

NOTES ON THE ZYGNEMALES.*

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The following notes principally concerning North American Zygnemales are based on a study of the specimens accumulated in the course of eight years collecting in central Illinois; a collection made by Mr. Charles Bullard, of Cambridge, Mass., in Massachusetts and New Hampshire; the specimens distributed in the *Phycotheca Boreali-Americana* by Collins, Holden and Setchell; the specimens distributed in *American Algae*, by Miss Josephine E. Tilden; the specimens in the U. S. National Herbarium; and small collections sent me by Professor Farlow, Miss Tilden, Professor A. B. Klugh, Professor D. S. Johnson and Miss Grace Stone. They have been compared with the species distributed by Wittrock and Nordstedt in their "*Algae Aquae dulcis exsiccatae*," and other valuable European and South American specimens sent me by Professors O. Borge and O. Nordstedt.

In determining almost any species of the Zygnemales it is absolutely essential that the specimens show both the vegetative cells and the mature spores. With the exception of a few species of *Mougeotia* the spores are colored either yellow, brown, or blue when they are mature. The characteristic markings of the median spore wall do not develop usually until this color appears. Consequently it is useless to attach names to vegetative specimens based on dimensions and number of chromatophores. Keys based on such characters are not only useless, but misleading.

Judging from my experience in Illinois it is highly probable that the list of North American forms will be considerably augmented, when intensive studies have been made at localities in the Southern United States. The most satisfactory method of collecting these forms is to take samples from the various ponds and streams at regular intervals of ten days, or two weeks, throughout the growing season. Many of the species show local variations and considerable experience is needed before many

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of the forms can be satisfactorily classified. The writer has in course of preparation an illustrated key to the group, in which figures for all of the species will be published.

DEBARYA Wittrock.

This genus is in many respects the most generalized of all the *Zygnemales*. It is distinguished by three important characteristics: (1) the entire contents of the gametangia enter into the making of the zygospore; (2) the zygospore is formed in the conjugating tube and is not cut off from the other parts of the gametangia by partition walls; (3) as the gametes move toward the tube during conjugation, their place is taken by a secretion of cellulose, which renders the gametangia solid and highly refractive. This secretion also occurs when a vegetative cell forms an aplanospore.

Debarya glyptosperma Wittrock.

This species has been recorded for America. It is not uncommon in Massachusetts and has also been found in Minnesota and Florida. In P. B.-A. No. 808 from Boswell, California is a somewhat smaller variety with blue spores associated with *Zygnema peliosporum* Wittr. The spores are common in the material and the vegetative cells and filaments occasional. Following is a diagnosis for this variety:

Var. **formosa** nov. var. Cellulis vegetativis $7.5-9\mu$ latis; zygosporis $24-30\mu \times 30-42\mu$, caeruleis; ceterum ut in typo.

Vegetative cells $7.5-9\mu$ in diameter, zygospores $24-30\mu \times 30-42\mu$ steel blue, otherwise like the type.

Debarya americana nov. sp.

Cellulis vegetativis $9-12\mu \times 27-120\mu$, ad dissepimenta constrictis; chromatophoris cum pyrenoidibus 2; cellulis fructiferis $10-14\mu \times 75-180\mu$; zygosporis ovoideis vel quadrato-ovoides, $20-40\mu \times 30-40\mu$, angulis rotundatis, productis, vel retusis; parthenosporis $15-20\mu \times 20-30\mu$, oblique ellipticis, cum polis retusis; mesosporio subtiliter et irregulariter verrucoso, maturitate luteo-brunneo.

Vegetative cells $9-12\mu \times 27-120\mu$ constricted at the end walls, chromatophore with two pyrenoids; fertile cells $10-14\mu \times 75-180\mu$; zygospores ovoid or quadrately ovoid, $20-40\mu \times 30-40\mu$, with angles rounded, produced, or retuse; parthenosporis $15-20\mu$ -

x 20-30 μ unilaterally ellipsoid with retuse ends; median spore wall minutely and irregularly verrucose, yellow-brown at maturity.

This species was collected by Professor A. B. Klugh, Kingston, Ontario. It is the material upon which the Ontario record for *Mougeotia calcarea* (Cleve) Wittr. is based. Of special interest is the chromatophore with two pyrenoids, which although an axile plate is distinctly two-lobed and forms an easy transition to the next species, in which the chromatophore resembles *Zygnema*. Type in herb. E. N. T. Collection No. 2950.

