SOME NEW FORMS OF SPIROGYRA AND ŒDOGONIUM*

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In collections of algæ from northwestern Iowa during† the summer of 1923 and from Ohio during the past four years, there have appeared some forms of Spirogyra and Oedogonium not previously described. In each of the following descriptions a Latin as well as an English diagnosis is given, supplemented by camera lucida drawings. In addition, notes are given on dates and places of collection and on relationships of each form of algæ described. There is appended a short discussion on the importance of knowing the manner of growth of groups of algæ, like the Oedogoniaceæ, if the collector desires to make a complete survey of any algal habitat.

The thanks of the writer are due Professor R. B. Wylie for the opportunity of collecting algæ in Iowa, and to Professor E. N. Transeau for critical suggestions given throughout the study of these new forms.

Spirogyra echinata nov. sp.

Cellulis vegetativis 88–96μ latis, diametro 1–2–plo longioribus, dissepimentis planis; chromatophoris 4–7, anfractibus .5–1.5; vellulis fructiferis abbreviatis, et uno latere (in quo conjugatio sequiter) inflatis; zygosporis ovoideis, maturitate bruneis, crass. 68–85μ, diam. 76–120μ, mesosporio echinato.

Vegetative cells 88–96μ x 84–160μ, with plane end walls; 4–7 chromatophores making .5 to 1.5 turns; fertile cells shortened and inflated on the conjugating side; zygospores ovoid, 68–85μ x 76–120μ, often placed transverse to the filament; median spore wall echinate, brown.

This species has an appearance, in general, sumilar to that of *Spirogyra rheinhardii* Chmiel. and of *S. diluta* Wood. From the former it differs in dimensions and number of chromato-

*Papers from the Department of Botany, The Ohio State University, No. 148.

†The writer, upon the invitation of Professor R. B. Wylie, Head of the Department of Botany, The Iowa State University, spent the summer of 1923 at the Iowa Lakeside Laboratory, near Milford, Iowa. Several hundred collections of algae were made in the vicinity of the Laboratory. A systematic account of all the filamentous algae found in these collections is in progress.

phores. From both it differs markedly in having the middle wall of the zygospore very prominently echinate, the length of the echinate protuberances ranging from 6 to 9μ. This alga was collected from a cut-off of the Little Sioux River near Montgomery, Iowa, July 17, 1923. Type in Iowa collections herb. L. H. T. Collection No. 121. Plate I, Fig. 1.

Spirogyra pellucida Kuetz. var. *minor* nov. var.

Cellulis vegetativis 30–36μ latis, diametro 2–3–plo longioribus; zygosporis, crass. 40–56μ, diam. 50–64μ; ceterum ut in typo.

Vegetative cells 30–36μ x 73–100μ; zygospores 40–56μ in thickness, 50–64μ in diameter; otherwise as in the type.

This variety is easily distinguished from the type by its smaller dimensions throughout, particularly of the zygospores. *Spirogyra pellucida* Kuetz. apparently has not so far been recorded from America. The variety was collected by Mr. B. S. Meyer of the Department of Botany, the Ohio State University, in Baumgardner's Pond near Columbus, Ohio, May 3, 1923. Type in L. H. T. collections No. 354. Plate I, Fig. 2.

Oedogonium iowense nov. sp.

Oedogonium dioicum, macrandrium; oogoniis singulis vel binis, globosis vel ellipsoideo-globosis, operculo apertis, circumscissione superiore; oosporis eadem forma ac oogoniis, oogonia complentibus vel non complentibus, membrana lævi; antheridiis ad 25-cellularibus; spermatozoidis binis, divisione horizontali ortis; cellula fili, basali forma, ut vulgo, elongata;

crassit.	cell. veget.	10–16μ;	altit.	44–100μ;
"	oogon	52–60μ;	"	60–80μ;
"	oospor	45–56μ;	"	50–64μ;
"	cell. antherid.	10–12μ;	"	10–20μ;
"	cell. basal	16–24μ;	"	60–80μ.

