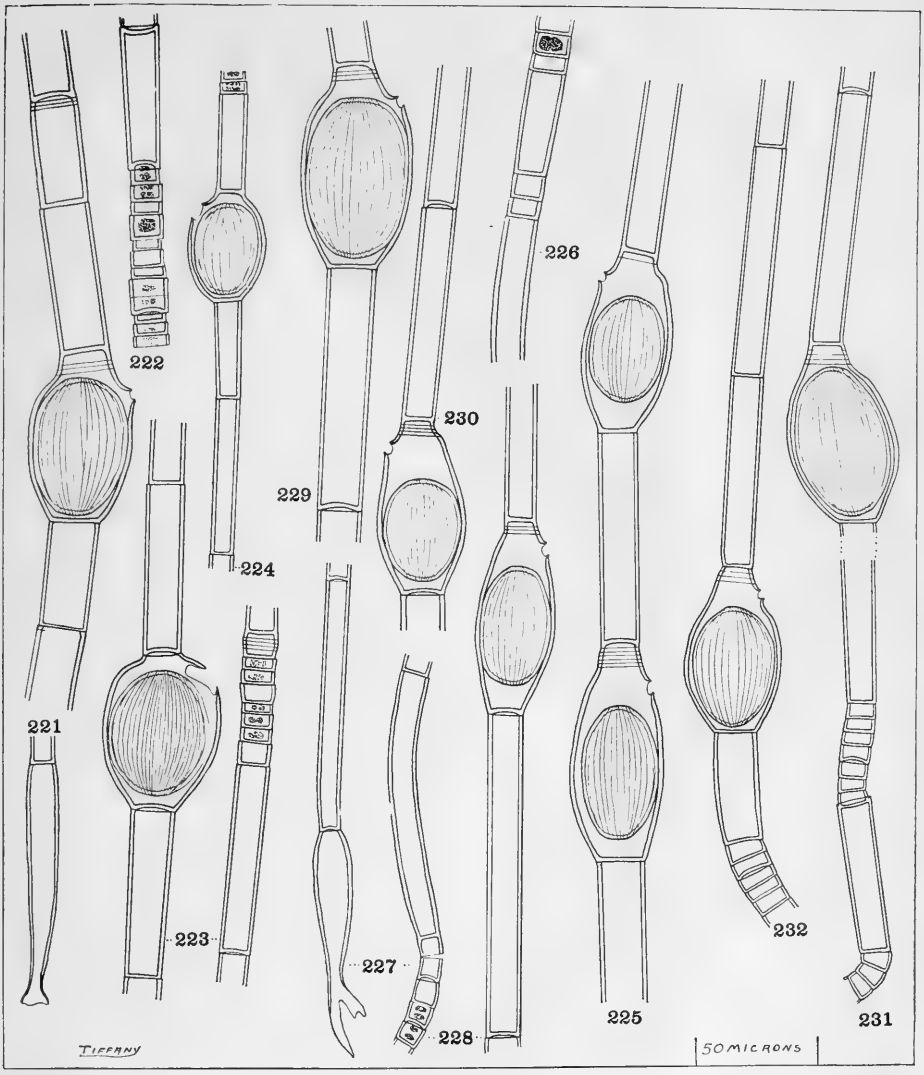
Fig. 208. **Oedogonium crassum** v. **longum** Transeau..... 88
Figs. 209 and 210. **Oe. rivulare** (Le Cl.) Al. Br. (Redrawn from Hirn)..... 84
Figs. 211 and 212. **Oe. landsboroughi** (Hass.) Wittr..... 87
Figs. 213 and 214. **Oe. landsboroughi** v. **norvegicum** Wittr..... 87



Page

Figs. 215 and 216. **Oedogonium fabulosum** Hirn. (Redrawn from Hirn)..... 83
Figs. 217 and 218. **Oe. fabulosum** v. **maximum** (West) Hirn. (Redrawn from West)..... 83
Fig. 219. **Oe. fabulosum** v. **columbianum** G. S. West. (Redrawn from West). 84
Fig. 220. **Oe. angustissimum** West and West. (Redrawn from West).....160

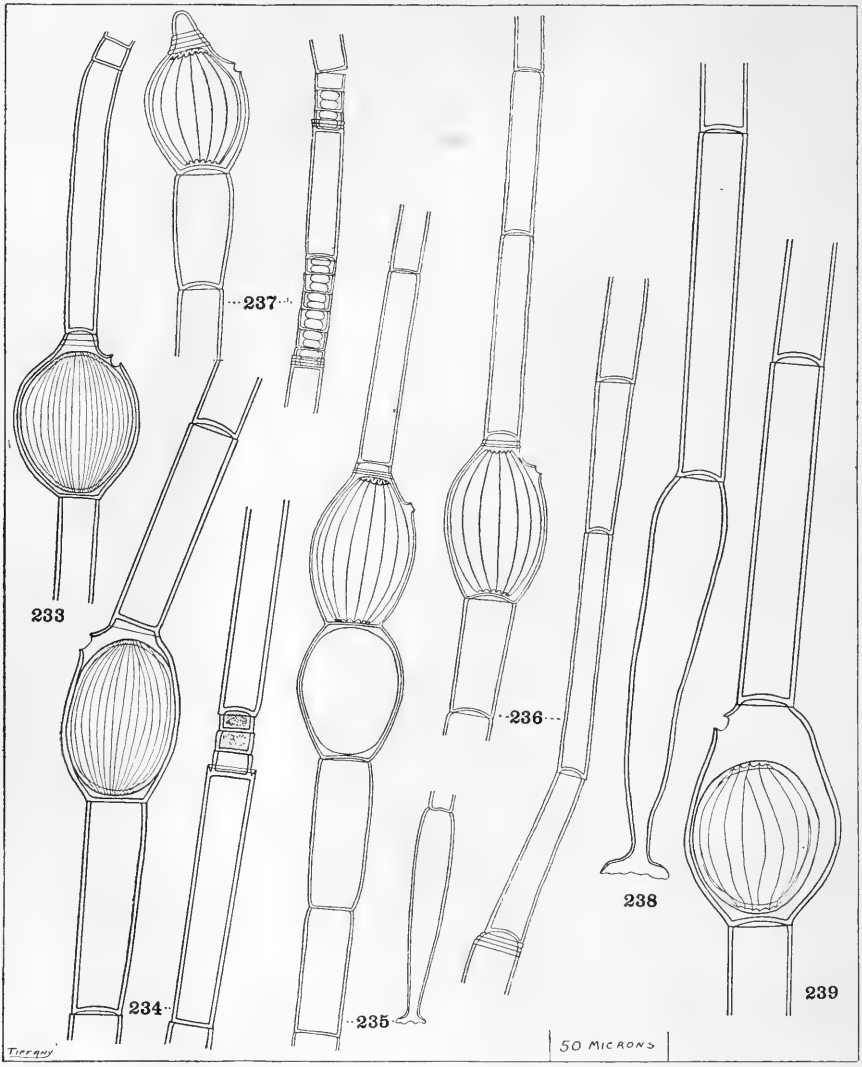
(This plate presents a comparison between the largest and smallest species of Oedogonium.)



Page

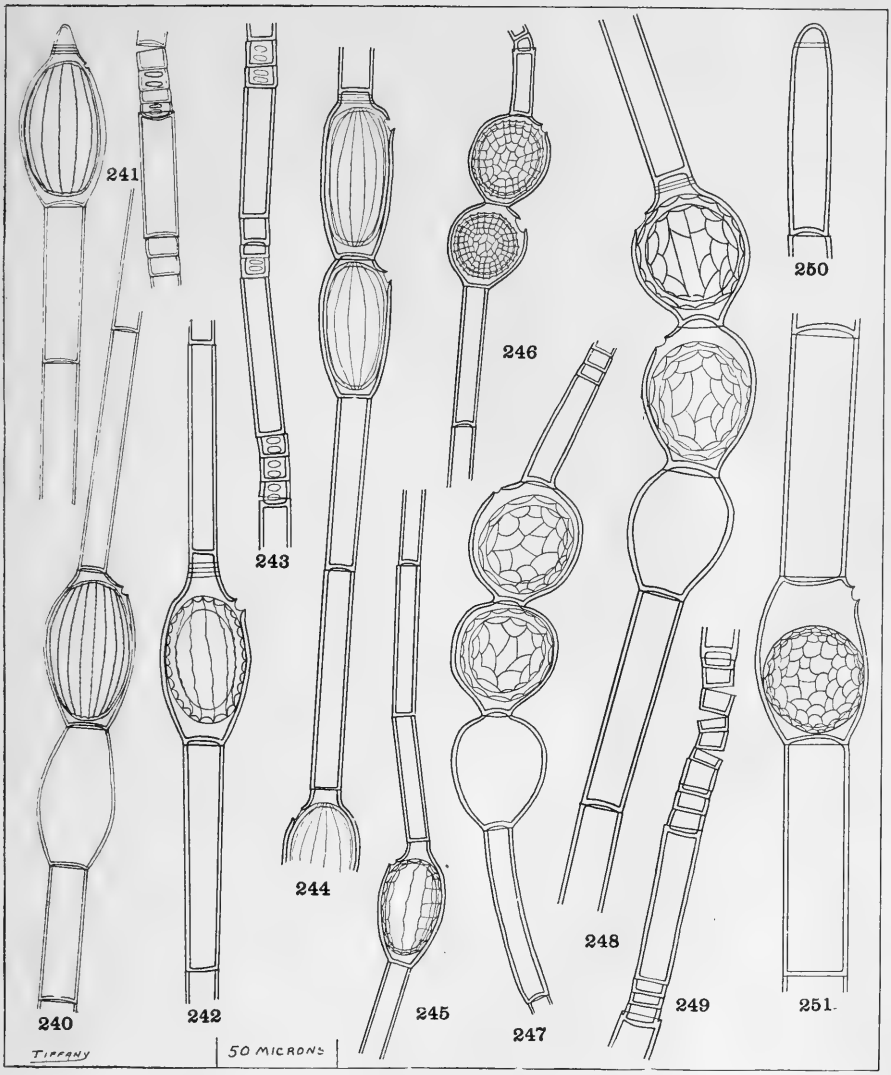
Figs. 221 and 222. **Oedogonium leiopleurum** Nord. and Hirn. (Redrawn from Hirn) 91
Fig. 223. **Oe. kjellmanii** Wittr.; Hirn. (Redrawn from Hirn) 89
Fig. 224. **Oe. paulense** Nord. and Hirn. (Redrawn from Schmidle) 90
Figs. 225 and 226. **Oe. boscii** (Le Cl.) Wittr 91
Figs. 227 and 228. **Oe. boscii** v. **occidentale** Hirn. (Redrawn from Hirn) 92
Fig. 229. **Oe. boscii** v. **notabile** Lemm. (Redrawn from Hirn) 92
Fig. 230. **Oe. boscii** f. **dispar** Hirn. (Redrawn from Hirn) 91
Fig. 231. **Oe. paludosum** (Hass.) Wittr 90
Fig. 232. **Oe. paludosum** v. **parvisporum** Hirn 90

PLATE XXVII.



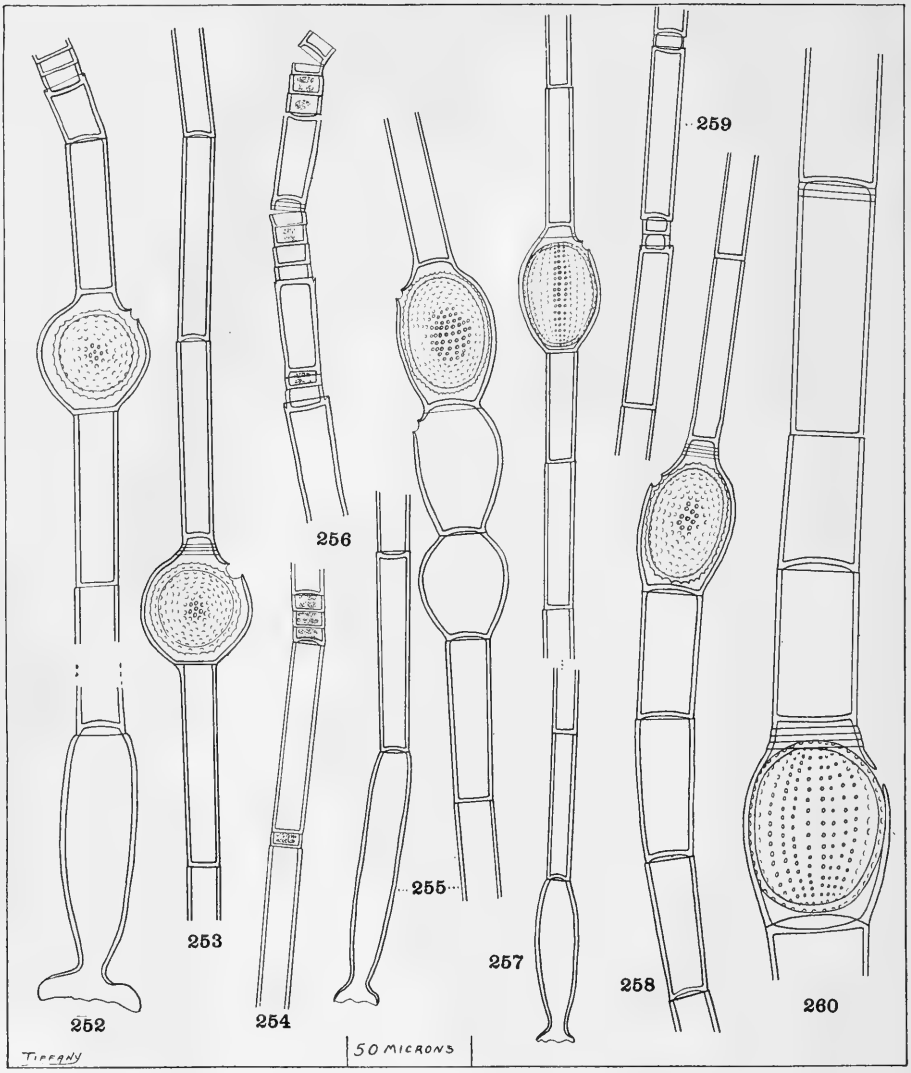
Page

Fig. 233. **Oedogonium paludosum** v. **americanum** Nord. (Redrawn from Hirn)..... 90
Fig. 234. **Oe. margaritiferum** Nord. and Hirn. (Redrawn from Hirn)..... 92
Figs. 235–237. **Oe. exocostatum** Tiffany..... 89
Figs. 238 and 239. **Oe. urceolatum** Nord. and Hirn. (Redrawn from Hirn)....167



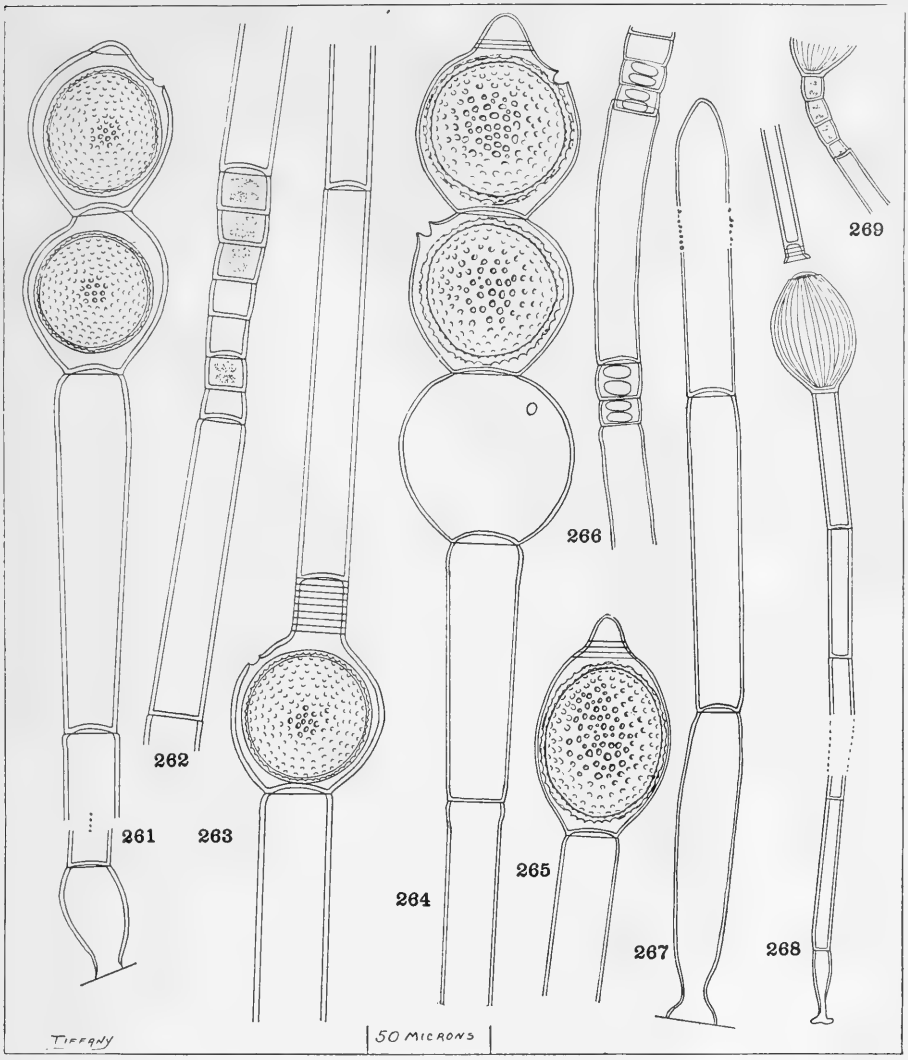
Page

Figs. 240 and 241. **Oedogonium crenulatocostatum** Wittr..... 92
Figs. 242 and 243. **Oe. crenulatocostatum** v. **longiarticulatum** Hansg..... 93
Fig. 244. **Oe. crenulatocostatum** f. **cylindricum** Hirn..... 93
Fig. 245. **Oe. crenulatocostatum** v. **aureum** Tilden. (Redrawn from Hirn)... 93
Fig. 246. **Oe. dictyosporum** Wittr. (Redrawn from Hirn)..... 94
Fig. 247. **Oe. arcyosporum** Nord. and Hirn. (Redrawn from Hirn)..... 94
Figs. 248–250. **Oe. areolatum** Lagerh. (Redrawn from Hirn)..... 94
Fig. 251. **Oe. hoehnei** Borge. (Redrawn from Borge).....165