Debarya decussata nov. sp.

Cellulis vegetativis 16-20 μ x 25-50 μ cylindraceis; chromatophoris asteroidiis duobus, singulis cum pyrenoidibus (ut in *Zygnemate*); zygosporis vel ovoideis, vel irregularibus, 24-30 μ x 30-48 μ cum angulis vel rotundatis, vel retusis, vel productis; aplanosporis uno latere ovoideis, 17-25 μ x 20-40 μ ; parthenosporis 15-20 μ x 20-30 μ ; membrana media sporarum scrobiculata, luteo-brunnea; akinetis ad dissepimenta constrictis, membrana subcrassa et glabra, 18-20 μ x 20-36 μ .

Vegetative cells 16-20 μ x 25-50 μ cylindrical; chromatophores two, stellate, each with a pyrenoid (as in *Zygnema*); zygosporis ovoid, quadrate-ovoid, or irregular, 24-30 μ x 30-48 μ , with rounded, retuse, or produced angles; aplanosporis unilaterally ovoid, 17-25 μ x 20-40 μ ; parthenosporis 15-20 μ x 20-30 μ ; median spore walls scrobiculate, yellow-brown; akinetes with smooth heavy walls, 18-20 μ x 20-30 μ .

Type in herb, E. N. T. Collections No. 1177, 1939, 1949, 2686 and 2918. I have specimens from several localities in central Illinois; Williamsport, Pa.; Minnesota; Mackinaw, Mich. and Kingston, Ontario.

This form is of great interest because of its resemblance, in the vegetative condition, to *Zygnema decussatum* (Vauch.) Transeau. Also because it shows not only the zygosporis, but aplanosporis and parthenosporis. In all cases the secretion of cellulose accompanies the process of spore formation. The unilaterally placed aplanosporis are strikingly different from those formed by the *Zygnemas*. In some of the Illinois ponds it regularly produces only zygosporis, in other ponds from which I have collections covering a period of several years it

fruited only asexually, producing aplanospores and akinetes. But several of the collections show all the forms of reproduction in different cells of the same filament.

The characteristics of this species suggest that the peculiar *Zygnema reticulatum*, which was described by Hallas in 1895*, is in reality a *Debarya*. The fact that the reproductive cells become filled with cellulose, that the aplanospores are very irregular in form and that the vegetative cells contain as high as seven chromatophores, are all in harmony with this idea. On this basis it is also easy to understand the most notable peculiarity of the species—that spores derived from cells with several chromatophores produce two or three sporelings.

With the addition of the two new American species and this Danish species ***Debarya reticulata*** (Hallas) nov. comb. the description of the genus needs to be modified as follows:

Vegetative cells cylindrical or constricted at the ends, varying from 1-16 diameters in length; chromatophore varying from an axile plate with two or more pyrenoids to stellate chromatophores, each with a central pyrenoid. Reproduction by zygospores formed of the complete contents of the gametangia; not cut off from the gametangia by partition walls; but in the process of conjugation, as the gametes pass into the conjugating tube, their place is taken by a secretion of cellulose. Aplanospores occupying only part of the sporogenous cell, the remainder being filled with cellulose. All spores variable in form. Parthenospores and akinetes occur not infrequently in some of the species. The walls of the aplanospores and parthenospores resemble the zygospores of the same species in their markings.

There are now eleven described species belonging to this genus. *D. immersa* W. West and *D. africana* G. S. West bear a close resemblance to *Mongeotia sphaerocarpa* Wolle. *D. Hardyi* G. S. West has much the same appearance as *Mongeotia viridis* (Kutz) Wittrock. *D. desmidiodes* W. & G. S. West, *D. calospora* (Palla) W. & G. S. West, *D. reticulata*, *D. americana*, and *D. decussata* have characters in common with the *Zygnemas*. *D. glyptosperma* has the vegetative characters common to several of the species, but its spores are quite unique among the *Zygnemales*.

*Hallas, E., Om en ny Zygnema-Art med Azygosporer. Bot. Tidsskrift 20:1-16. 1895.

ZYGNEMA Agardh.**Z. pectinatum** (Vauch.) Agardh.