Dioecious, macrandrous; oogonia single or in groups of two, globose or ellipsoid-globose, operculate, division superior; oospores of the same form as the oogonia which they completely fill or not, membrane smooth; antheridia 1-25 celled, sperms two, division horizontal; basal cells of filament commonly elongated;

Diam.	veg. cells	10–16μ;	length	44–100μ;
"	oogonia	52–60μ;	"	60–80μ;
"	oospores	45–56μ;	"	50–64μ;
"	antheridial cells	10–12μ;	"	10–20μ;
"	basal cells	16–24μ;	"	60–80μ.

This species bears some resemblance to *Oe. welwitschii* West, from which it differs in having smaller vegetative cells and larger oogonia. It differs from *Oe. pringsheimii* Cram.; Wittr. in having larger oogonia and oospores. The fact that the fruiting cells have a diameter of 3–6 times that of the vegetative cells gives this form a distinct place among the globose operculate species of Oedogonium. It was collected during July and August, 1923, in sloughs and bayous of West Lake Okoboji, Iowa. Type in Iowa collections herb. L. H. T. Collections No. 161, 194, 213. Plate III, Figs. 1–3.

Oedogonium latiusculum nov. sp.

Oedogonium dioicum, macrandrium; oogoniis singulis vel binis, globosis vel ellipsoideo-globosis, operculo apertis, circumscissione mediana, latissima; oosporis eadem forma ac oogoniis, oogonia complentibus vel fere complentibus, membrana lævi; plantis masculis paullulum crassioribus quam femineis; antheridiis unicellularibus, saepe cum cellulis vegetativis alternis; spermatozoidis singulis; cellulis vegetativis evidenter capitellatis; cellula fili basali subhemisphærica, non elongata; filis haud raro calce incrustatis;

crassit.	cell. veg. fem.	10–18 μ;	altit.	16–40 μ;
"	cell. veget. masc.	14–20 μ;	"	16–40 μ;
"	oogon.	32–36 μ;	"	32–40 μ;
"	oospor.	28–32 μ;	"	28–34 μ;
"	cell. antherid.	14–18 μ;	"	12–20 μ;
"	cell. basal.	16–24 μ;	"	12–16 μ.

Oedogonium dioecious, macrandrous; oogonia single or in groups of two, globose to ellipsoid-globose; oogonium operculate, division median, very wide; oospores of the same form as the oogonia, which they very nearly or completely fill, wall smooth; male plants somewhat larger than the female; antheridia unicellular, usually separated by a single vegetative cell, sperm one; vegetative cells distinctly capitellate; basal cell of filament subhemispherical, not elongated; filaments not infrequently incrusted with lime;

diam.	veg. cells, female.	10–18 μ;	length	16–40 μ;
"	veg. cells, male.	14–20 μ;	"	16–40 μ;
"	oogonia.	32–36 μ;	"	32–40 μ;
"	oospores.	28–32 μ;	"	28–34 μ;
"	antheridial cells.	14–18 μ;	"	12–20 μ;
"	basal cells.	16–24 μ;	"	12–16 μ.

This species is evidently near *Oe. pratense* Transeau, but differs in its much shorter and distinctly capitellate vegetative cells, in the shape of its basal cells, and in the differently shaped operculate oogonium with its wide opening. The dioecious habit

and the distinctly capitellate vegetative cells easily separate it from *Oe. acmandrium* Elfv. and from *Oe. psægmatosporum* Nordst. From *Oe. capitellatum* Wittr. it is further distinguished by its larger dimensions throughout. It was collected in June, July, and August, 1923, in Miller's Bay of West Lake Okoboji, in the East Bay of Spirit Lake, in Clear Lake, and in Swan Lake, Iowa. Type in Iowa collections herb. L. H. T. Collections No. 7, 146, 168, 212. Plate III, Figs. 4–6.

Oedogonium infimum nov. sp.