Page

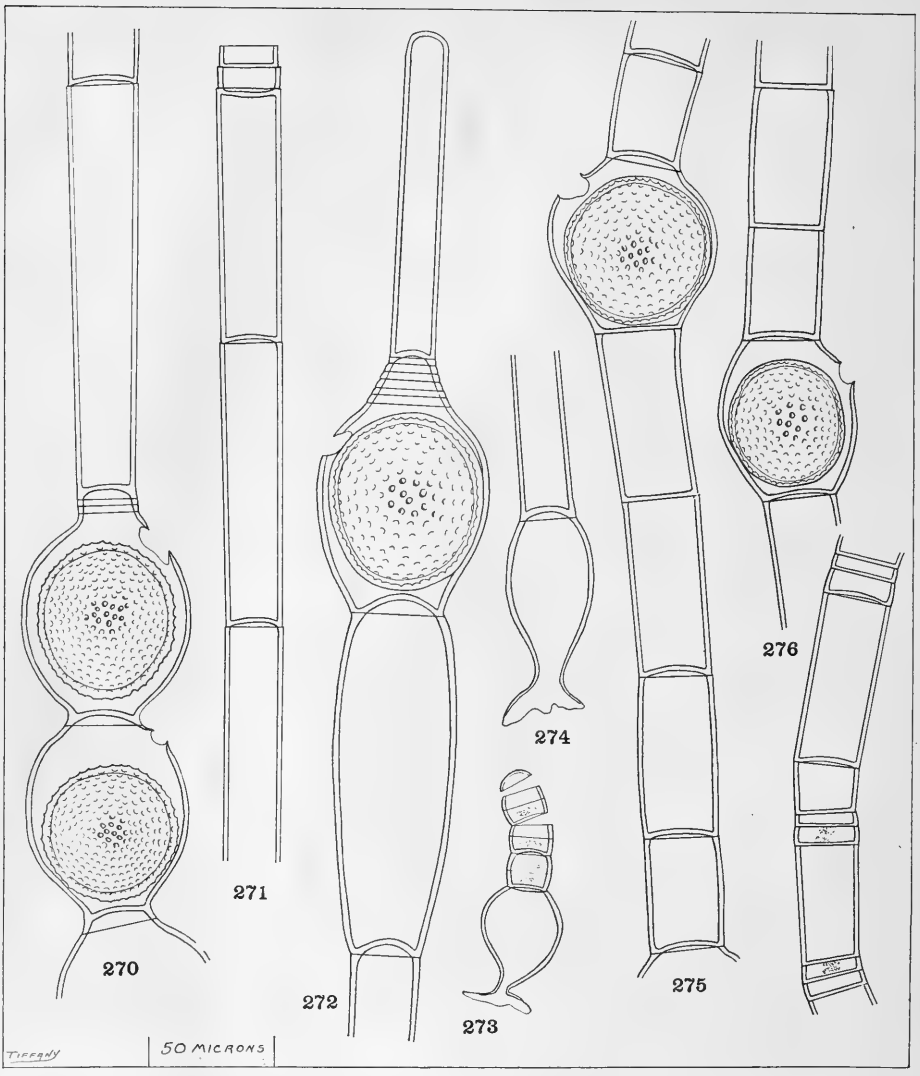
Fig. 252. **Oedogonium foveolatum** Wittr. (Redrawn from Hirn)..... 95
Figs. 253 and 254. **Oe. argenteum** Hirn..... 96
Figs. 255 and 256. **Oe. punctatum** Wittr. (Redrawn from Hirn)..... 96
Fig. 257. **Oe. capense** Nord. and Hirn. (Redrawn from Hirn).....166
Figs. 258 and 259. **Oe. scrobiculatum** Wittr. (Redrawn from Hirn)..... 95
Fig. 260. **Oe. giganteum** Kuetz.; Wittr. (Redrawn from Hirn).....165



Page

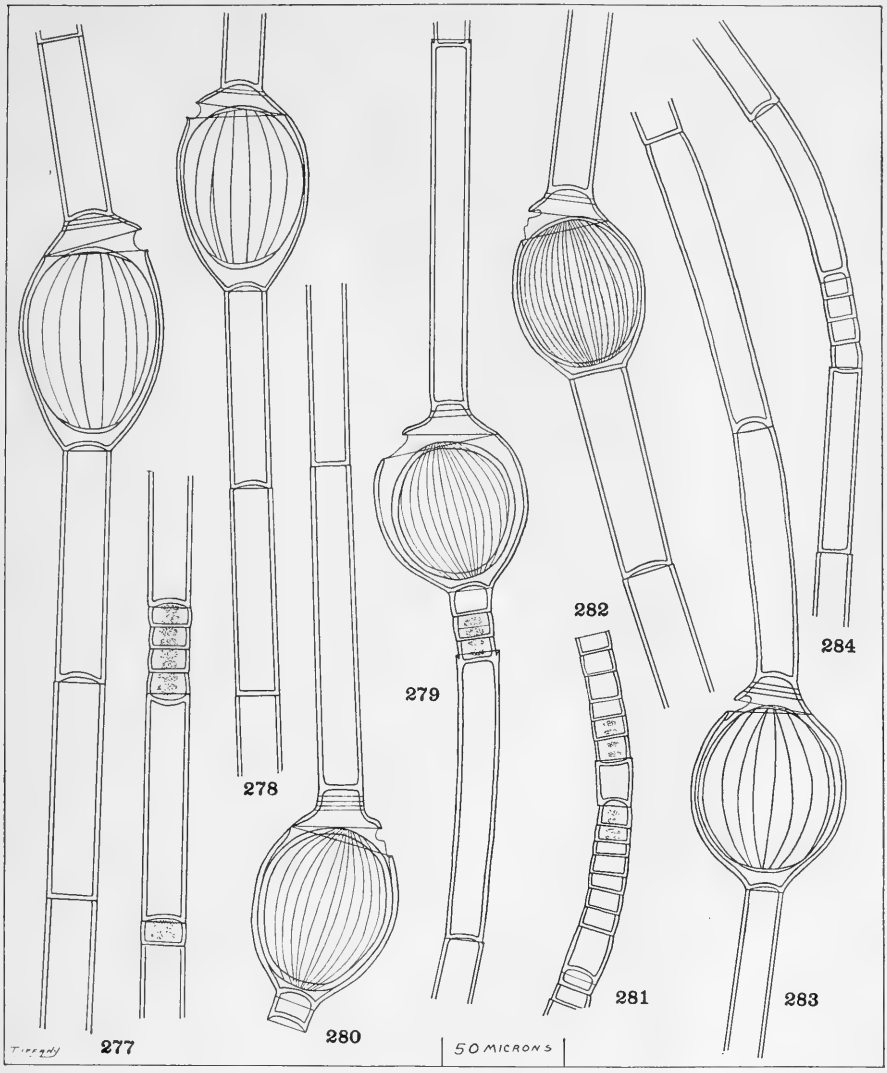
Figs. 261–263. **Oedogonium tiffanii** Ackley..... 95
Figs. 264–267. **Oe. wyliei** Tiffany..... 97
Figs. 268 and 269. **Oe. pseudacrosporum** Wittr. (Redrawn from Hirn)..... 98

PLATE XXXI.



Page

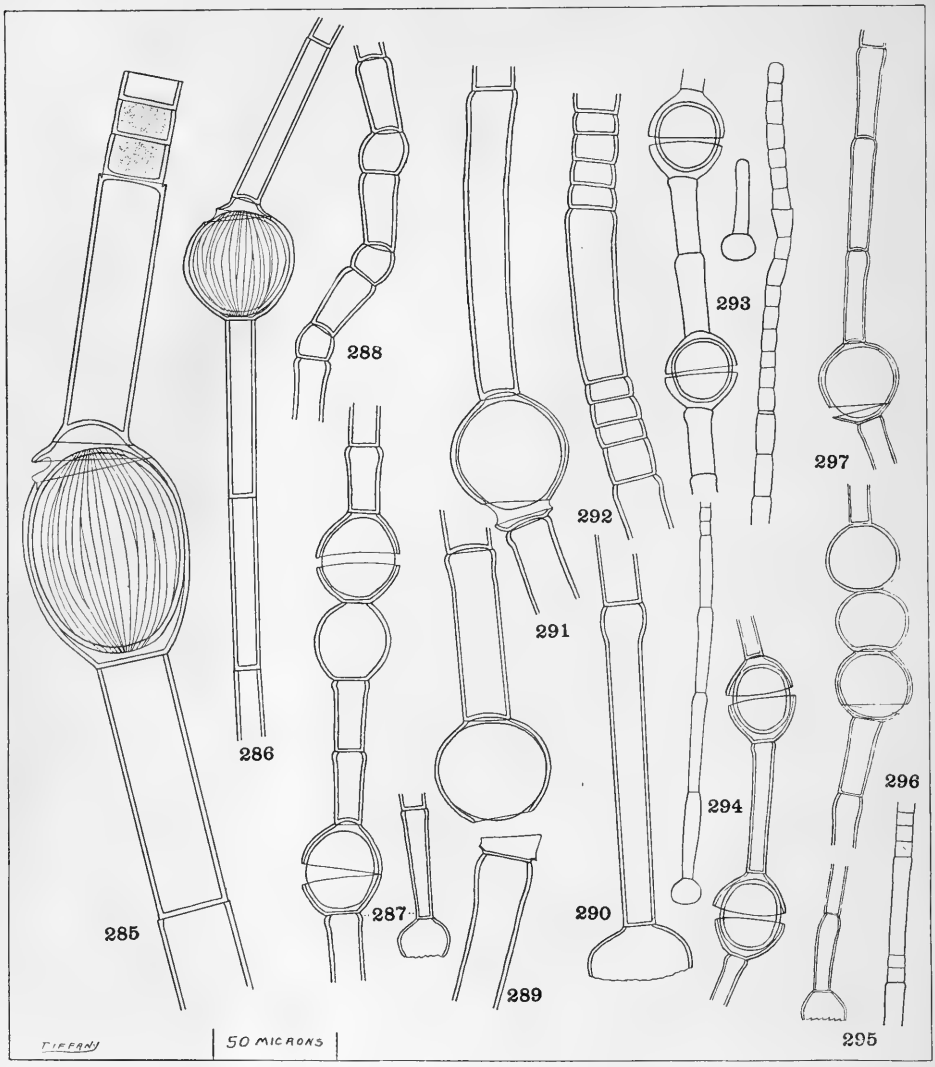
Figs. 270 and 271. **Oedogonium taphrosporum** Nord. and Hirn. (Redrawn from Hirn)..... 97
Figs. 272–274. **Oe. verrucosum** Hallas. (Redrawn from Hallas)..... 95
Figs. 275 and 276. **Oe. americanum** Transeau..... 97



Page

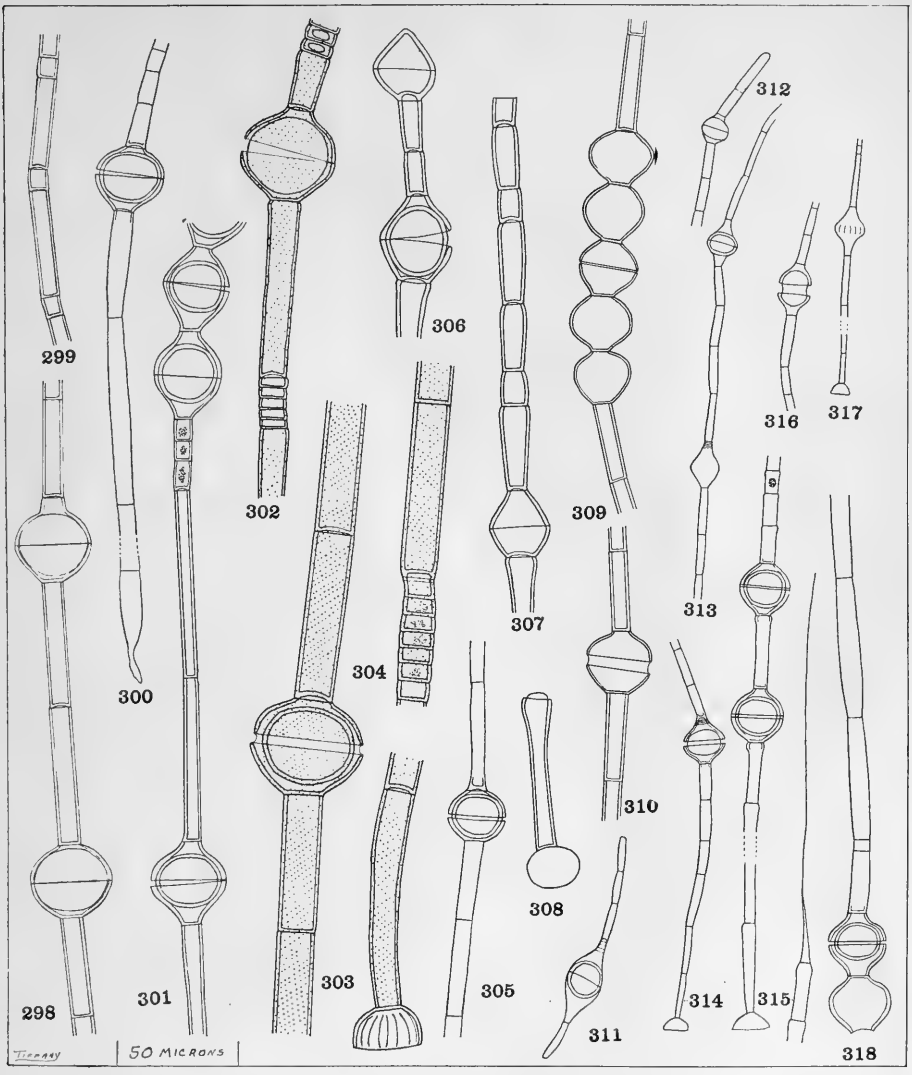
Fig. 277. **Oedogonium paucocostatum** Transeau..... 98
Fig. 278. **Oe. paucocostatum** v. **gracilis** Tiffany..... 98
Fig. 279. **Oe. nobile** Wittr. (Redrawn from Hirn)..... 99
Fig. 280. **Oe. nobile** v. **minus** Hirn. (Redrawn from Hirn).....100
Figs. 281 and 282. **Oe. tumidulum** (Kuetz.) Wittr. (Redrawn from Hirn).... 99
Figs. 283 and 284. **Oe. australianum** Hirn. (Redrawn from Hirn)..... 99

PLATE XXXIII.



Page

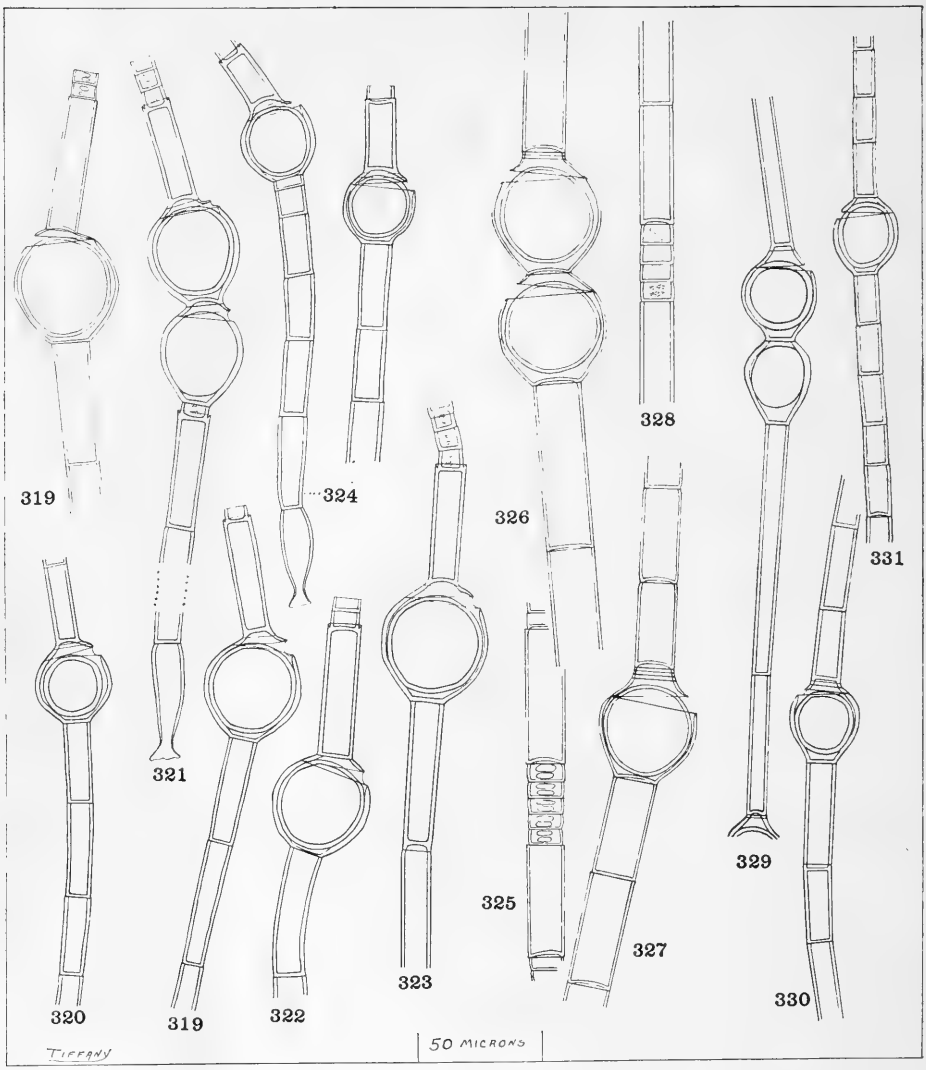
Fig. 285. **Oedogonium insigne** Hirn. (Redrawn from Hirn)....100
Fig. 286. **Oe. sol** Hirn. (Redrawn from Hirn)....167
Figs. 287 and 288. **Oe. latiusculum** Tiffany....102
Figs. 289–292. **Oe. infimum** Tiffany....101
Fig. 293. **Oe. howardii** G. S. West. (Redrawn from West)....101
Fig. 294. **Oe. howardii** v. **minus** Tiffany....102
Figs. 295–297. **Oe. inversum** Wittr....100