This is probably common in the eastern half of the United States at least. In Illinois along with the type occurs the variety *conspicuum* (Hass.) Kirchner, and a variety with large spores. This latter variety in fact is more common than the type.

var. **crassum** nov. var. Cellulis vegetativis 30-40 μ x 20-80 μ ; zygosporis 40-55 μ x 50-60 μ , ceterum ut in typo.

Vegetative cells 30-40 μ x 20-80 μ ; zygosporis 40-55 μ x 50-60 μ , otherwise like the type. Type in herb. E. N. T. Collections No. 2350, 2392, 2660, 2685.

Z. ericetorum (Kütz) Hansgirg.

Professor G. S. West has studied the reproduction of this species and finds that it is a true Zygnema and that the description and figure by De Bary, which shows the cutting off of two special gametangia before the union of the gametes is at fault, consequently there is no longer any need of maintaining the genus *Zygogonium* Kützing.

Z. peliosporum Wittrock.

Specimens of this species have been distributed under the name of *Z. chalybeospermum* Hansgirg, in P. B.-A. No. 808 from Boswell, Calif. (N. L. Gardner); Amer. Alg. No. 156 from Ft. Collins, Colo. (J. H. Cowan); and Amer. Alg. No. 392 from Vancouver, B. C. (J. E. Tilden). *Z. chalybeospermum* has the median wall smooth, but the spores of all of the above specimens have distinctly scrobiculate median walls. In size the specimens show a somewhat greater variation in dimensions than has been recorded for European localities.

Z. cruciatum (Vauch) Agardh.

Specimens of this species have been found at Fath Pond, north of Coffeen, Ill., in which both zygosporis and aplanosporis occurred in abundance. The aplanosporis fill or slightly enlarge the vegetative cells as in *Z. Collinsianum* Transeau,* but the ends of the spores are usually more nearly truncate, 34-50 μ x 30-80 μ . At Casey, Ill., a variety with the same dimensions but steel blue spores occurs in the old Ice Plant Pond.

*See Fig. 3, Plate XXV, Amer. Jour. Bot. 1:301. 1914.

var. **caeruleum** nov. var. Cellulis vegetativis et sporis ut in typo, sed membrana media sporarum caerulea.

Vegetative cells and spores as in the type, except that the median spore wall is steel blue. Type in Collection E. N. T. No. 495.

Zygnema stellinum (Müller) Agardh.

The specimen distributed under the name *Z. insigne* (Hass.) Kütz. in the P. B.-A. No. 457, from Chestnut Hill, Mass. (G. F. Moore), belongs to this species as shown by the scattered mature spores. This species is common everywhere in central Illinois. In the U. S. Natl. Herb. is a specimen from Baltimore Co., Md., (J. D. Smith). In Amer. Alg. No. 157, a specimen from St. Paul, Minn., (J. E. Tilden) shows both zygospores and aplanospores. The aplanospores are cylindric ovoid in form, occupying the entire cell $30-33\mu \times 40-88\mu$, median wall scrobiculate.

Zygnema cylindricum nov. sp.

Cellulis vegetativis $28-33\mu \times 28-66\mu$; zygosporis incognitis; aplanosporis cylindricis vel tumido-cylindricis, $30-33\mu \times 24-58\mu$, sporangia complentibus; membrana media brunnea scrobiculata.

Vegetative cells $28-33\mu \times 28-66\mu$; zygosporis unknown; aplanospores cylindric or tumid-cylindric, $30-33\mu \times 24-58\mu$, filling the sporangia, median wall brown, scrobiculate. Type in Herb. E. N. T. No. 1164, 1177.

This species is not uncommon in ponds, and pools throughout central Illinois. It was at first classified as aplanosporic material of *Z. stellinum* (Müller) Agardh. On going over the specimens in all my collections, however, it was found that in no case were the filaments containing the aplanospores connected with the filaments containing zygospores. This must be the final test of the identity of the species, as it occurs in some collections alone, sometimes associated only with fruiting *Zygnema pectinatum*, and sometimes with *Z. stellinum*.

Zygnema rhynchonema Hansg.