Oedogonium dioicum, macrandrium; oogoniis singulis, globosis vel subglobosis (vel interdum parte basalari paullo magis evoluta subpyriformi-globosis), operculo apertis, circumscissione infima; oosporis globosis vel subdepresso-globosis, oogonia fere complentibus, membrana lævi; plantis masculis paullo crassioribus quam femineis; antheridiis 1-10 cellularibus, spermatozoidis binis; cellulis vegetativis evidenter capitellatis; cellula fili basali subhemisphærica, non elongata; filis haud raro calce incrustatis;

crassit.	cell. veget. fem.	12–18μ;	altit.	60–140μ;
"	cell. veget. masc.	16–20μ;	"	60–140μ;
"	oogon.	40–48μ;	"	41–50μ;
"	oospor.	40–44μ;	"	38–42μ;
"	cell. antherid.	14–20μ;	"	8–12μ;
"	cell. basal.	30–42μ;	"	16–24μ.

Oedogonium dioecious, macrandrous; oogonia single, 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; antheridia 1–10 celled, sperms two; vegetative cells distinctly capitellate; basal cell of filament subhemispherical, not elongated; filaments not infrequently incrusted with lime.

diam.	veg. cells, female.	12–18μ;	length	60–140μ;
"	veg. cells, male.	16–20μ;	"	60–140μ;
"	oogonia.	40–48μ;	"	41–50μ;
"	oospores.	40–44μ;	"	38–42μ;
"	antheridial cells.	14–20μ;	"	8–12μ;
"	basal cells.	30–42μ;	"	16–24μ.

This species bears some resemblance to *Oe. inversum* Wittr. and the variety *subclusum* (Wittr.) Hirn. It differs from both in its larger dimensions and in having the male filaments larger than the female. The decidedly basal division of the operculate oogonium is its chief distinctive character. Hirn* in his

*Hirn, Karl E. Monographie und Iconographie der Oedogoniaceen. Helsingfors. 1900, p. 43.

tabular arrangement of the species of Oedogonium makes seven subdivisions of the globose, operculate forms, depending upon the position of the division of the oogonium. These subdivisions are: "Circumscissio: suprema, superior, supramediana, mediana, inframediana, inferior, infima." Hirn records no form of Oedogonium belonging to the group "Circumscissione infima." This, therefore, is apparently the first record of any species, either poriferous or operculate, belonging in that class; to designate such a decidedly basal opening the specific name *infimum* (L. *infimus*, lowest) is given. The outer spore wall, when not fully mature, sometimes appears slightly undulate, but this must not be taken to indicate an Oedogonium with rough-walled spores. So far this species has been recorded from Swan Lake and Clear Lake, Iowa, collected during July and August, 1923. Type in Iowa collections herb. L. H. T. Collections No. 146, 155, 231. Plate II, Figs. 6–9.

Oedogonium exospirale nov. sp.

Oedogonium dioicum, nannandrium, idioandrosporum; oogoniis singulis vel rarius binis, subglobosis vel oboviformi-globosis (rarius subhexagonis), poro mediano apertis; oosporis globosis vel subglobosis, oogonia fere complentibus, membrana duplici: episporio costis spiralter dispositis, costis spiralibus numero 5–8, utrinque in polo, in sectione horizontali, fere mediano, nunquam verticali sito conniventibus, endosporio lævi; cellulis suffultoribus tumidis; androsporangiis 1–6 cellularibus; cellula fili basali forma, ut velgo, elongata; nannandribus paullulum curvatis, in cellulis suffultoribus sedentibus, antheridio exteriore, 1–3 cellulari;

crassit.	cell. veget.	8–12μ;	altit.	60–88μ;
"	cell. suffult.	16–28μ;	"	60–88μ;
"	oogon.	40–44μ;	"	44–48μ;
"	oospor.	32–38μ;	"	38–40μ;
"	cell. andros.	12–16μ;	"	14–20μ;
"	stip. nannandr.	14–16μ;	"	30–40μ;
"	cell. antherid.	8–12μ;	"	14–16μ.