Page

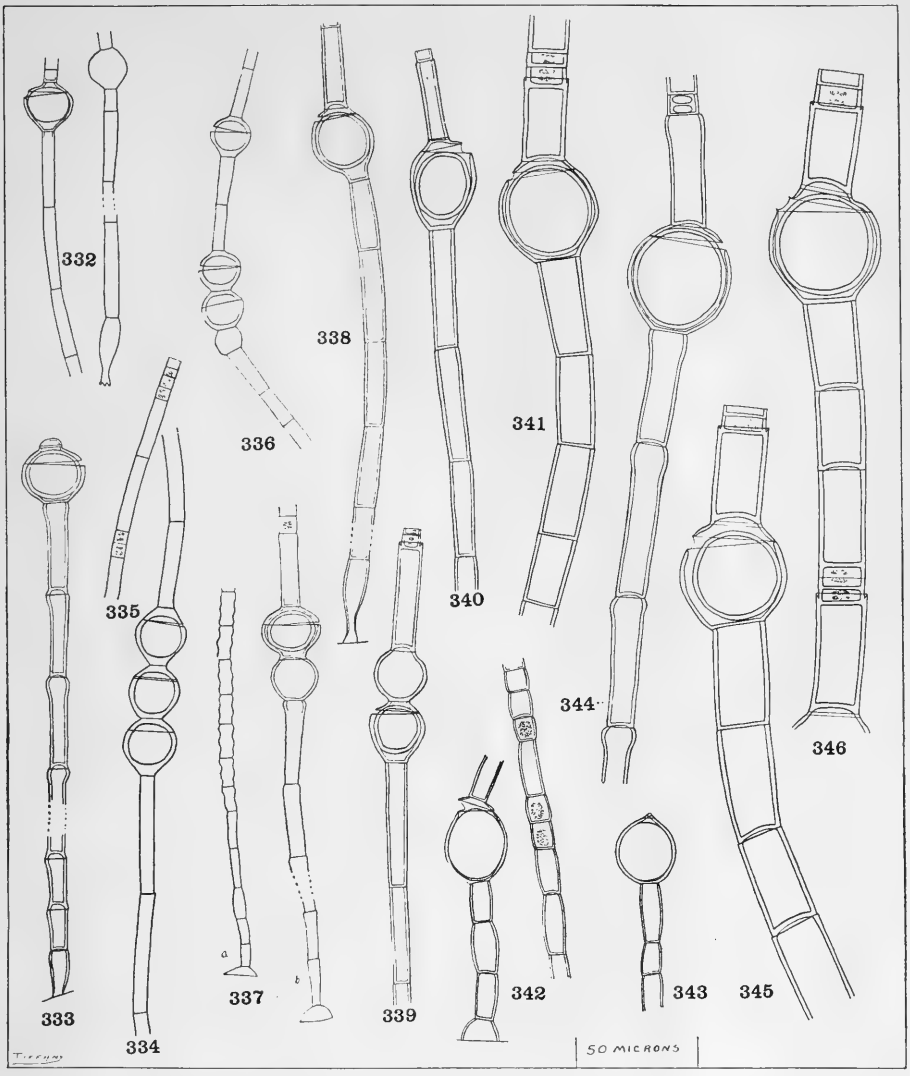
Figs. 298 and 299. **Oedogonium pratense** Transeau.....102
Fig. 300. **Oe. acmandrium** Elfv. (Redrawn from Hirn).....103
Fig. 301. **Oe. psaegmatosporum** Nordst. (Redrawn from Hirn).....103
Fig. 302. **Oe. minus** Wittr.....103
Figs. 303 and 304. **Oe. punctatostriatum** De Bary. (Redrawn from Hirn).....104
Fig. 305. **Oe. poecilosporum** Nordst. and Hirn. (Redrawn from Hirn).....168
Figs. 306–308. **Oe. quadratum** Hallas. (Redrawn from Hallas).....105
Figs. 309 and 310. **Oe. calvum** Wittr. (Redrawn from Hirn).....169
Fig. 311. **Oe. fusus** Hallas. (Redrawn from Hallas).....162
Fig. 312. **Oe. inconspicuum** Hirn. (Redrawn from Nordstedt).....160
Fig. 313. **Oe. inconspicuum** Hirn.....160
Fig. 314. **Oe. tapeinosporum** Wittr.....159
Fig. 315. **Oe. capitellatum** Wittr. (Redrawn from Hirn).....104
Fig. 316. **Oe. pusillum** Kirchner.....161
Fig. 317. **Oe. excisum** Wittr. and Lund. (Redrawn from Wittrock).....160
Fig. 318. **Oe. gunnii** Wittr.....110

BIOLOGICAL



Page

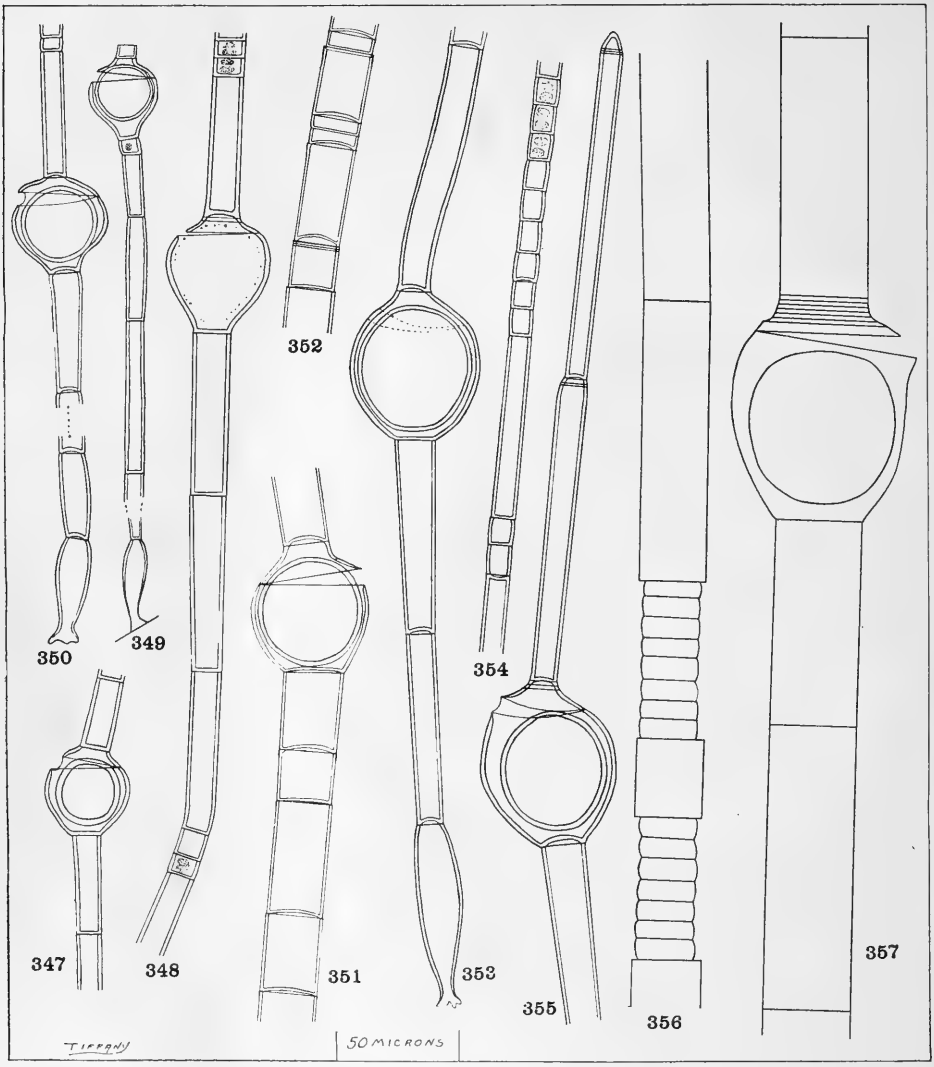
Fig. 319. **Oedogonium crispum** (Hass.) Wittr.....113
Fig. 320. **Oe. crispum** v. **hawaiense** Nord. (Redrawn from Hirn).....114
Fig. 321. **Oe. crispum** v. **gracilescens** Wittr. (Redrawn from Hirn).....114
Fig. 322. **Oe. crispum** f. **granulosum** (Nord.) Hirn. (Redrawn from Hirn)...113
Fig. 323. **Oe. crispum** f. **inflatum** Hirn. (Redrawn from Hirn).....113
Fig. 324. **Oe. crispum** v. **uruguayense** M. & W. (Redrawn from Hirn).....114
Figs. 325 and 326. **Oe. pringsheimii** Cramer; Wittr.....107
Figs. 327–330. **Oe. pringsheimii** v. **nordstedtii** Wittr.....108
Fig. 331. **Oe. pringsheimii** v. **abbreviatum** Hirn. (Redrawn from Hirn).....107



Page

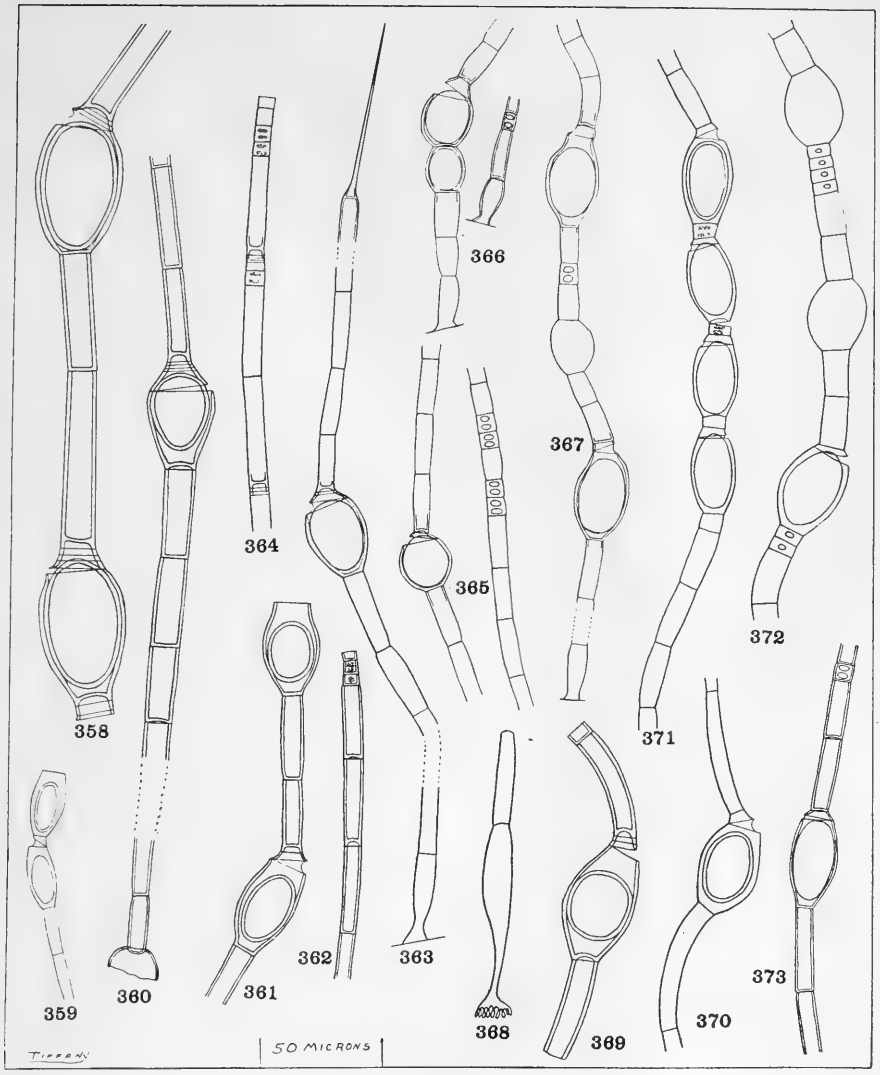
Fig. 332. **Oedogonium petri** Wittr. (Redrawn from Hirn).....105
Fig. 333. **Oe. spurium** Hirn. (Redrawn from Hirn).....164
Figs. 334 and 335. **Oe. mitratum** Hirn.....105
Fig. 336. **Oe. virceburgense** Hirn. (Redrawn from Hirn).....164
Fig. 337. **Oe. sphaerandrium** Wittr. and Lund. (a. After Borge. b. After Nordstedt).....112
Fig. 338. **Oe. pithophorae** Wittr. (Redrawn from Hirn).....112
Fig. 339. **Oe. loricatum** Hirn. (Redrawn from Hirn).....111
Fig. 340. **Oe. simplex** Hirn. (Redrawn from Hirn).....111
Fig. 341. **Oe. autumnale** Wittr. (Redrawn from Hirn).....112
Figs. 342 and 343. **Oe. nanum** Wittr.; Tiffany.....109
Fig. 344. **Oe. bohemicum** Hirn.....105
Fig. 345. **Oe. rupestre** Hirn. (Redrawn from Hirn).....114
Fig. 346. **Oe. rupestre** f. **pseudautumnale** Hirn. (Redrawn from Hirn).....115

PLATE XXXVII.



Page

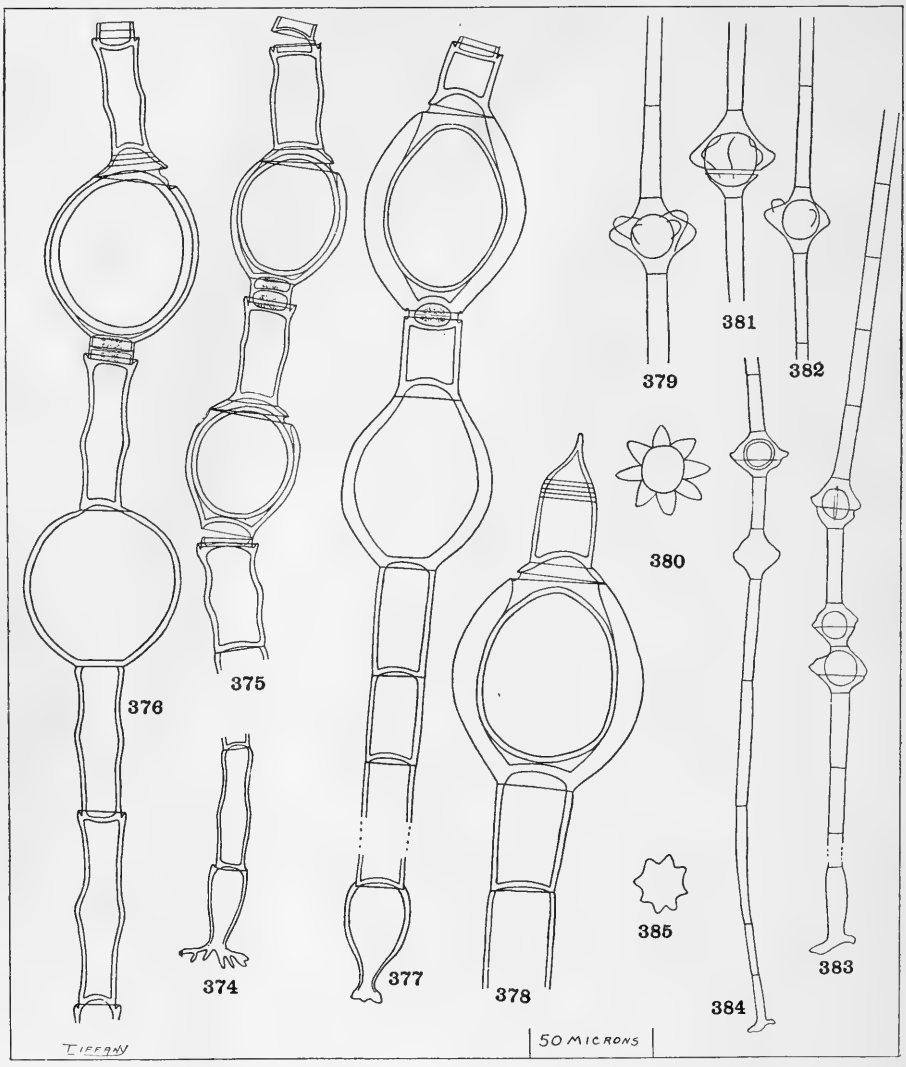
Fig. 347. **Oedogonium obesum** (Wittr.) Hirn. (Redrawn from Hirn).....112
Fig. 348. **Oe. pyriforme** Wittr. (Redrawn from Hirn).....110
Fig. 349. **Oe. pyrulum** Wittr. (Redrawn from Hirn).....111
Fig. 350. **Oe. pyrulum** v. **amplius** Taylor.....111
Figs. 351 and 352. **Oe. welwitschii** West.....106
Figs. 353–355. **Oe. iowense** Tiffany.....106
Figs. 356 and 357. **Oe. dioicum** Carter. (After Carter).....107

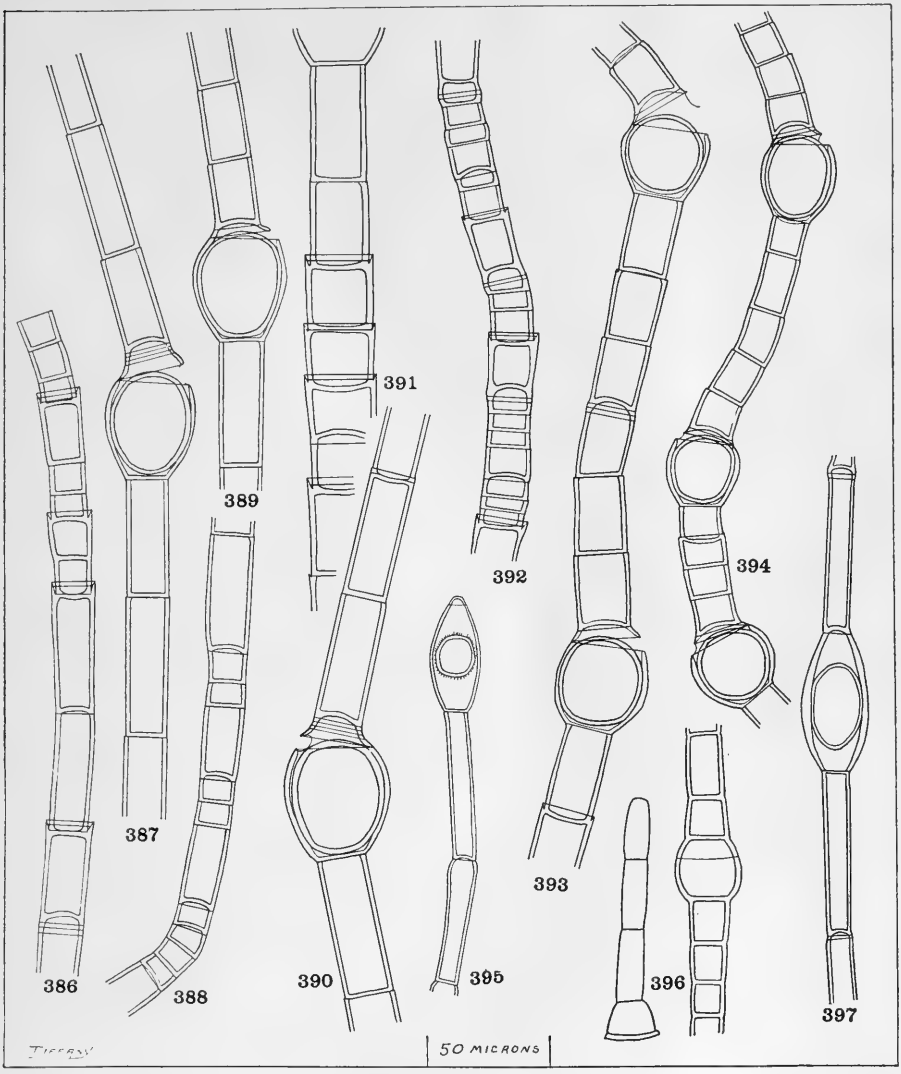


Page

Fig. 358. **Oedogonium ahlstrandii** Wittr. (Redrawn from Hirn).....115
Fig. 359. **Oe. selandiae** Hallas. (After Hallas).....161
Fig. 360. **Oe. sancti thomae** Wittr. and Cleve.....161
Fig. 361 and 362. **Oe. porrectum** Nord. and Hirn. (Redrawn from Hirn).....109
Figs. 363 and 364. **Oe. pisanum** Wittr. (Redrawn from Hirn).....109
Figs. 365 and 366. **Oe. pisanum** v. **gracilis** Trans. and Tiff.....110
Fig. 367. **Oe. oblongum** Wittr.....117
Figs. 368 and 369. **Oe. oblongum** f. **sphaericum** (Hallas) Hirn. (After Hallas).117
Fig. 370. **Oe. oblongum** f. **majus** (Nord.) Hirn. (Redrawn from Hirn).....117
Fig. 371. **Oe. kirchneri** Wittr. (Redrawn from Hirn).....116
Fig. 372. **Oe. oblongellum** Kirch. (After W. and G. S. West).....116
Fig. 373. **Oe. gracillimum** Wittr. and Lund.....116

PLATE XXXIX.