In a collection of algae made at the Minnesota Seaside Station, Vancouver Island, B. C., in 1901, by Professor Tilden, is a form which perhaps belongs here. The vegetative cells are from $22-28\mu$ in diameter, and $32-52\mu$ in length, while the European specimens are described as $16-20\mu$ in diameter and

2-6 diameters long. The Vancouver specimens are producing both aplanospores (globose, 24-26 μ in diam.), and zygospores (ovoid 24-28 μ x 36-44 μ) by the union of gametes through the partition wall separating the two gametangia. The specimens show some evidences of being in an abnormal condition.

SPIROGYRA Link.

S. Juergensii Kützing.

The specimen in P. B.-A. No. 510 from Knightsville, R. I., distributed under the name of *S. longata* (Vauch) Kütz. with cell diameter 27-30 μ , and ellipsoid spores 30-33 μ in diameter, fertile cells enlarged, evidently belongs to this species. The spores of *S. longata* are distinctly ovoid with rounded ends. In the Illinois specimens the spores of *S. Juergensii* frequently occur with diameters up to 33 μ .

S. varians (Hass.) Kütz.

The varieties *scrobiculata* Stockman and *minor* Teodoresco have not been reported from America. They both occur rarely in Illinois. The latter I have also seen in material collected by Mr. Charles Bullard, at Lynnfield, Mass. The former is characterized by its scrobiculate spores, the latter by its smaller dimensions throughout. In my herbarium *S. varians scrobiculata* is represented in Collections No. 1799, and 1881; and *S. varians minor* in Collection No. 2951.

S. Borgeana nov. sp.

Cellulis vegetativis 30-35 μ x 50-200 μ , dissepimentis planis, chromatophoris singulis anfractibus arctis 1.5-5; cellulis fractiferis altero latere inflatis, altero latere (in quo conjugatio sequitur) rectis; zygosporis ellipticis, 33-40 μ x 54-70 μ , membrana media flava, glabra.

Vegetative cells 30-35 μ x 50-200 μ , end walls plane, 1 chromatophore making 1.5-5 turns; fertile cells inflated on the outer side, straight on the conjugating side; zygospores ellipsoid 33-40 μ x 54-70 μ , median wall yellow, smooth. Type in herb. E. N. T. Coll. No. 1883, 1890. Charleston, Illinois.

This species bears some resemblance to a form of *S. varians* figured by Professor Borge.* It differs from his figure in that the conjugating side of the fertile cells is not at all swollen,

*Borge, O., Beitrage zur Algenflora von Schweden.

and the dimensions are somewhat larger. If this form had been found but once it would have been passed over as a variation intermediate between *S. Juergensii* and *S. varians*. But it has been found several successive years in a small stream south, and at a small pond west of Charleston, Illinois.

S. lutetiana Petit.

So far as I am aware no specimens of this species have been found in America. The Illinois record in my list* is an error. The P. B.-A. specimen labelled *S. lutetiana* is *S. fallax* (Hansg.) Wille, as shown by its often replicate cell walls, verrucose spores and the number of chromatophores.

S. velata Nordstedt var. **occidentalis** Transeau.

Specimens of this variety have been distributed in the P. B.-A. No. 96, under the name of *S. dubia* Kütz. var. *longiarticulata* Kütz. from Oak Bay, Victoria, British Columbia (N. L. Gardner). The spores are for the most part not mature but they show the characteristic scrobiculate markings of the median wall.

S. Lagerheimii Wittrock.

This species is not uncommon in central Illinois. The specimen labelled *S. communis* in P. B.-A. No. 1416, from Winchester, Mass., has a cell diameter over 30μ , and the spores are ellipsoid instead of ovoid. The median spore wall in the mature spores is punctate. Here also belongs the P. B.-A. specimen No. 365, Falmouth, Mass. Both the vegetative cells and the spores are considerably below the lower dimensions for *S. porticalis*. The P. B.-A. specimen No. 1668, *S. porticalis* var. *tenuispira* Collins establishes this name as a synonym of *S. Lagerheimii*. Professor Farlow has recently sent me a specimen of this species from Chocorua, N. H.

S. daedalea Lagerheim.

This species has recently been found in a pond south of Coffeen, Ill. The spores show the characteristic markings and the dimensions are near those of the original collection. The spores are slightly more rhomboidal than in the type material, which I have seen. In herb. E. N. T. Collection No. 2912, 2850.