Oedogonium dioecious, nannandrous, idioandrosporous; oogonia single or rarely in groups of two, subglobose or oboviform-globose (rarely subhexagonal), pore median; oospores globose or subglobose, nearly filling the oogonia, membrane double, outer spore wall 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 spore wall smooth; suffultory cells swollen; androsporangia 1–6 celled; basal cells elongate; dwarf males a little curved, situated on the suffultory cells, with exterior antheridia 1–3 celled;

diam.	veg. cells	8–12μ;	length	60–88μ;
"	suffultory cells	16–28μ;	"	60–88μ;
"	oogonia	40–44μ;	"	44–48μ;
"	oospores	32–38μ;	"	38–40μ;
"	androsporan. cells	12–16μ;	"	14–20μ;
"	dwarf male stipe	14–16μ;	"	30–40μ;
"	antheridial cells	8–12μ;	"	14–16μ.

Forms of Oedogonium nearest this species are *Oe. illinoiense* Transeau and *Oe. spirale* Hirn. From both it differs in the considerably smaller dimensions of the vegetative and fruiting cells. It further differs from the former in being idioandrosporous. It is readily separated from *Oe. huntii* Wood by the median position of the pore of the oogonium and by its dimensions. The form was recorded from the East Bay of Spirit Lake and from a slough north of West Lake Okoboji, Iowa, during July and August, 1923. Type in Iowa collections herb. L. H. T. Collections No. 161, 168. Plate II, Figs. 1–3.

Oedogonium supremum nov. sp.

Oedogonium dioicum, nannandrium, idioandrosporum; oogoniis singulis vel rarius 2–4 continuis, globosis vel ellipsoideo-globosis, sæpe terminalis; operculo apertis, circumscissione surpema, operculo sæpe deciduo; oosporis eadem forma ac oogoniis, hæc plaen complentibus, membrana lævi; cellulis suffultoriis eadem forma ac cellulis ceteris; androsporangiis 1–6 cellularibus; cellulis vegetativis evidenter capitellatis; cellula fili basali forma, ut vulgo, elongata; nannandribus late oboviformibus, unicellularibus, in oogonis sedentibus;

crassit.	cell. veget	24–32μ;	altit.	60–132μ;
"	oogon	66–78μ;	"	72–90μ;
"	oospor	60–66μ;	"	66–84μ;
"	cell. andros	26–28μ;	"	30–40μ;
"	nannandr	20–24μ;	"	24–26μ;
"	cell. basal	28–32μ;	"	90–110μ.

Oedogonium dioecious, nannandrous, idioandrosporous; oogonia single or rarely in groups of 2–4, globose or ellipsoid-globose, often terminal, operculate, division at the upper extremity of the oogonium, lid often deciduous; oospores of the same form as the oogonia which they completely fill, membrane smooth; suffultory cells of the same form as the other vegetative cells; androsporangia 1–6 celled; vegetative cells distinctly capitellate; basal cell of the filament elongated; nannandrium broadly oboviform, unicellular, situated on the oogonia;

diam.	veg. cells	24–32μ;	length	60–132μ;
"	oogonia	66–78μ;	"	72–90μ;
"	oospores	60–66μ;	"	66–84μ;
"	androsporan. cells	26–28μ;	"	30–40μ;
"	dwarf males	20–24μ;	"	24–26μ;
"	basal cells	28–32μ;	"	90–110μ.

This species is nearest *Oe. praticolum* Transeau and *Oe. obtruncatum* Wittr., from both of which it differs in having much larger dimensions and differently shaped oogonia and oospores. The terminal cells are not apiculate. It differs from *Oe. kitutae* West in being operculate, and in the general form of the vegetative and fruiting cells. Since this species is one of the few forms whose operculate division is at the upper extremity of the oogonium, the specific name *supremum* (L. *supremus*, highest) is applied. It was found in West Lake Okoboji, Iowa, during August, 1923. Type in Iowa collections herb. L. H. T. Collection No. 194. Plate I, Figs. 3 and 4; Plate II, Figs. 4 and 5.

Oedogonium grande Kuetz.; Wittr. var. *robustum* (Hirn) nov. comb. Hirn: Monographie und Iconographie der Oedogoniaceen, p. 144, 1900.