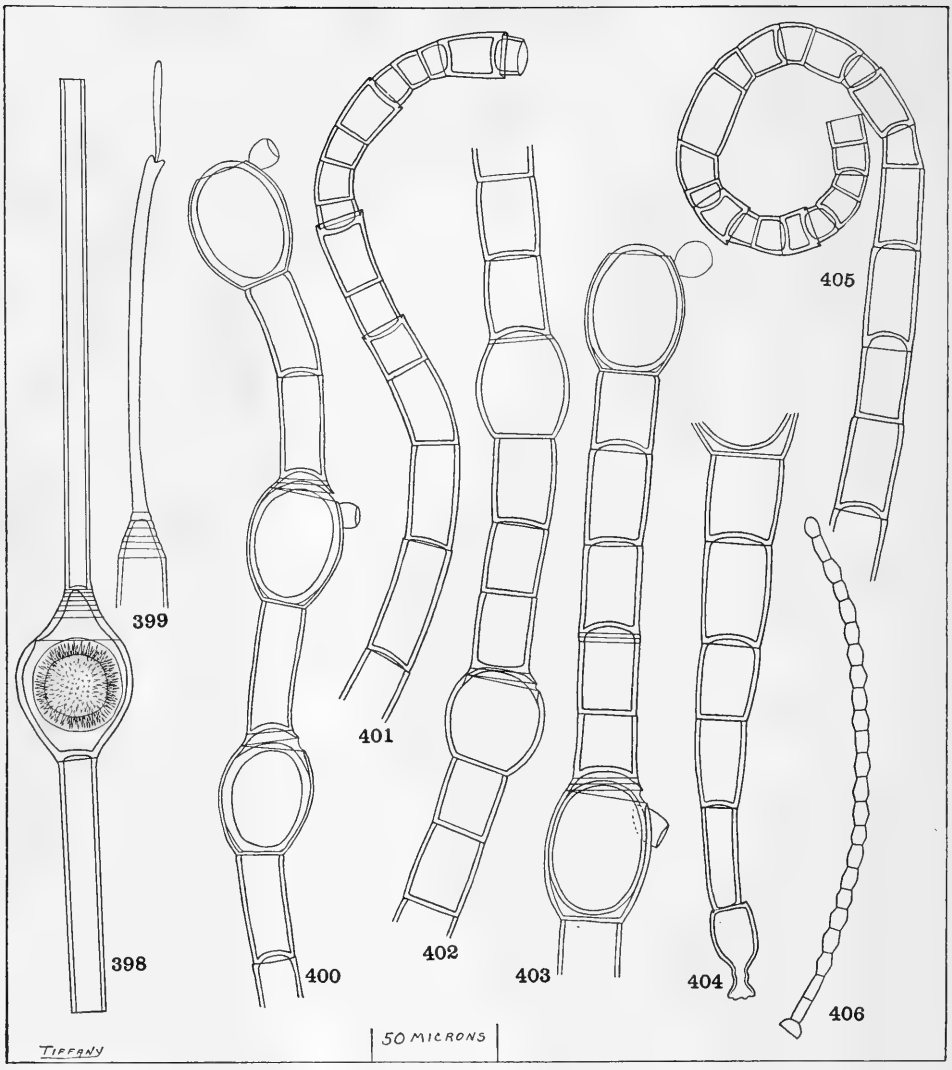




Page

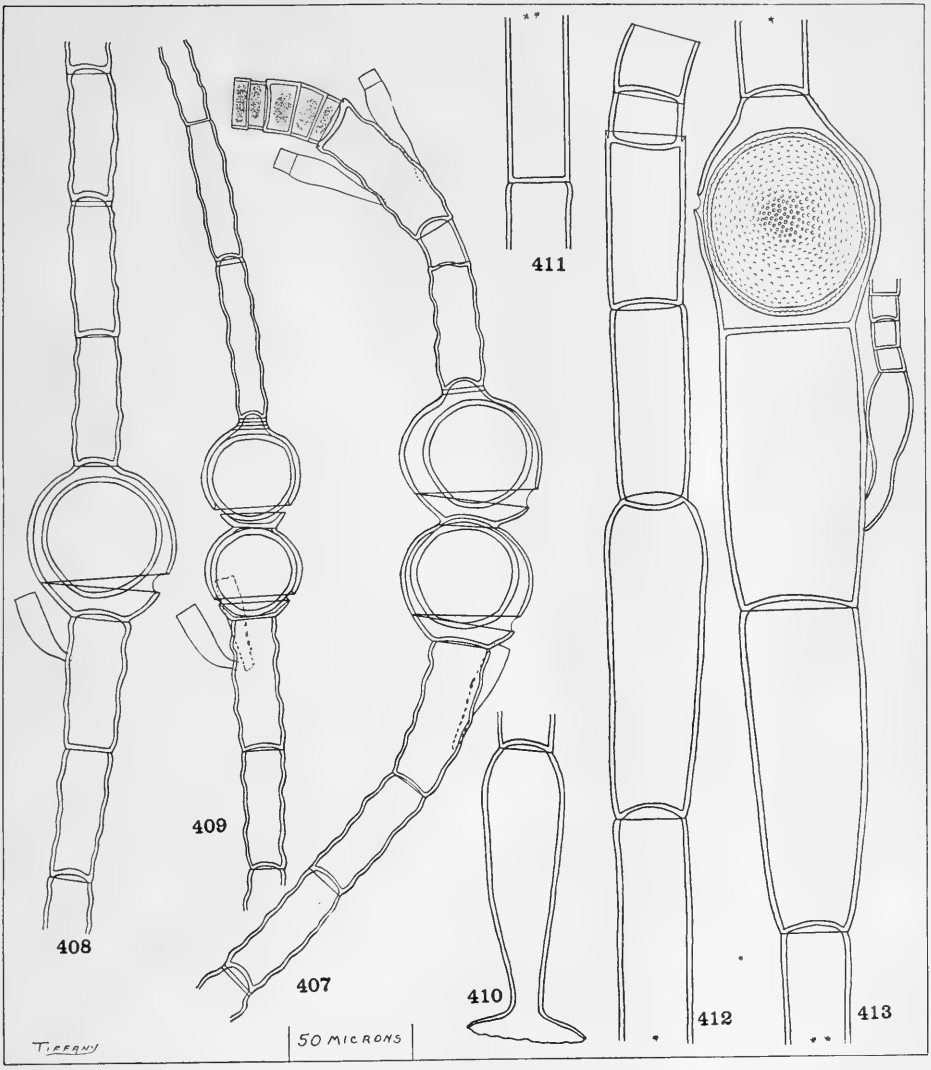
Figs. 386 and 387. **Oedogonium vesicatum** (Lyng.) Wittr. (Redrawn from Hirn) 162
Figs. 388 and 389. **Oe. rhodosporum** (Welw.) Wittr. (Redrawn from Hirn) ... 162
Figs. 390 and 391. **Oe. montagnei** Fior.-Mazz. (Redrawn from Hirn) 162
Figs. 392 and 393. **Oe. pluviale** Nord. (Redrawn from Hirn) 150
Fig. 394. **Oe. flexuosum** Hirn. (Redrawn from Hirn) 163
Fig. 395. **Oe. pilosporum** West. (Redrawn from West) 165
Fig. 396. **Oe. consociatum** Collins and Hervey. (Redrawn from Collins) 167
Fig. 397. **Oe. inclusum** Hirn. (Redrawn from Hirn) 169

PLATE XLI.



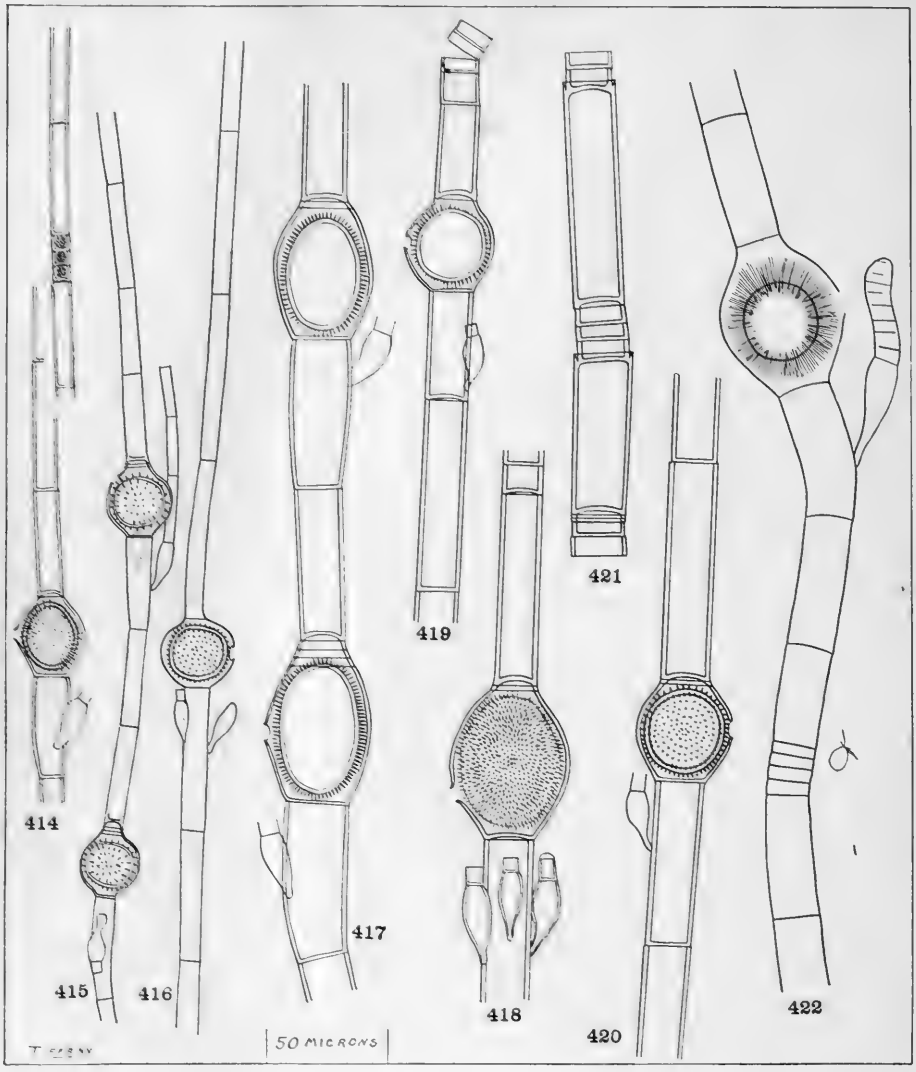
Page

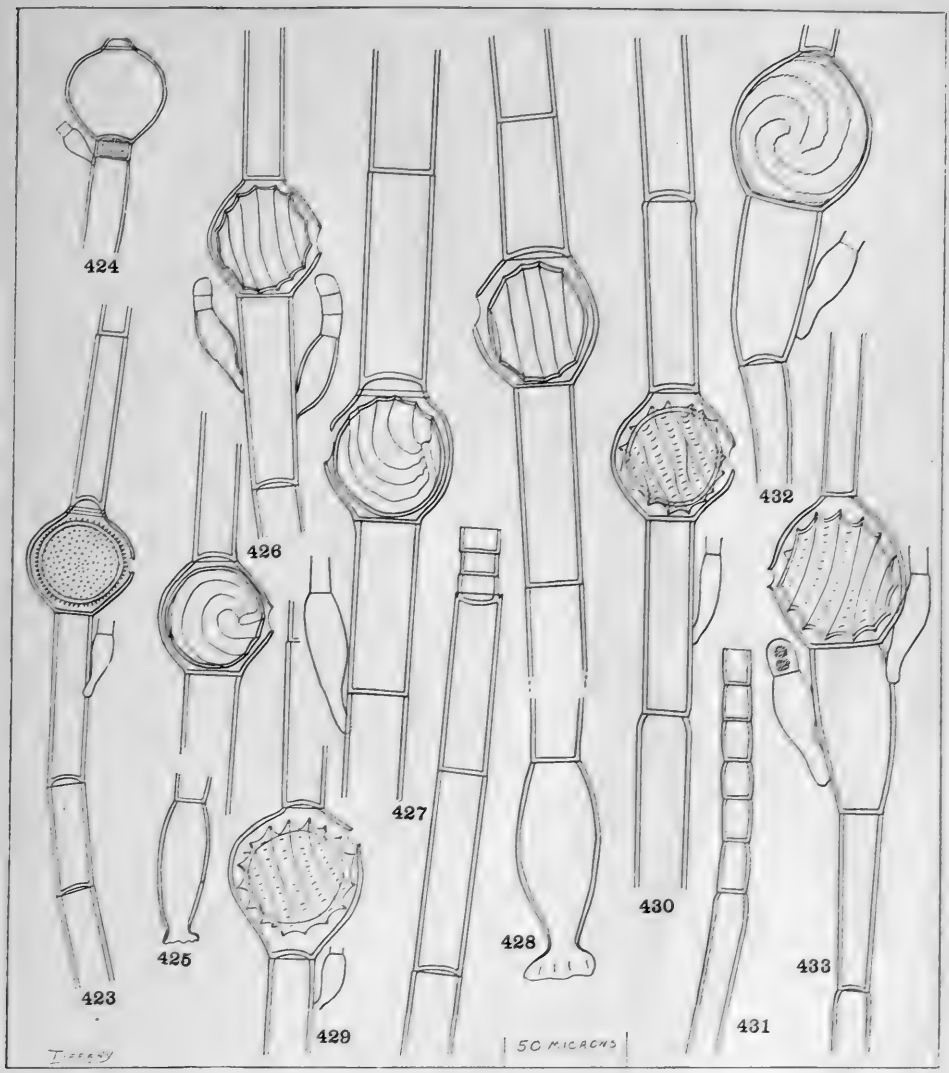
Figs. 398 and 399. **Oedogonium velatum** Hallas. (Redrawn from Hallas).....164
Figs. 400 and 401. **Oe. implexum** Hirn. (Redrawn from Hirn).....153
Fig. 402. **Oe. fonticola** Al. Br. (Redrawn from Hirn).....163
Figs. 403–405. **Oe. spectabile** Hirn. (Redrawn from Hirn).....153
Fig. 406. **Oe. reinschii** Roy.....172



Page

Fig. 407. **Oedogonium undulatum** (Breb.) Al. Br.; Wittr. (Redrawn from Hirn) 118
Fig. 408. **Oe. undulatum** v. **americanum** Trans. 119
Fig. 409. **Oe. undulatum** f. **senegalense** (Nord.) Hirn. 119
Figs. 410–413. **Oe. nebraskense** Ohashi (slightly on larger scale) 119