*Transeau, E. N., Annotated list of the Algae of Eastern Illinois. Trans. Ill. Acad. Sci. 6:69-89, 1913.

S. Goetzei Schmidle.

This species previously known only from the tropics has been found in the collection of Mr. Charles Bullard, from Wellfleet, Mass. In herb. E. N. T. Collection No. 2954.

S. submarina (Collins) nov. comb.

This species was described by Collins as a variety of *S. decimina* (Müller) Kütz. which it somewhat resembles in the form of the vegetative cells. The spores, however, are distinctly ellipsoid, while those of *S. decimina* are ovoid. The dimensions are much smaller than those of *S. decimina*. It seems better therefore to recognize this as a distinct species. It has been collected in Massachusetts, Connecticut and Bermuda.

E. ellipsozona Transeau.

Described originally from Illinois, I have seen specimens during the past year from Maine, Massachusetts and Minnesota. Professor G. S. West* described about the same time a species from Columbia, South America, which appears to be a form of this same species. The vegetative cells are considerably larger, the chromatophores are six (or five) in number, and the spores are at the upper limit of size of the North American form. As our specimens all show, a wider range of dimensions and number of chromatophores, the South American form is best classified as a variety under the name *S. ellipsozona* var. **splendida** (G. S. West) nov. comb.

S. propria nov. sp.

Cellulis vegetativis 60-68 μ x 80-150 μ , dissepimentis planis; chromatophoris 3, anfractibus arctis .5-1; cellulis fructiferis cylindricis; zygosporis ellipticis 42-60 μ x 80-120 μ ; membrana media sporarum scrobiculis irregularis ornata, luteo-brunnea.

Vegetative cells 60-68 μ x 80-150 μ , end walls plane; 3 chromatophores making .5-1 turn in the cell; fertile cells cylindrical; zygosporis ellipsoid, 42-60 μ x 80-120 μ , median wall irregularly pitted, yellow-brown. Type in herb. E. N. T. Coll. No. 2666. Coffeen, Illinois.

*West, G. S., A contribution to our knowledge of the Freshwater Algae of Columbia. Memores de la Societe neuchateloise des Sciences Naturelles 5:1013-1051. Neuchatel, 1914.

This species is very distinct in the form of its spores and their position in the fertile cells. Lateral conjugation only has been observed. It is possible that the number of chromatophores is more variable, but in all the vegetative cells in which they could be counted there were three.

Spirogyra braziliensis (Nordstedt) nov. comb.

Owing to the indefinite and imperfect description of *S. lineata* Suring., the variety *Braziliensis* Nordstedt, of which we have a perfect description and specimens (W. & N. Alg. aq. dulc. exsicc. No. 360), should be given specific rank. Its connection with *S. lineata* is very problematical.

S. fluviatilis Hilse.

In all the published descriptions of this species the spores are described as smooth, and the number of chromatophores is given as four. I have seen many specimens from Illinois, and collections from the upper peninsula of Michigan (T. L. Hankinson), Minnesota (J. E. Tilden), Hawaii (J. E. Tilden), Massachusetts (P. B.-A. No. 1217), Pennsylvania (E. N. T.) and Guatemala (W. A. Kellerman). In all cases the mature spores are brown and scrobiculate, and the number of chromatophores is three or four.

S. nova-angliae nov. sp.

Cellulis vegetativis 50-60 μ x 200-350 μ , dissepimentis planis; chromatophoris 3-5, anfractibus arctis 2.5-4.5; cellulis fructiferis non inflatis; zygosporis ovoideis 50-65 μ x 80-120 μ : membrana media sporarum reticulata et dense punctata, flava.

Vegetative cells 50-60 μ x 200-350 μ , end walls plane; 3-5 chromatophores making 2.5-4.5 turns; fertile cells not inflated; zygosporis ovoid 50-65 μ x 80-120 μ : median wall reticulate and densely punctate, yellow in color.

This species was first found in the collections of Mr. Bullard from Beaver Dam, Brook Pond, Natick; the pond west of Winter Pond, Winchester; and the Middlesex Fells, Mass. Recently the same form was found in a large prairie pond south of Coffeen, Illinois. Its position in the genus is near *S. mal-meana* Hirn. In herb. E. N. T. Collections No. 2952, 2953 and 2900.