Var. omnibus partibus crassioribus;

crassit.	cell. veget. fem.	32–46μ;	altit. 80–200μ;
"	cell. veget. masc.	32–42μ;	" 80–200μ;
"	oogon.	52–68μ;	" 75–90μ;
"	oospor.	50–64μ;	" 68–88μ;
"	cell. antherid.	30–36μ;	" 10–16μ.

Somewhat larger than the type in all dimensions;

diam.	veg. cells, female.	32–46μ;	length 80–200μ;
"	veg. cells, male.	32–42μ;	" 80–200μ;
"	oogonia.	52–68μ;	" 75–90μ;
"	oospores.	50–64μ;	" 68–88μ;
"	antheridial cells.	30–36μ;	" 10–16μ.

Although listed by Hirn as a robust form of *Oe. grande*, its very common occurrence in American material generally, either with the type or separate, seems to warrant a varietal rank. The American forms are considerably larger than the type. This variety along with the type is normally a summer annual, occasionally fruiting as early as June or as late as September. Plate III, Fig. 7.

Filaments of Spirogyra are usually found free-floating in quiet bodies of water, or remain stationary because they are associated, accidentally or otherwise, with other algæ or flowering plants that are attached to the substratum. It generally is true that one is likely to find a considerable mass of a species of Spirogyra, if collections are made in the proper season, instead of isolated individuals.

Species of Oedogonium, on the contrary, may be attached by holdfast cells during their entire vegetative and reproductive periods of growth. Some forms, such as *Oe. capilliforme* Kuetz.; Wittr., *Oe. crassiusculum idioandrosporum* Nordst. et Wittr., *Oe. grande* Kuetz.; Wittr., and *Oe. anomalum* Hirn, frequently form individual or collective masses of considerable size with holdfast cells difficult to find. Such species as *Oe. iowense, Oe. latiusculum, Oe. infimum, Oe. supremum,* and *Oe. exospirale* (described above), as well as many others, including *Oe. inversum* Wittr., *Oe. nanum* Wittr., and *Oe. praticolum* Transeau, are not known to form such masses. They occur as epiphytes on the leaves and stems of submerged higher plants and on species of Cladophora, Pithophora, and larger Oedogoniums. The number of such epiphytes upon their hosts is usually small and is further reduced pretty close to a minimum in the small sample that makes up the microscopic mount of the material. It is for the reason of this more or less solitary existence that species of Oedogonium are so often overlooked by collectors of algæ, not only in the field but also after they may be safely preserved in collections!

Many of the smaller species of Oedogonium are often so incrusted with such a heavy deposit of lime (mostly $CaCO_3$) that even generic identification is difficult. If filaments so incrusted are placed on a slide, a few drops of lactic acid added, and the whole gently heated, the entire incrustation is removed without injury to the cells or changes in their dimensions. In addition, the basal cells, often a species criterion, are made perfectly visible.