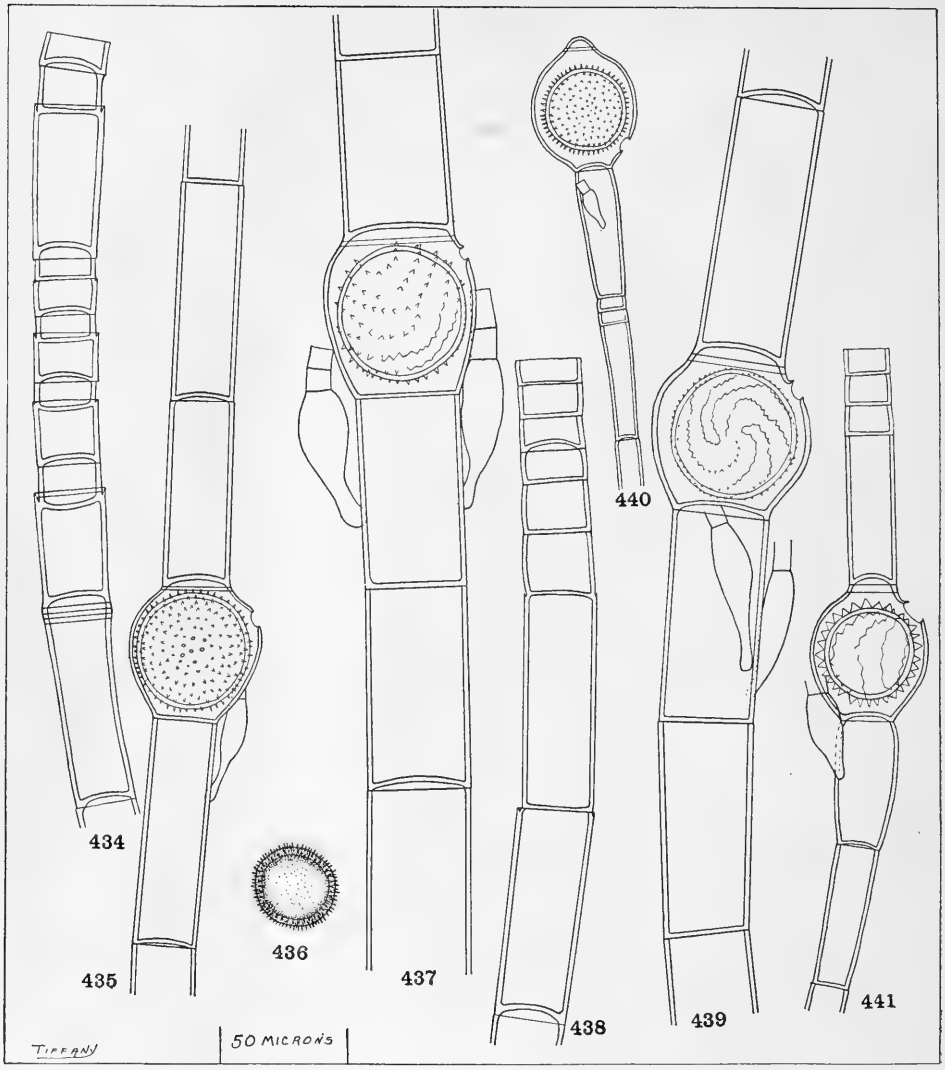




Page

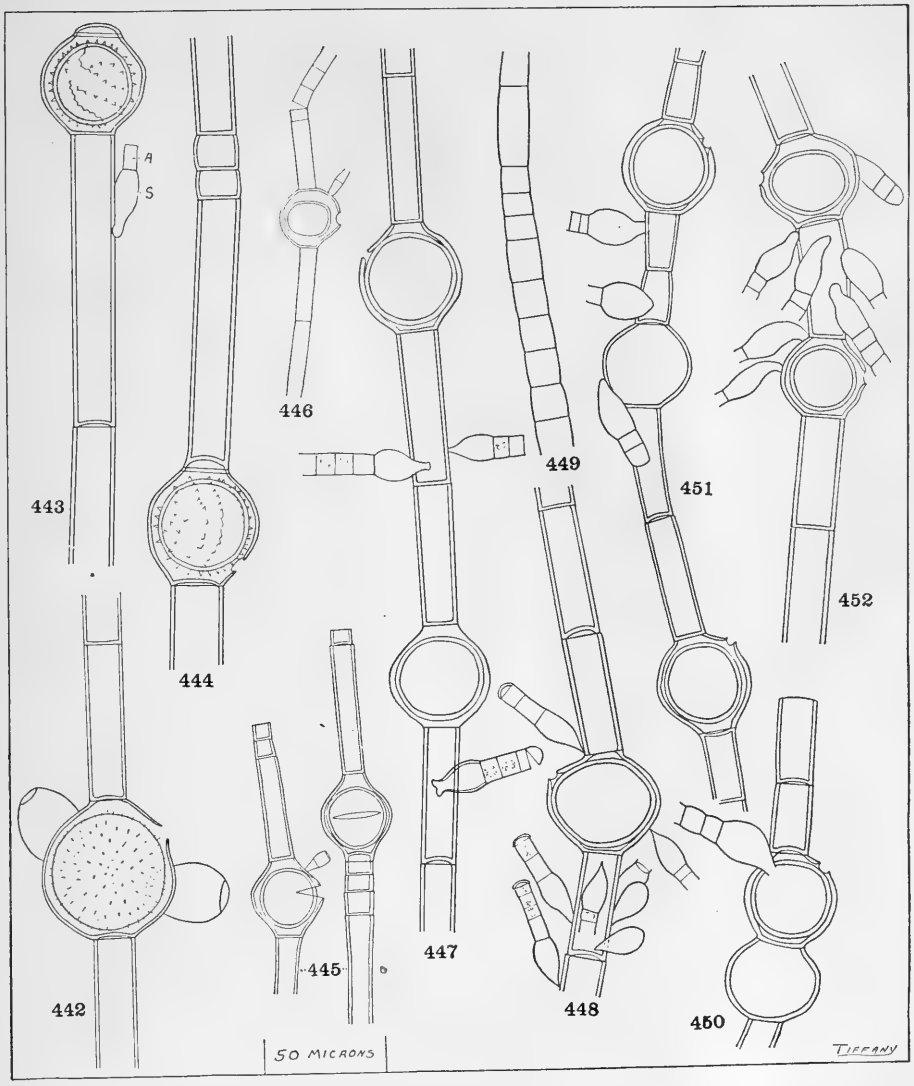
Figs. 423 and 424. **Oedogonium pungens** Hirn. (Redrawn from Hirn).....122
Figs. 425 and 426. **Oe. exospirale** Tiffany.....122
Figs. 427 and 428. **Oe. spirale** Hirn. (Redrawn from Hirn).....123
Fig. 429. **Oe. spirale** v. **latviense** Tiffany.....123
Fig. 430. **Oe. spirale** v. **acutum** West and West. (Redrawn from West).....123
Figs. 431–433. **Oe. illinoisense** Transeau. (Redrawn from Transeau).....123

PLATE XLV.



Page

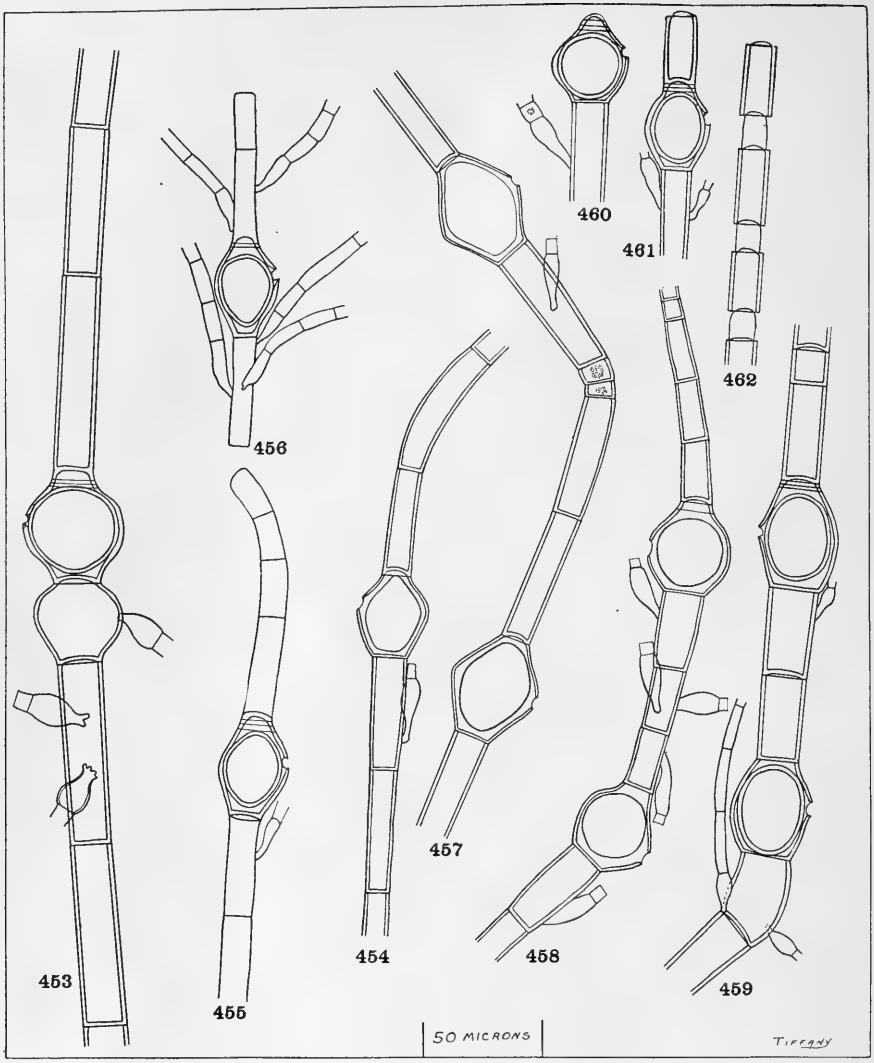
Figs. 434 and 435. **Oedogonium lindmanianum** Wittr. (Redrawn from Hirn)..133
Fig. 436. **Oe. echinatum** (Wood) Wittr. Oospore. (After Wood).....133
Fig. 437. **Oe. donnellii** Wolle; Hirn. (Redrawn from Hirn).....132
Figs. 438 and 439. **Oe. donnellii** v. **wittrockianum** Hirn. (Redrawn from Hirn).....132
Fig. 440. **Oe. hispidum** Nordst. (Redrawn from Hirn).....137
Fig. 441. **Oe. stellatum** Wittr. (Redrawn from Hirn).....127



Page

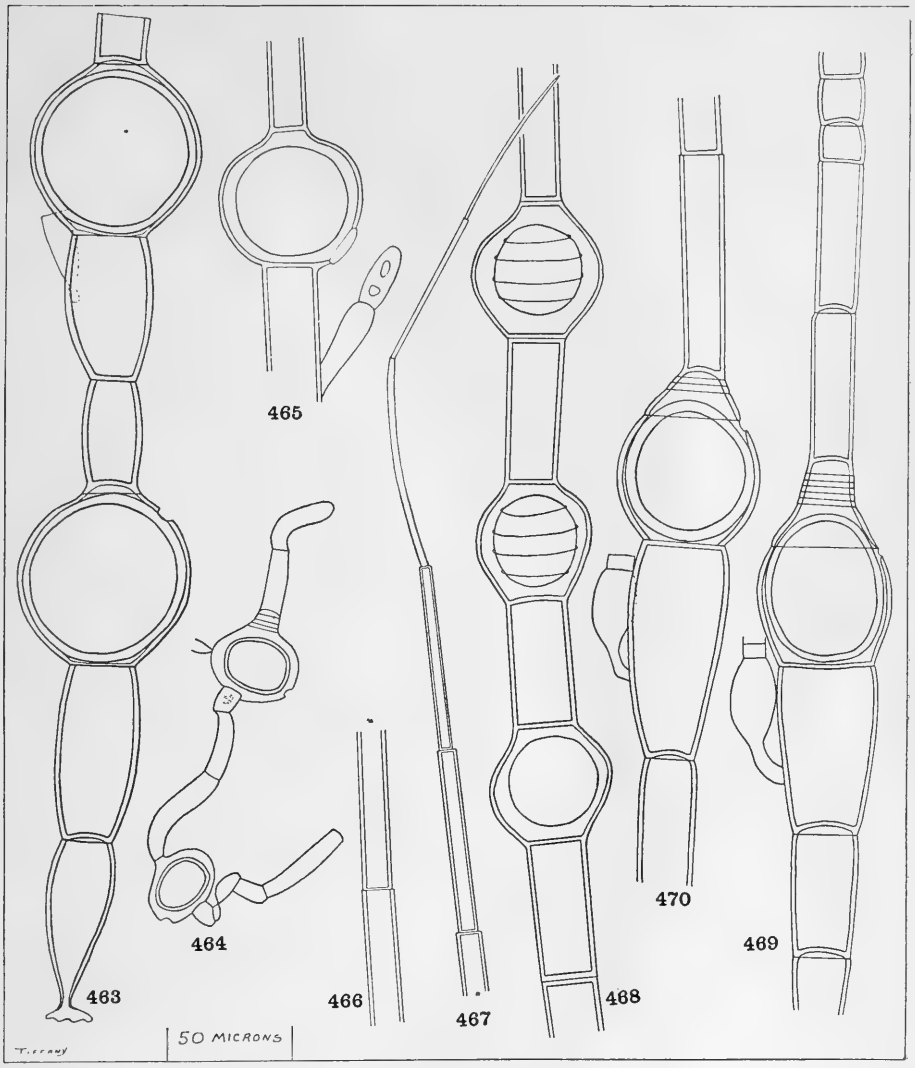
Fig. 442. **Oedogonium manschuricum** Skvortzow. (After Skvortzow).....126
Fig. 443. **Oe. cleveanum** Wittr. (A, antheridium; S, dwarf male stipe).....138
Fig. 444. **Oe. cleveanum** Wittr. (Redrawn from Hirn).....138
Fig. 445. **Oe. semiapertum** Nord. and Hirn. (Redrawn from Hirn).....124
Fig. 446. **Oe. depressum** Pringsh. (Redrawn from Hirn).....124
Fig. 447. **Oe. irregulare** Wittr.....131
Figs. 448 and 449. **Oe. irregulare** v. **condensatum** (Hallas) Hirn. (After Hallas).....132
Figs. 450 and 451. **Oe. multisporum** Wood.....131
Fig. 452. **Oe. multisporum** v. **magnum** Ackley.....131

PLATE XLVII.



Page

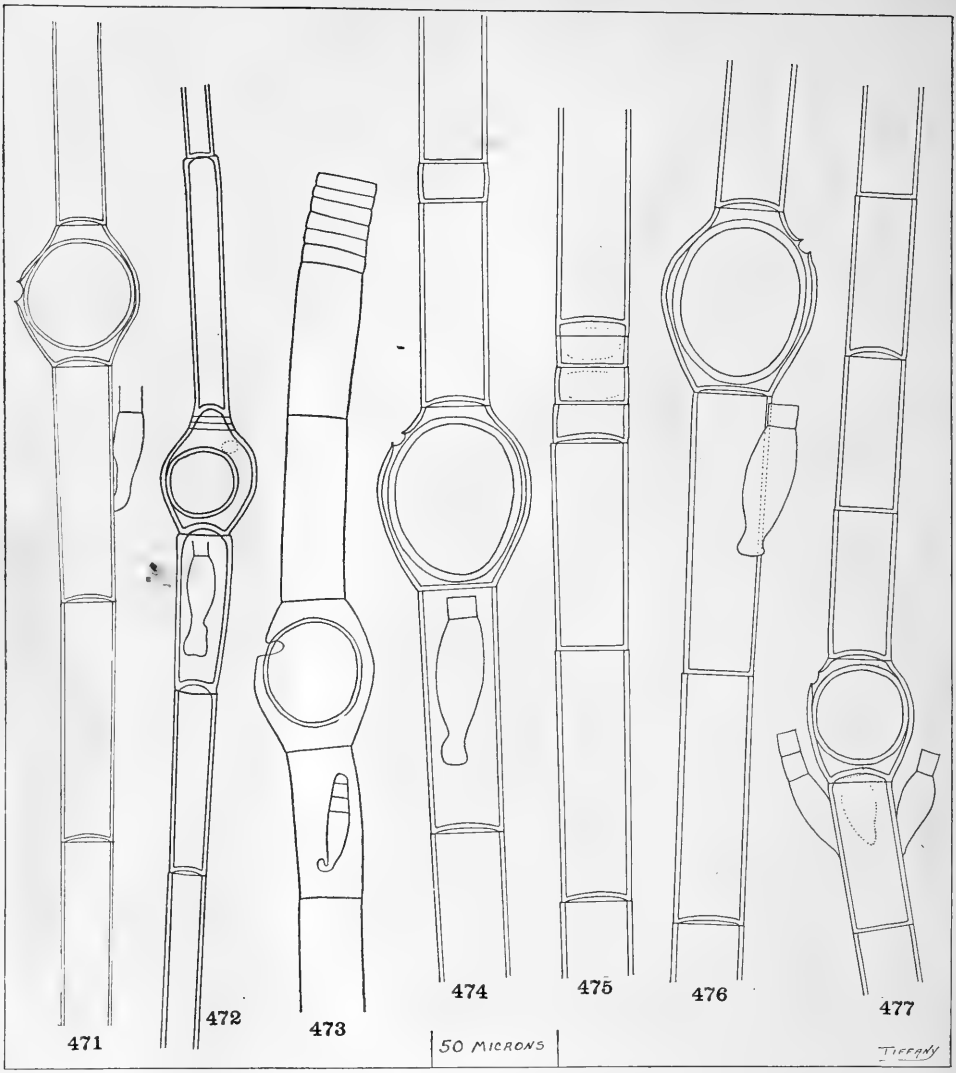
Fig. 453. **Oedogonium gallicum** Hirn. (Redrawn from Hirn)....124
Fig. 454. **Oe. sexangulare** Cleve....126
Figs. 455 and 456. **Oe. sexangulare** v. **angulosum** (Hallas) Hirn. (After Hallas)....126
Fig. 457. **Oe. sexangulare** v. **majus** Wille. (Redrawn from Hirn)....127
Fig. 458. **Oe. braunii** Kuetz; Pringsh....125
Fig. 459. **Oe. braunii** v. **zehneri** Tiffany....125
Figs. 460–462. **Oe. braunii** v. **hafniense** (Hallas) Hirn. (After Hallas)....125



Page

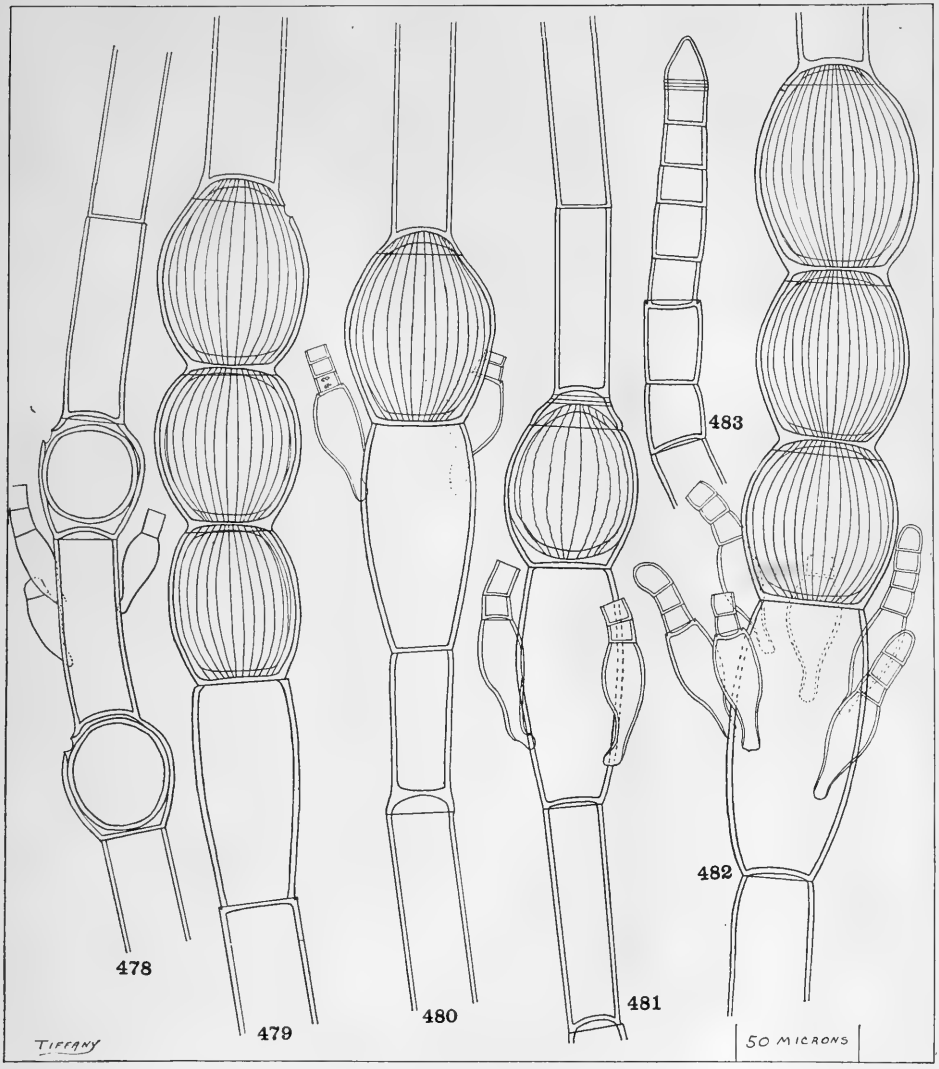
Fig. 463. **Oedogonium alternans** Wittr. and Lund. (Redrawn from Hirn).....128
Fig. 464. **Oe. contortum** Hallas. (After Hallas).....147
Figs. 465–468. **Oe. huntii** Wood. (After Wood).....137
Fig. 469. **Oe. borisianum** (Le Cl.) Wittr.....128
Fig. 470. **Oe. borisianum** v. **westii** Tiffany and Brown.....128

PLATE XLIX.