S. diluta Wood.

I first came across this species in Mr. Bullard's collection from the pond west of Winter Pond, Winchester, Mass. On going over Wood's description, its identity with *S. diluta* is unmistakable. The position, color and form of the spore, and the shape of the fertile cells is perfectly represented in Wood's figure. The dimensions also correspond. Wolle is responsible for confusing this species with *S. nitida* (Dillw.) Link, but a glance at Wood's figure is sufficient to show that it is very different from that species. The P. B. A. specimen No. 513 (labelled *S. nitida*) from Bridgeport, Conn., belongs here. Miss Grace Stone also sent me a collection of this species from near New York City. In the U. S. National Herbarium is another specimen from Bois Sabbi, Louisiana, April 7th, 1891, (A. B. Langlois). Recently the species has been collected at Donnelson, Illinois, by Mr. Frank Harris.

The vegetative cells are usually shorter than in *S. nitida*, the spores are ovoid, not ellipsoid, and the spore wall is verrucose, or reticulate-verrucose, chestnut brown in color. In herb. E. N. T. Coll. No. 2900.

S. crassa Kützing.

Var. **formosa** nov. var. Varietas gracilis, cellulis vegetativis $80-95\mu \times 80-270\mu$; zygosporis $88-100\mu \times 120-150\mu \times 70-90\mu$; cetrum ut in typo.

A small variety, vegetative cells $80-95\mu \times 80-270\mu$; zygosporis $88-100\mu \times 120-150\mu \times 70-90\mu$; otherwise similar to the type. Type in herb. E. N. T. Coll. No. 1939. This variety occurs in a pond east of Ashmore, Ill.

S. submaxima Transeau.

This species which was described from Illinois has been found with nearly the same dimensions in the collections from Middlesex Fells, and South Peabody Station, Mass., sent me by Mr. Chas. Bullard.

S. micropunctata nov. sp.

Cellulis vegetativis $30-36\mu \times 120-300\mu$, dissepimentis planis, chromatophoris singulis anfractibus arctis 3-7; cellulis fructiferis modo binis vel quaternis inter cellulas vegetativas distributis, modo continuis, altero latere (in quo conjugatio

sequitur) inflatis, altero rectis; tubo conjugationis plerumque ex cellula mascula emisso; zygosporis ellipticis $37-42\mu$ x $57-100\mu$ membrana media micropunctata et lutea.

Vegetative cells $30-36\mu$ x $120-300\mu$, end walls plane; 1 chromatophore making 3-7 turns; fertile cells scattered in twos or fours among vegetative cells, or continuous, inflated on the conjugating side, outer side straight; conjugating tubes formed almost wholly by the male cell, zygosporis ellipsoid $37-42\mu$ x $57-70\mu$, median wall minutely punctate, yellow. Type in herb. E. N. T. Coll. No. 2470, 2953.

This species was first found in the West Big Four Pond, east of Charleston, Illinois. It has since been found in a collection from Chocorua, N. H., sent me by Mr. Chas. Bullard. It evidently belongs in the *punctata* group of the Spirogyras, but in form and markings of the spore, and the shape of the fertile cells it is amply distinct from its nearest allies; *S. punctiformis* Transeau and the next species to be described.

S. reflexa nov. sp.

Cellulis vegetativis $30-40\mu$ x $120-300\mu$, dissepimentis planis; chromatophoris singulis anfractibus arctis $3-8\mu$ cellulis fructiferis binis vel quaternis inter cellulas vegetativas distributis, inflatis et valde reflexis; tubo conjugationis ex cellula mascula emisso; zygosporis ellipticis, $44-54\mu$ x $90-150\mu$, membrana media glabra et luteo-brunnea.

Vegetative cells $30-40\mu$ x $120-300\mu$, with plane end wall; 1 chromatophore making 3-8 turns; fertile cells in groups of 2 or 4, inflated or enlarged and strongly reflexed; conjugating tube formed by the male cells; zygosporis ellipsoid, $44-54\mu$ x $90-150\mu$, median wall smooth, yellow-brown. Type in herb. E. N. T. Collection No. 2661, 2664, 2912.

This species has been under observation for four years and has been collected from ponds near Casey, Lerna, Coffeen and Donnellson, Illinois. The large, smooth spores, the reflexed conjugating cells, and the tube produced wholly by the male cells are the distinguishing characteristics.