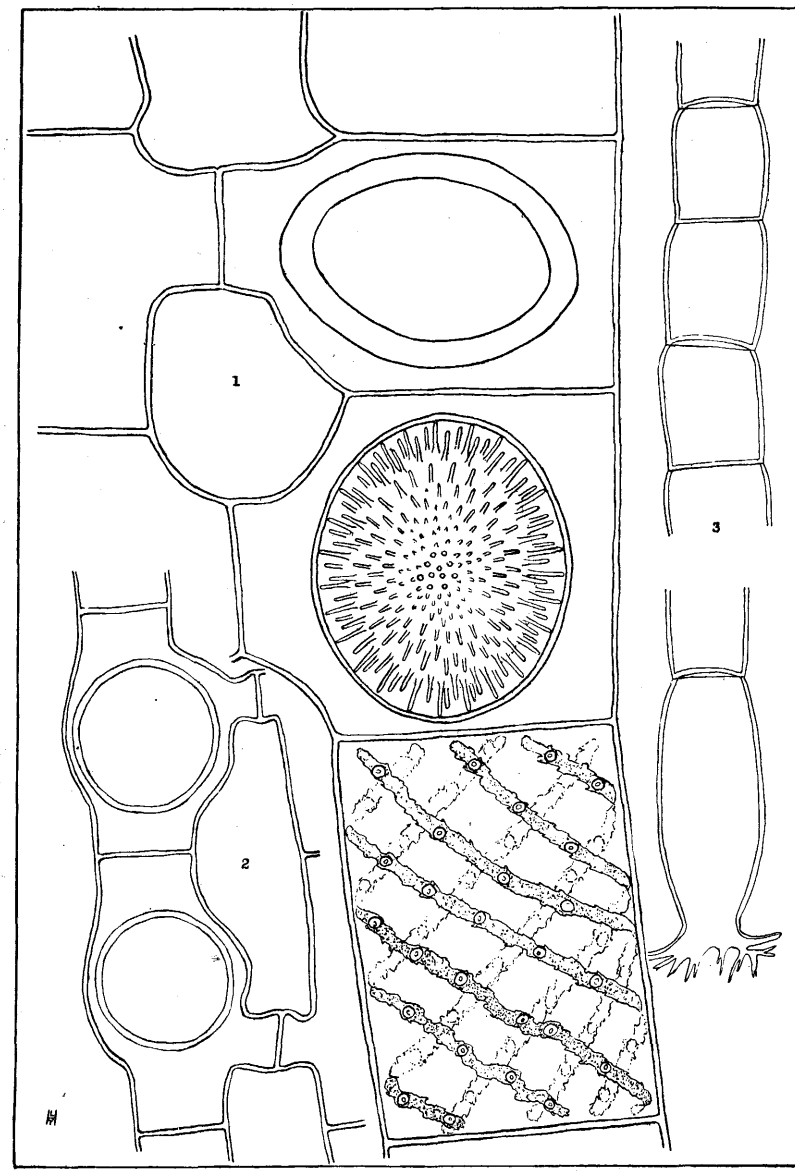
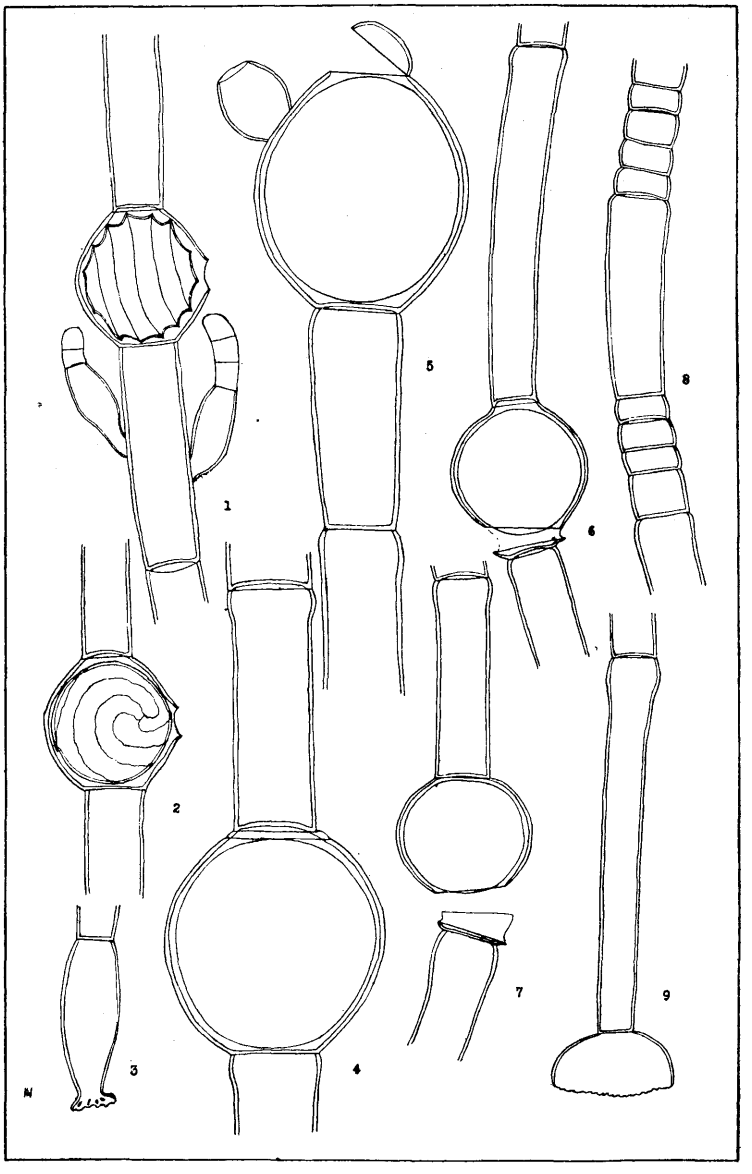
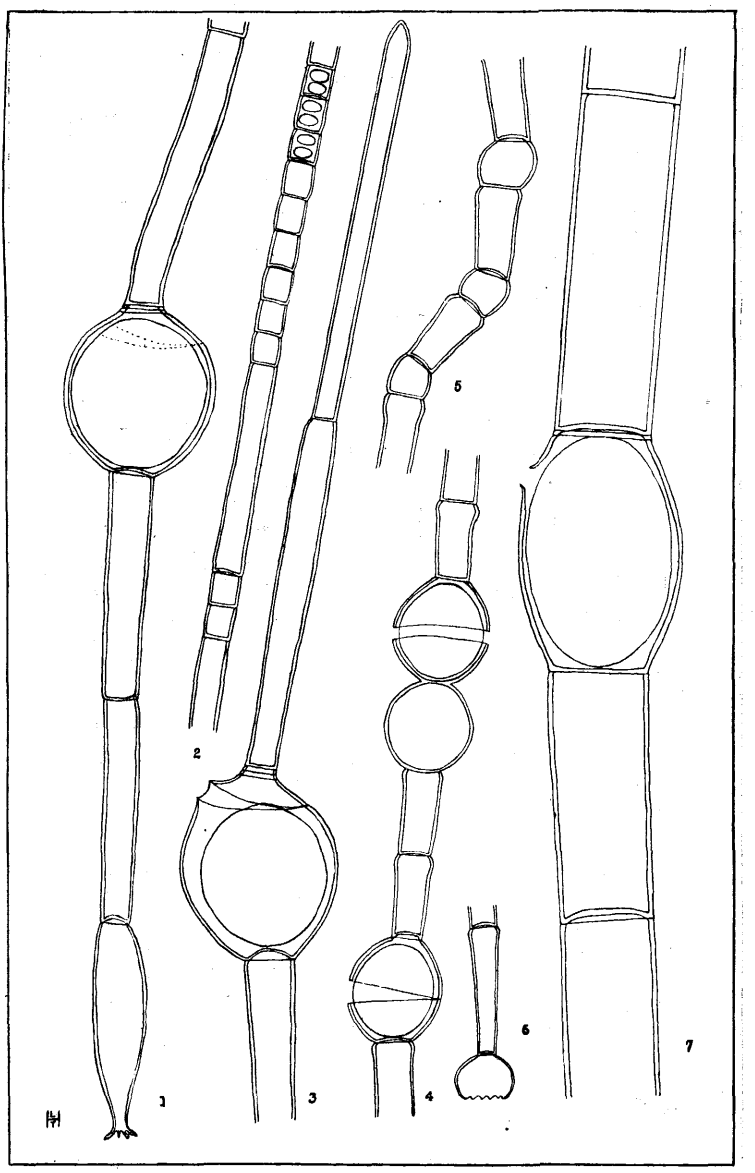


Fig. 1. *Spirogyra echinata,* showing chromatophores of one vegetative cell, a mature zygospore with echinate protuberances, and the variable position of the spore.
Fig. 2. *Spirogyra pellucida* var. *minor.*
Fig. 3. Androsporangial cells of *Oedogonium supremum.*
Fig. 4. Basal cell of filament of *Oedogonium supremum.*



Figs. 1–3. *Oedogonium exospirale.*
Figs. 4–5. *Oedogonium supremum.*
Figs. 6–9. *Oedogonium infimum.*



Figs. 1–3. *Oedogonium iowense.*
Figs. 4–6. *Oedogonium latiusculum.*
Fig. 7. *Oedogonium grande* var. *robustum.*