Page

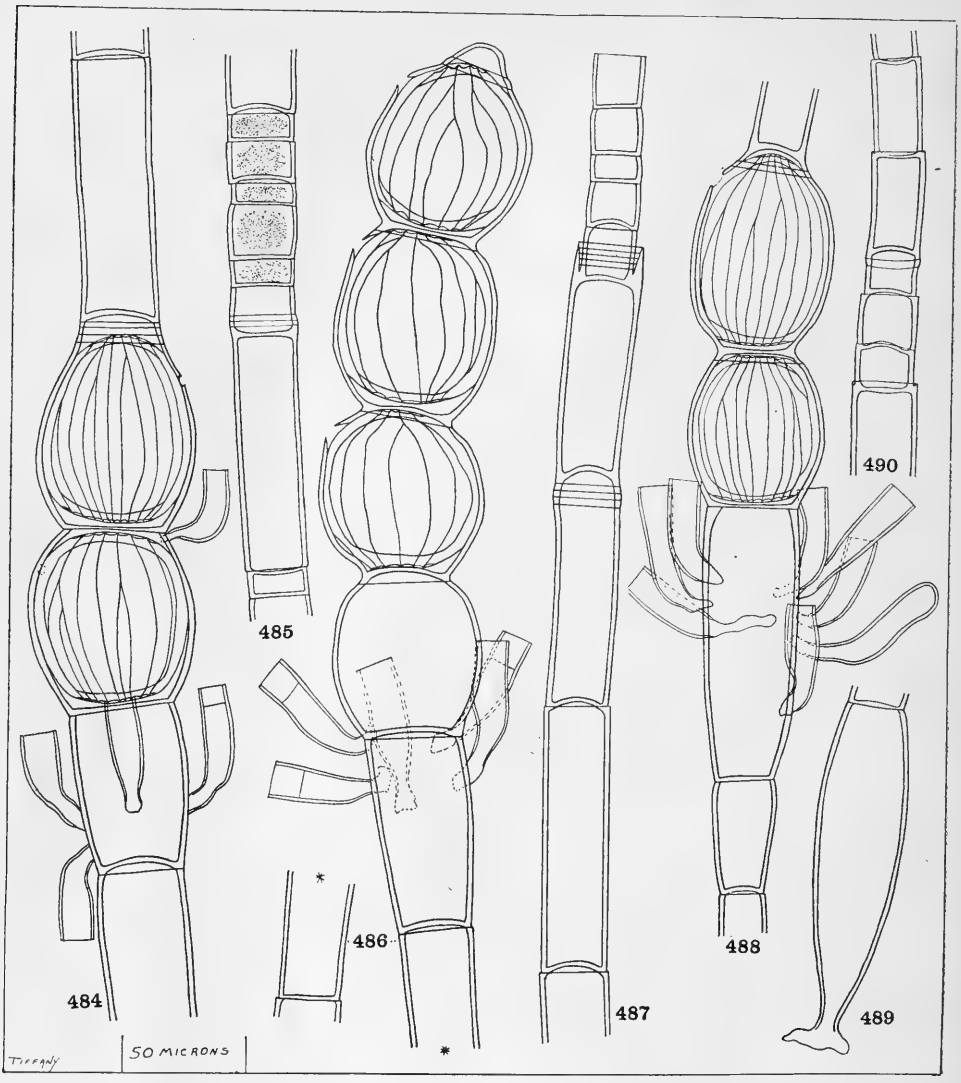
Fig. 471. **Oedogonium flavescens** (Hass.) Wittr.....125
Fig. 472. **Oe. silvaticum** Hallas. (After Hallas).....127
Fig. 473. **Oe. victoriense** G. S. West. (After West).....129
Fig. 474. **Oe. crassiusculum** Wittr.....129
Figs. 475 and 476. **Oe. crassiusculum** v. **idioandrosporum** Nord. and Wittr....130
Fig. 477. **Oe. crassiusculum** v. **cataractum** (Wolle) Tiffany.....130



Page

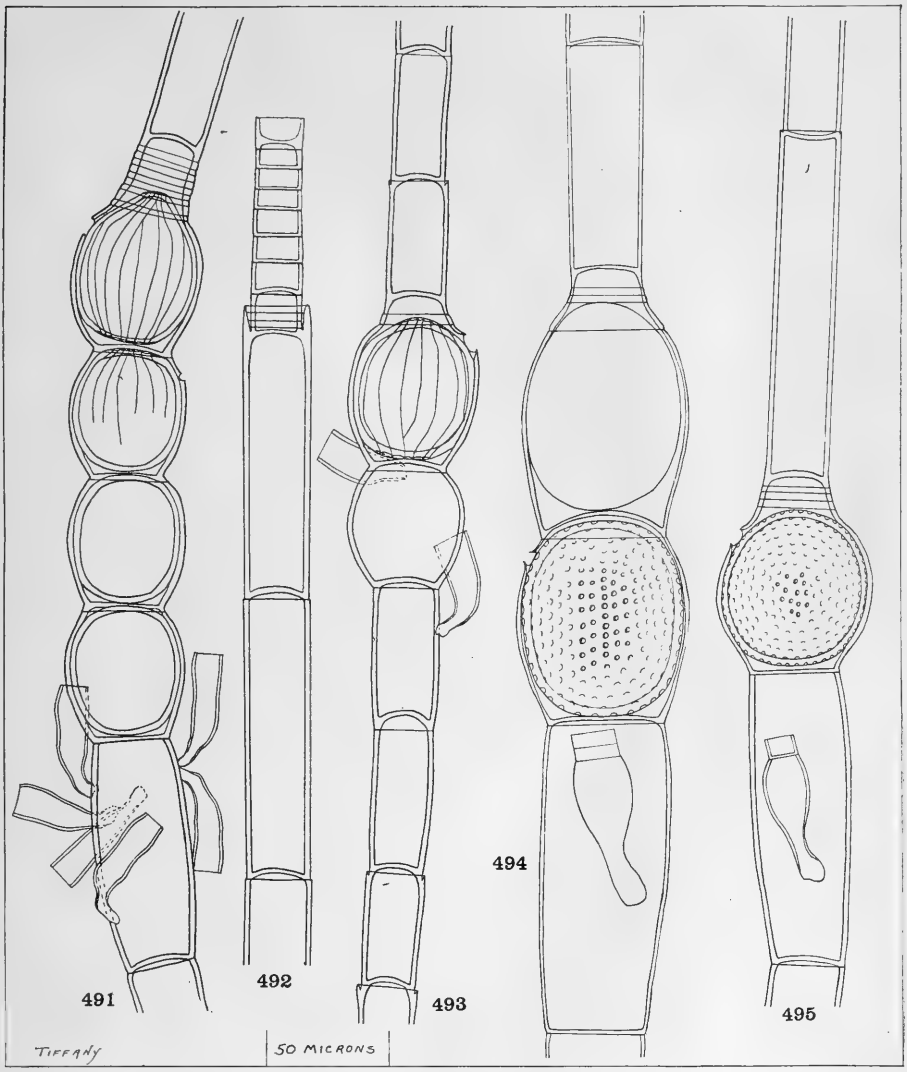
Fig. 478. **Oedogonium crassiusculum** v. **arechavaletae** (Wittr.) Hirn. (Redrawn from Hirn) 130
Figs. 479 and 480. **Oe. wolleanum** Wittr. (Redrawn from Hirn) 135
Fig. 481. **Oe. wolleanum** v. **concinnum** Hirn. (Redrawn from Hirn) 135
Figs. 482 and 483. **Oe. wolleanum** f. **insigne** (Nord.) Hirn. (Redrawn from Hirn) 136

PLATE LI.



Page

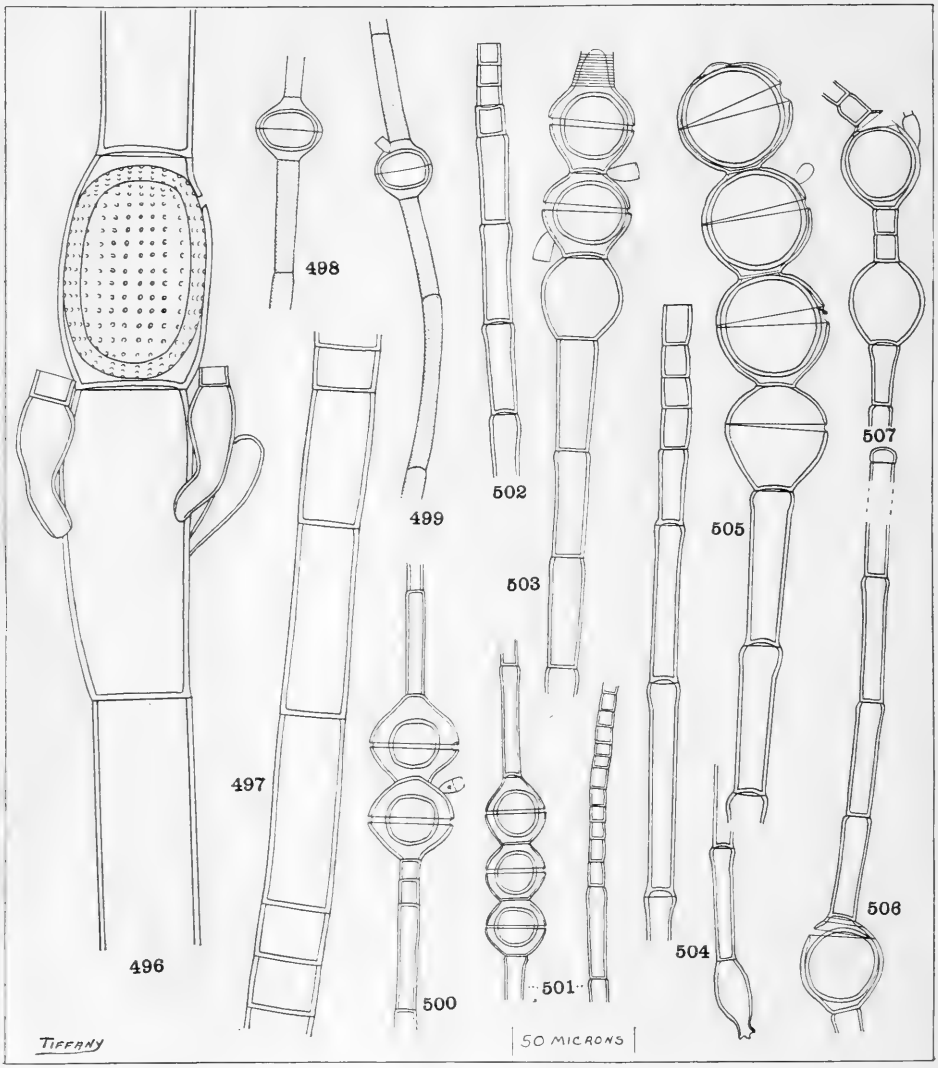
Figs. 484 and 485. **Oedogonium cyathigerum** Wittr.....133
Figs. 486 and 487. **Oe. cyathigerum** f. **perfectum** Hirn. (Redrawn from Hirn)..134
Figs. 488–490. **Oe. cyathigerum** f. **ornatum** (Wittr.) Hirn. (Redrawn from Hirn).....134



Page

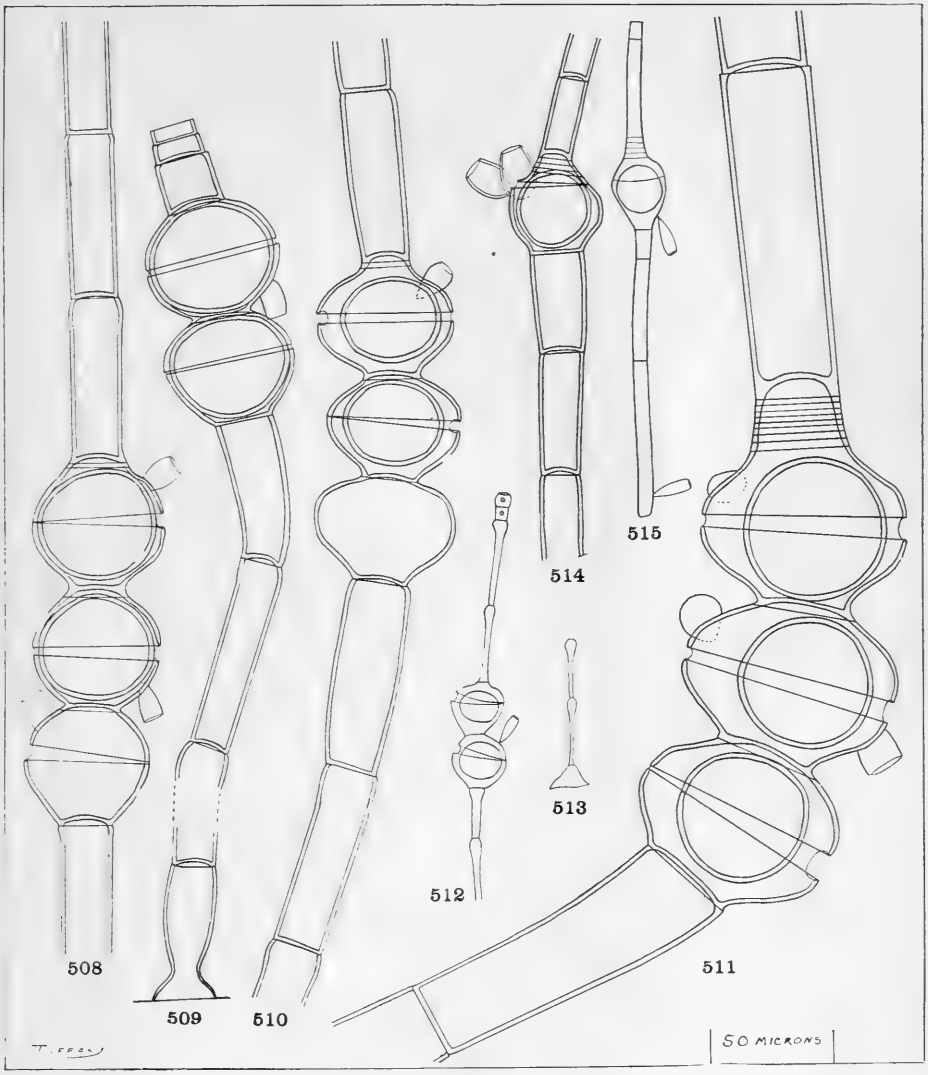
Figs. 491 and 492. **Oe. cyathigerum** v. **hormosporum** (West) Hirn. (Redrawn from Hirn)....135
Fig. 493. **Oe. cyathigerum** v. **ellipticum** M. and W. (Redrawn from Hirn)....134
Fig. 494. **Oe. concatenatum** (Hass.) Wittr....136
Fig. 495. **Oe. concatenatum** f. **hutchinsiae** (Wittr.) Hirn....136

PLATE LIII.



Page

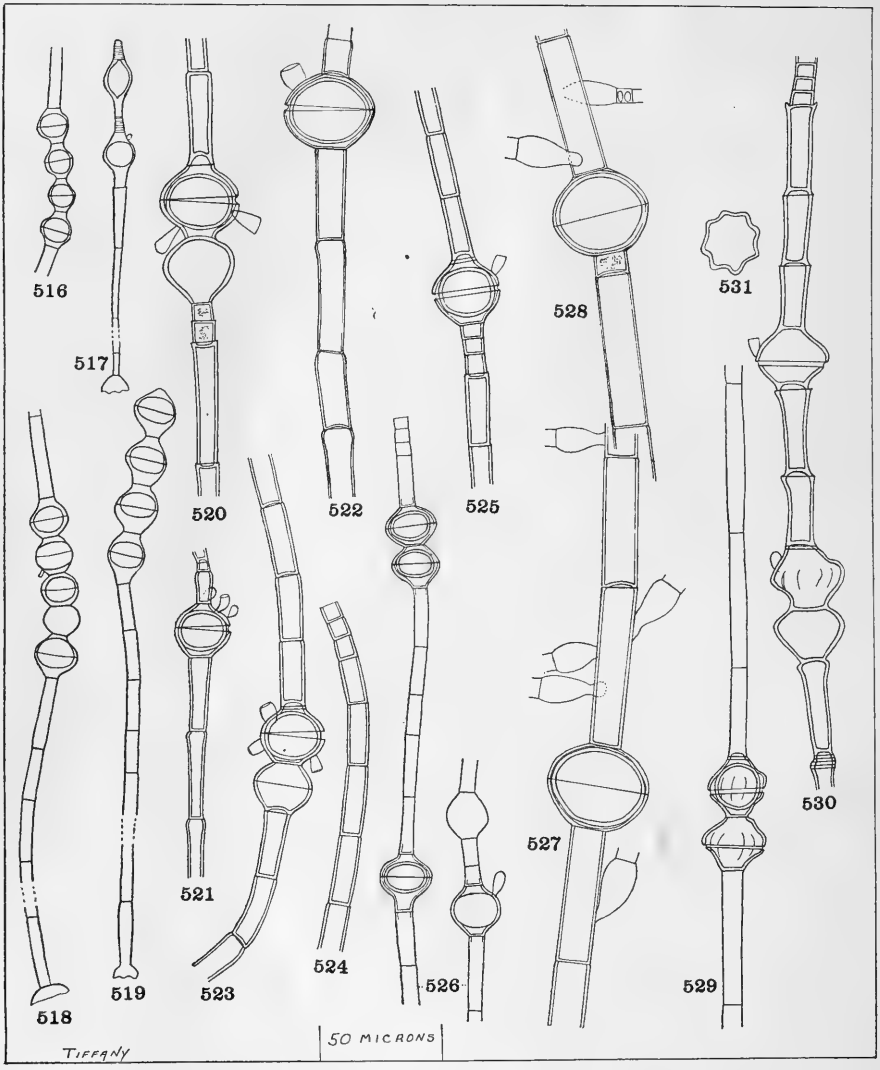
Figs. 496 and 497. **Oedogonium concatenatum** v. **rectangulare** Rich. (After Rich)..... 137
Figs. 498 and 499. **Oe. elegans** West and West. (After West)..... 138
Fig. 500. **Oe. areschougii** Wittr. (After Wittrock)..... 140
Fig. 501. **Oe. areschougii** v. **americanum** Tiffany..... 140
Figs. 502 and 503. **Oe. areschougii** f. **robustum** Hirn. (Redrawn from Hirn)..... 140
Figs. 504 and 505. **Oe. bengalense** Hirn. (Redrawn from Hirn)..... 139
Figs. 506 and 507. **Oe. rigidum** Hirn. (Redrawn from Hirn)..... 139



Page

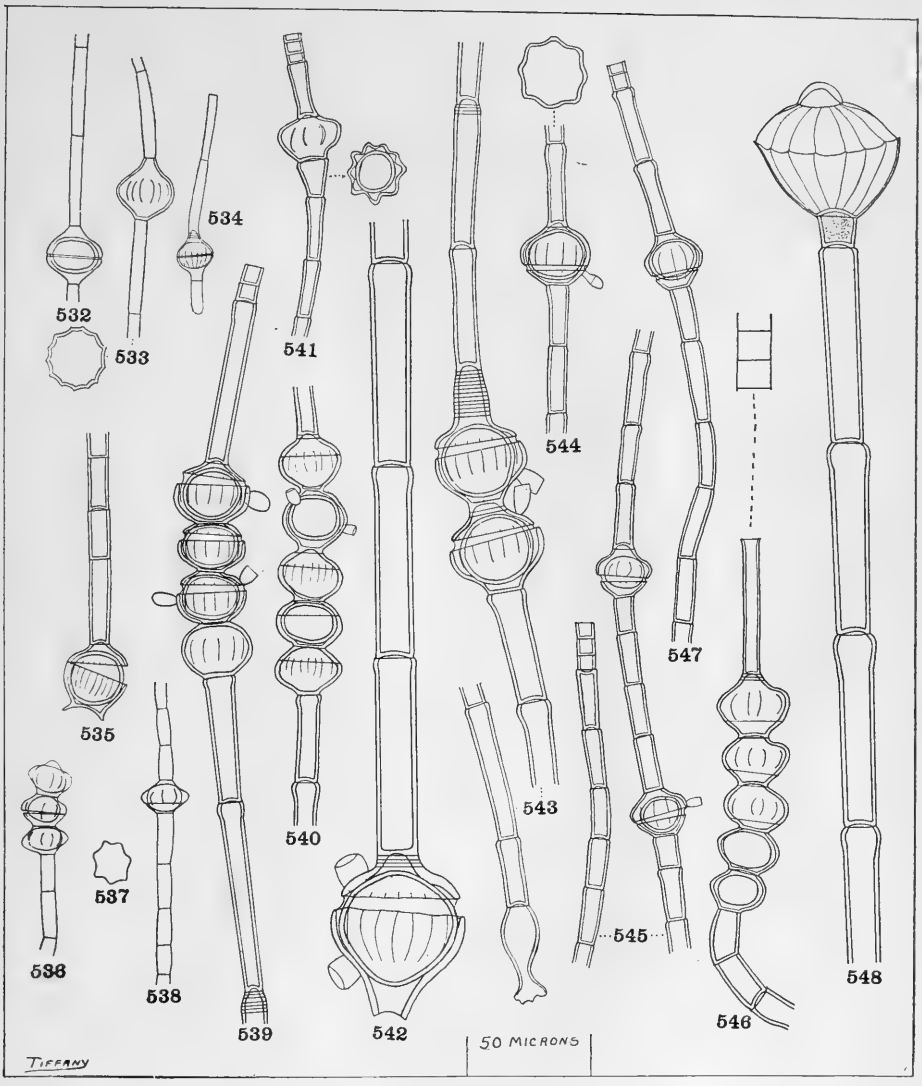
Fig. 508. **Oedogonium brasiliense** Borge. (Redrawn from Hirn).....140
Fig. 509. **Oe. indicum** Hirn. (Redrawn from Hirn).....139
Fig. 510. **Oe. confertum** Hirn. (Redrawn from Hirn).....141
Fig. 511. **Oe. perspicuum** Hirn. (Redrawn from Hirn).....141
Figs. 512 and 513. **Oe. clavatum** Hallas. (After Hallas).....141
Fig. 514. **Oe. mirandrium** Skuja. (After Skuja).....147
Fig. 515. **Oe. danicum** Hallas. (After Hallas).....145

PLATE LV.



Page

Figs. 516 and 517. **Oedogonium longicolle** Nord.; Hirn. (After Nordstedt)...144
Figs. 518 and 519. **Oe. longicolle** v. **senegalense** Nord. (After Nordstedt)....144
Fig. 520. **Oe. decipiens** Wittr. (After Wittrock).....145
Figs. 521 and 522. **Oe. decipiens** f. **dissimile** Hirn.....145
Figs. 523 and 524. **Oe. decipiens** v. **africanum** Tiffany. (Redrawn from Hirn).145
Fig. 525. **Oe. decipiens** v. **bernardense** (Bates) Hirn. (Redrawn from Hirn)..146
Fig. 526. **Oe. rothii** (Le Cl.) Pringsh. (After Pringsheim).....144
Figs. 527 and 528. **Oe. macrospermum** West and West.....146
Fig. 529. **Oe. uleanum** Hirn. (Redrawn from Hirn).....170
Fig. 530. **Oe. bahusiense** Nordst. (After Nordstedt).....142
Fig. 531. **Oe. bahusiense** Nordst., oogonium seen from above.....142

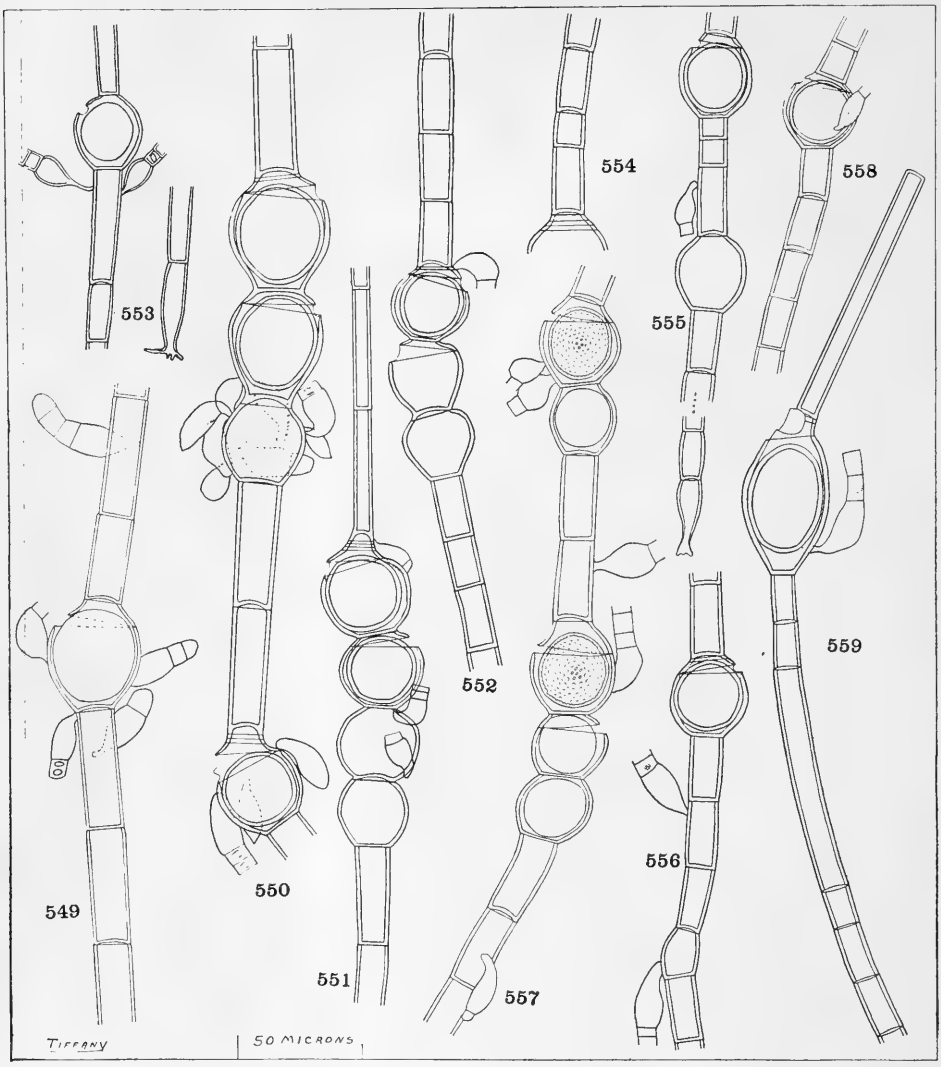


Page

Figs. 532 and 533. **Oedogonium crenulatum** Wittr. (After Wittrock).....171
Fig. 534. **Oe. crenulatum** v. **gracilius** (Nord.) Hirn. (Redrawn from Hirn)...171
Fig. 535. **Oe. plicatulum** Wittr. (Redrawn from Hirn).....170
Figs. 536–538. **Oe. lagerstedtii** Wittr. (Redrawn from Hirn).....170
Fig. 539. **Oe. oelandicum** Wittr.; Hirn.....142
Fig. 540. **Oe. oelandicum** f. **minus** Borge. (Redrawn from Borge).....142
Fig. 541. **Oe. pulchrum** Nord. and Hirn. (Redrawn from Hirn).....170
Fig. 542. **Oe. boreale** Hirn. (Redrawn from Hirn).....147
Fig. 543. **Oe. megaporum** Wittr.....142
Fig. 544. **Oe. platygynum** Wittr. (After Wittrock).....143
Fig. 545. **Oe. platygynum** f. **obtusum** Hirn. (Redrawn from Hirn).....143
Fig. 546. **Oe. platygynum** v. **continuum** Nordst. (After Nordstedt).....143
Fig. 547. **Oe. platygynum** v. **novae zelandiae** Hirn. (After Nordstedt).....144
Fig. 548. **Oe. costatum** Transeau.....146

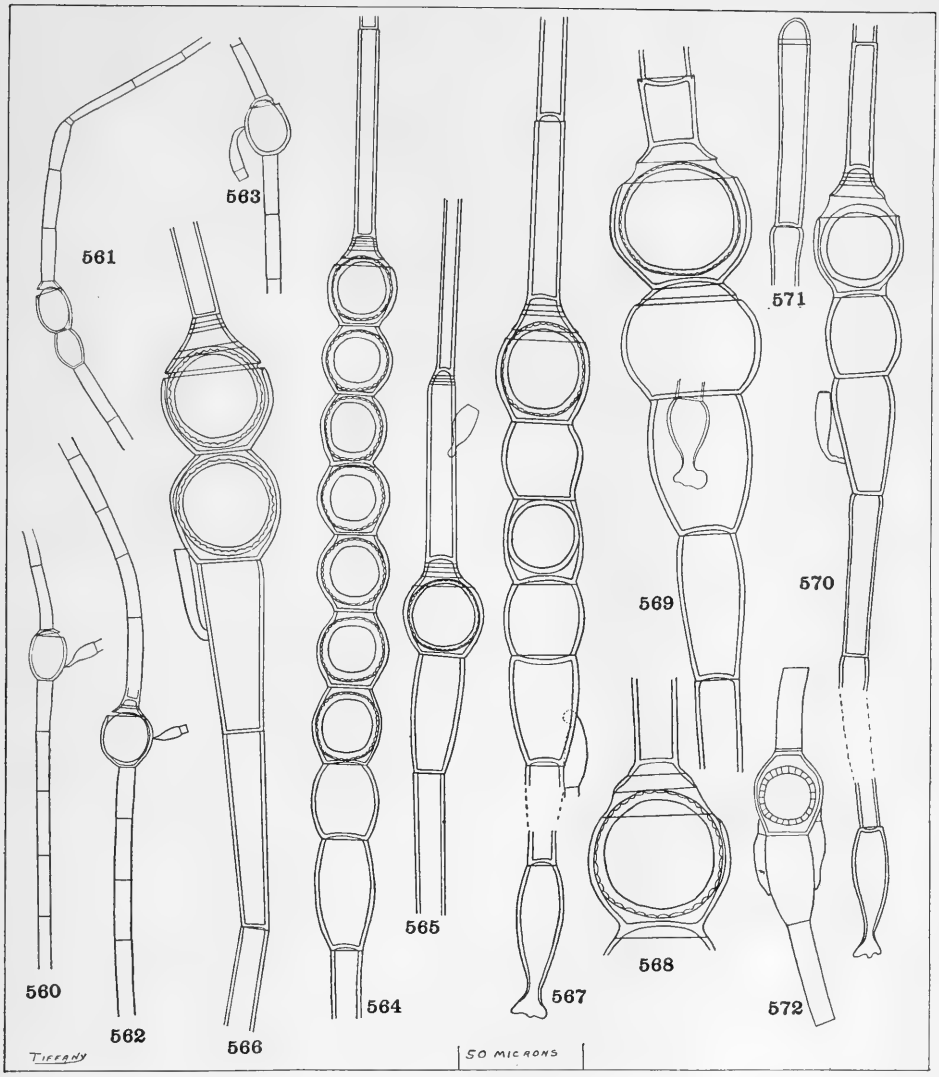
(Figs. 533, 537, 541, 544 show also oogonia in optical section seen from above.)

PLATE LVII.



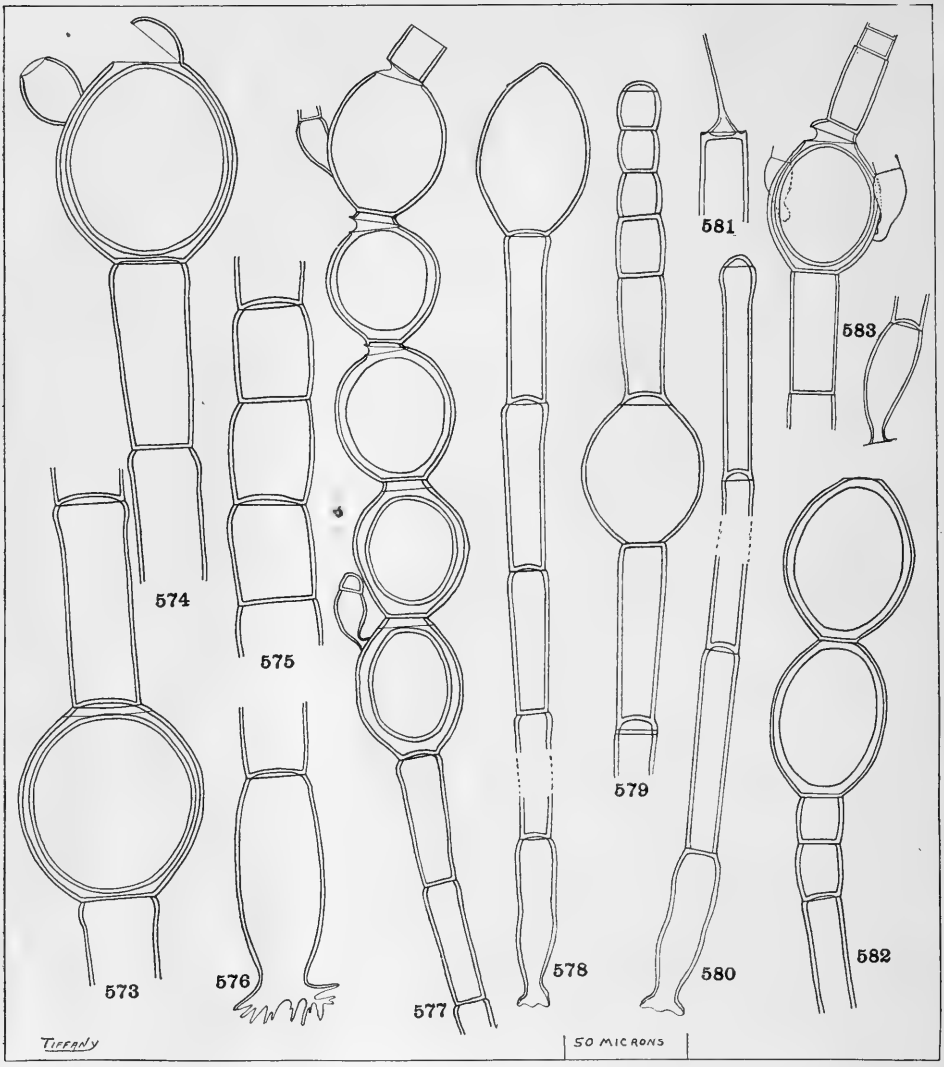
Page

Fig. 549. **Oedogonium macrandrium** Wittr.....151
Fig. 550. **Oe. macrandrium** f. **acuminatum** Hirn. (Redrawn from Hirn).....151
Fig. 551. **Oe. macrandrium** f. **aemulans** Hirn. (Redrawn from Hirn).....151
Fig. 552. **Oe. macrandrium** f. **lundense** (Wittr.) Hirn. (Redrawn from Hirn).....151
Fig. 553. **Oe. macrandrium** v. **propinquum** (Wittr.) Hirn.....152
Figs. 554–556. **Oe. macrandrium** v. **hohenackerii** (Wittr.) Tiffany.....152
Fig. 557. **Oe. macrandrium** v. **scrobiculatum** Ackley. (Redrawn from Ackley).....152
Fig. 558. **Oe. laetevirens** Wittr. (Redrawn from Hirn).....150
Fig. 559. **Oe. hoersholmiense** Hallas. (Redrawn from Hallas).....150



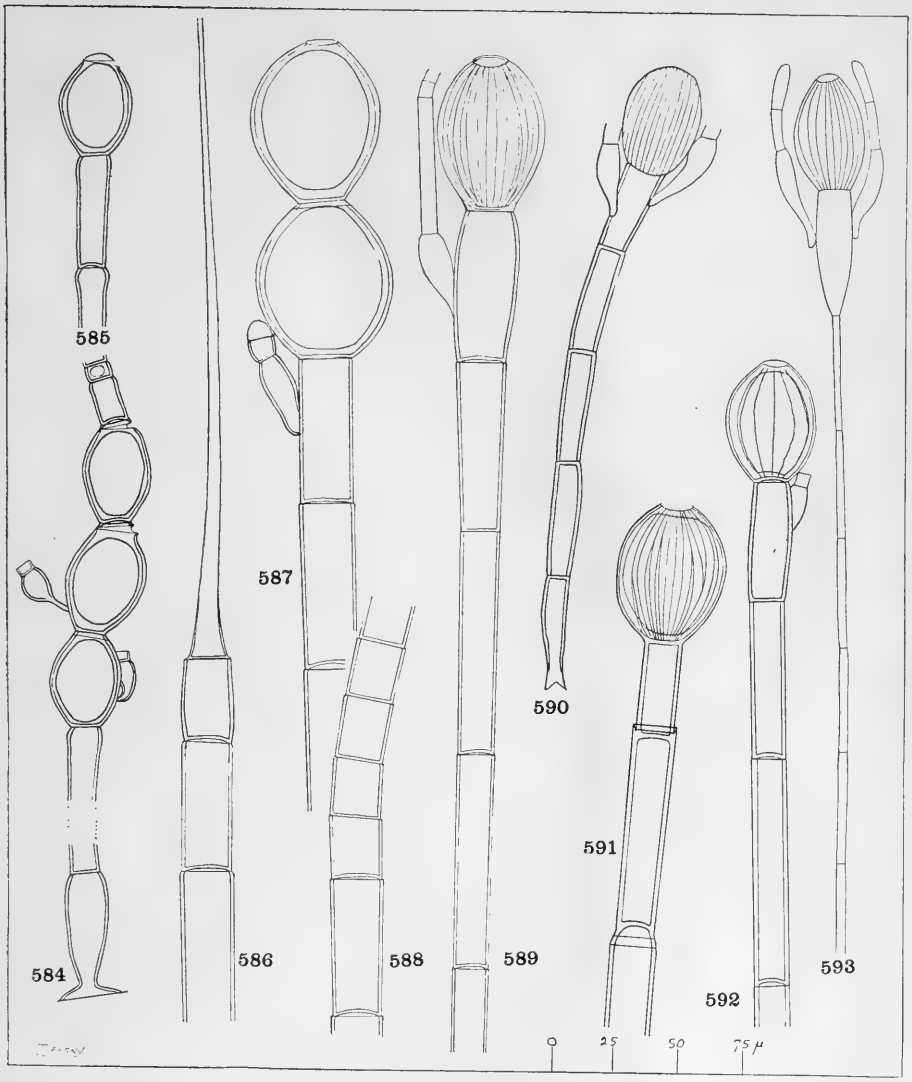
Page

Fig. 560. **Oedogonium rugulosum** Nordst. 148
Fig. 561. **Oe. rugulosum** f. **minutum** (Hansg.) Hirn. (Redrawn from Hirn)... 149
Fig. 562. **Oe. rugulosum** f. **rotundatum** Hirn. (Redrawn from Hirn)..... 149
Fig. 563. **Oe. longatum** Kuetz. 148
Figs. 564 and 565. **Oe. monile** Berk. and Harv. (Redrawn from Hirn)..... 154
Fig. 566. **Oe. monile** f. **victoriense** G. S. West. (After West)..... 154
Fig. 567. **Oe. monile** f. **borgei** Hirn. (Redrawn from Hirn)..... 154
Figs. 568 and 569. **Oe. monile** v. **eminens** Hirn. (Redrawn from Hirn)..... 154
Figs. 570 and 571. **Oe. hians** Nord. and Hirn. (Redrawn from Hirn)..... 149
Fig. 572. **Oe. schmidlei** Gutw. (After Gutwinski)..... 148



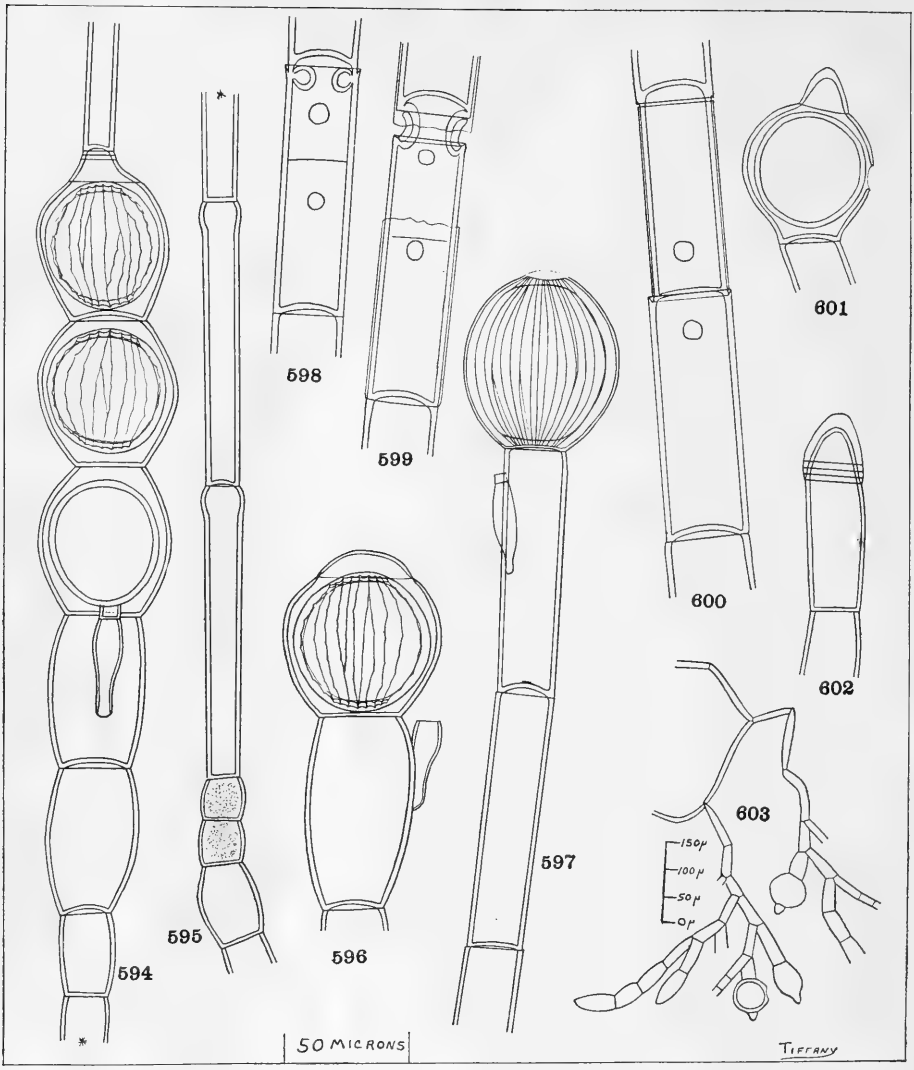
Page

Figs. 573–576. **Oedogonium supremum** Tiffany.....156
Fig. 577. **Oe. obtruncatum** Wittr.....155
Fig. 578. **Oe. obtruncatum** v. **ellipsoideum** Wittr. (Redrawn from Hirn).....155
Figs. 579–582. **Oe. obtruncatum** v. **completum** Hirn. (Redrawn from Hirn)...155
Fig. 583. **Oe. ciliatum** (Hass.) Pringsh.....153



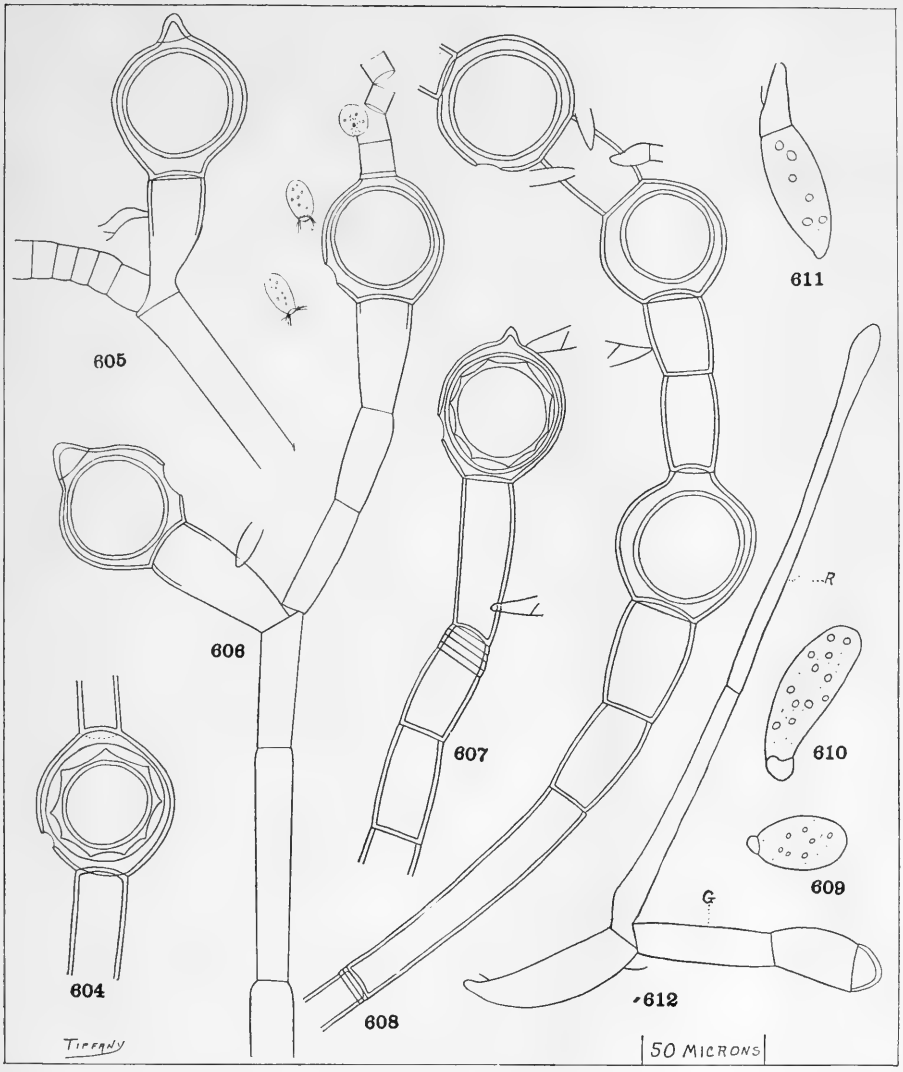
Page

Figs. 584 and 585. **Oedogonium wabashense** Tiffany.....156
Figs. 586–588. **Oe. praticolum** Transeau.....156
Fig. 589. **Oe. acrosporum** De Bary.....157
Fig. 590. **Oe. acrosporum** f. **boreale** (Wolle) Hirn. (After Wolle).....158
Fig. 591. **Oe. acrosporum** v. **majusculum** Nordst. (After Hirn).....159
Fig. 592. **Oe. acrosporum** v. **bathmidosporum** (Nord.) Hirn. (After Hirn).....158
Fig. 593. **Oe. acrosporum** v. **floridense** Wolle. (After Wolle).....158



Page

Figs. 594–596. **Oedogonium michiganense** Tiffany 157
Fig. 597. **Oe. tentoriale** Nordst. and Hirn 157
Figs. 598–600. Vegetative cell of **Oe. crassiusculum** Wittr. v. **idioandrosporum** N. and W. showing cell division and formation of apical cap 130
Figs. 601 and 602. **Oedocladium media** Lewis. (After Lewis) 52
Fig. 603. **Oedocladium media** Lewis, habit sketch. (After Lewis) 52



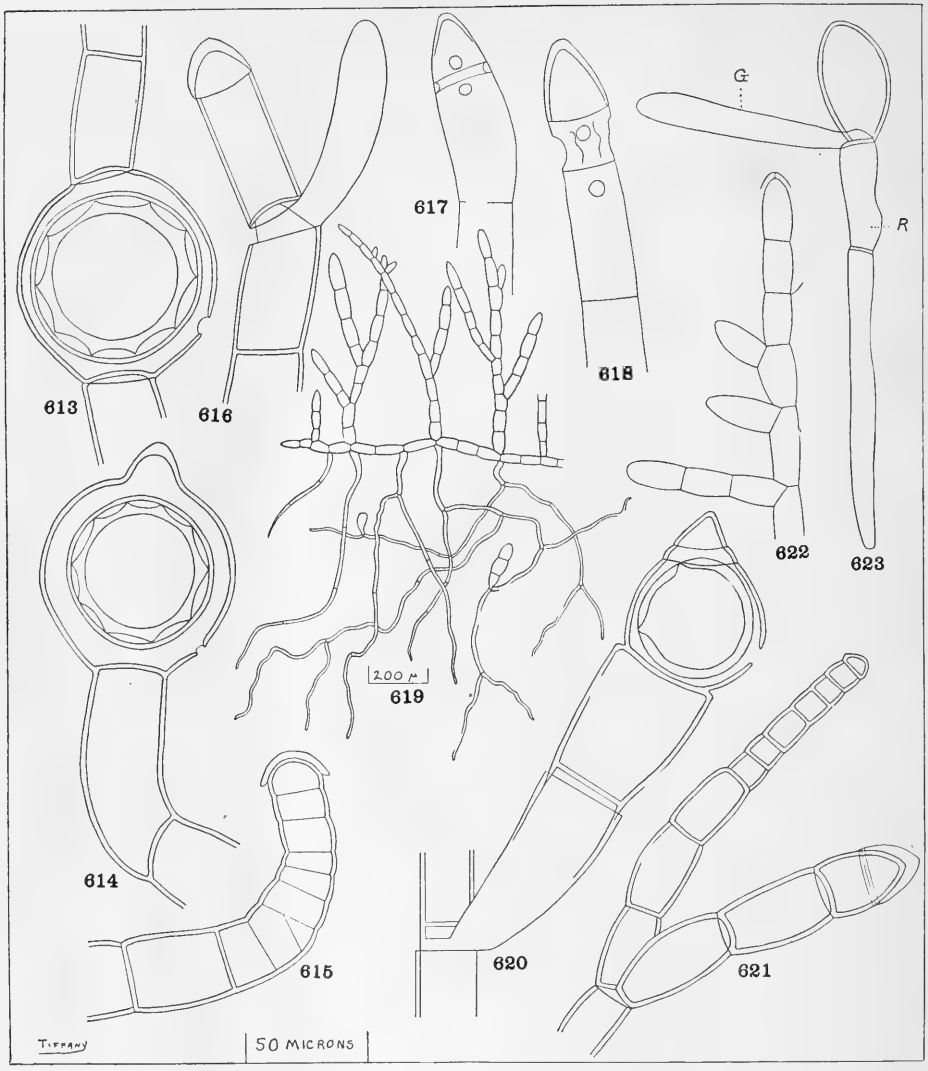
Page

Figs. 604–608. **Oedocladium hazenii** Lewis, showing habit and reproductive structures. Fig. 606, escape of androspores from androsporangia. (After Lewis) 52

Figs. 609–611. **Oedocladium hazenii** Lewis, stages in the germination of a zoospore. (After Lewis) 52

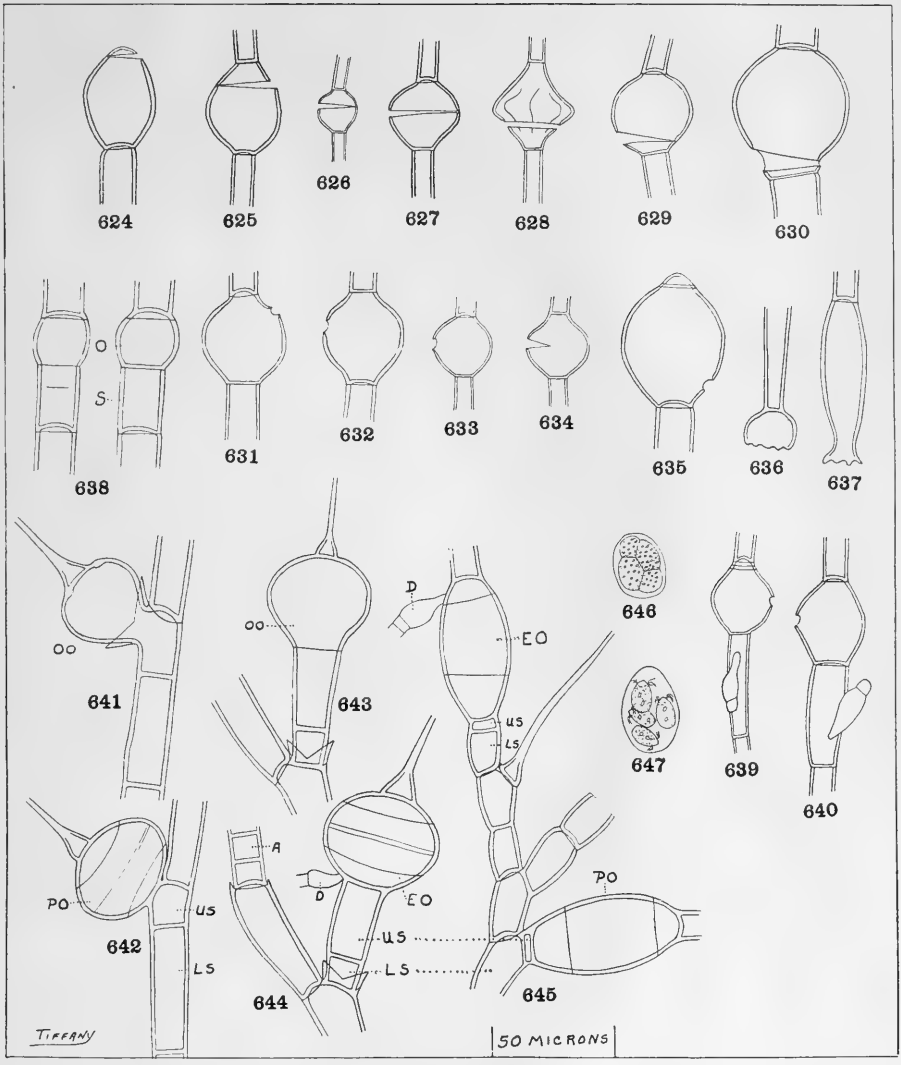
Fig. 612. **Oedocladium hazenii** Lewis, sporeling. (After Lewis). (R, rhizoidal cell; G, green cell of vegetative filament) 52

PLATE LXIII.



Page

Figs. 613–615. **Oedocladium albemarlensis** Lewis. (After Lewis)..... 51
Figs. 616-618. **O. albemarlensis** Lewis. Stages in cell division and branching..... 51
Fig. 619. **Oedocladium protonema** Stahl. Habit sketch, showing vegetative and rhizoidal cells, the latter with two resting cells. (Redrawn from Stahl.) 51
Figs. 620 and 621. **O. protonema** Stahl. Male and female branches. (Redrawn from Stahl)..... 51
Fig. 622. **O. protonema** Stahl. Part of filament with three side branches. (Redrawn from Stahl)..... 51
Fig. 623. **O. protonema** Stahl. Sporeling. (Redrawn from Stahl). (G, cell of green filament; R, rhizoidal cell)..... 51



Figs. 624–630. Different positions of operculum in operculate oogonia of Oedogonium. 624, supreme; 625, superior; 626, supramedian; 627, median; 628, inframedian; 629, inferior; 630, infimus (basal).

Figs. 631–635. Different positions of pore in poriferous oogonia of Oedogonium. 631, superior; 632, supramedian; 633 and 634, median; 635, inferior.

Fig. 636. Subhemispherical basal cell of Oedogonium.

Fig. 637. Elongated type of basal cell of Oedogonium.

Fig. 638. Formation of oogonium **O** and suffultory cell **S** from a division of a vegetative cell, in Oedogonium.

Figs. 639 and 640. Suffultory cells of Oedogonium.

Figs. 641–645. Formation of oogonium in Bulbochaete. **OO,** young oogonium; **PO,** patent oogonium; **EO,** erect oogonium; **US,** upper suffultory cell; **LS,** lower suffultory cell; **D,** dwarf male with antheridium; **A,** androsporangium.

Figs. 646 and 647. Development of 4 zoospores from germinating oospore. (After Juranyi.)

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