S. hydrodictya nov. sp.

Cellulis vegetativis $75-100\mu$ x $210-360\mu$, dissepimentis planis, chromatophoris 7-10, modo subrectis longitudinalibus, modo spiralibus anfractibus arctis .1-.5; cellulis fructiferis inflatis vel

subinflatis; tubo conjugationis ex cellula mascula emisso; zygosporis lenticularibus vel globoso-lenticularibus, $80-120\mu \times 110-195\mu$, membrana media scrobiculis obsita, brunnea.

Vegetative cells $75-100\mu \times 210-360\mu$, end walls plane, 7-10 chromatophores, either straight, or spiral making .1-.5 turns; fertile cells inflated or subinflated; conjugating tube formed by the male cell; zygosporis lenticular or globose-lenticular $80-120\mu \times 110-195\mu$, median wall brown, pitted. Type in herb. E. N. T. Coll. No. 2661, 2665. Coffeen, Illinois.

This is one of the most remarkable forms described in this genus. It combines large size, the lenticular spore form, and the habit of forming the conjugating tube entirely by the male cell. The conjugating tube has walls heavier than those of any known species. Conjugation is both lateral and scalariform, and occurs between scattered cells, very rarely continuous for 6-8 cells. In the fruiting condition the filaments form a mesh-work which suggests the specific name. It has thus far been found only in the Fath Pond, north of Coffeen, Illinois.

S. protecta Wood.

A study of American specimens of this species from Massachusetts, Connecticut, New Jersey, Michigan and Illinois, shows that like *S. Grevilleana* there are always some cells with two chromatophores. I have twice found this species producing aplanospores.

S. tenuissima (Hass.) Kütz var. **rugosa** Transeau.

P. B.-A. specimen No. 456, Easton's Pt., Newport, R. I., belongs to this variety rather than the type, as shown by the scrobiculate spore wall. In Mr. Bullard's collection there are also specimens of the variety from Pennannock, N. J., and from Spy Pond, Lake St., Arlington, Mass.

S. Farlowii nov. sp.

Cellulis vegetativis $24-30\mu \times 70-180\mu$, dissepimentis replicatis; chromatophoris singulis, rarius duobus, anfractibus arctis 2.5-6; cellulis fructiferis inflatis (ad $39-60\mu$); zygosporis ellipticis, polis plus minus acuminatis, $32-45\mu \times 48-93\mu$, membrana media glabra, lutea.

Vegetative cells $24-30\mu \times 70-180\mu$, end walls replicate; 1 (rarely 2) chromatophore making 2.5-6 turns; fertile cells

inflated to 39-60 μ ; zygosporae ellipsoid, ends more or less pointed, 32-45 μ x 48-93 μ , median wall smooth, yellow. Type in herb. E. N. T. Coll. No. 2955, 2956, 2957.

In Mr. Bullard's collection there are specimens of this species from Lexington, Arlington, and Middlesex Fells, Mass. The P. B.-A. specimen No. 362, labeled *S. Grevilleana*, from Medford, Mass., belongs here, rather than to *S. Grevilleana*, in which the spores are distinctly ovoid with broad rounded ends.

S. groenlandica Rosenvinge.

This interesting form is characterized by quadrately inflated fertile cells, highly refractive cell walls, and unusually long cells and spores. In Mr. Bullard's collection there are specimens from Stony Brook, South Framingham, Middlesex Fells, Wayside Inn, North Eastham, and Malden Fells, Massachusetts. The P. B.-A. specimen No. 363 labelled *S. inflata*, Orange, Conn., belongs to this species.

S. fallax (Hansgirg) Wille.

This species is one of several forms near *S. insignis* (Hass.) Kützing. If Wille's description is correct and identical with Hansgirg's material, then *S. inconstans* Collins becomes a synonym of *S. fallax*. Hansgirg's figure suggests that the filaments in his material are homosexual. While Wille's description and figure suggests that the filaments are reflexed and that conjugation does not regularly occur between parallel filaments, with the spores all in one filament. It is difficult to decide just where these rough-spored forms belong as the earlier authors did not pay much attention to spore markings. In this connection the note by Professor Nordstedt in connection with specimen No. 958 in Wittrock and Nordstedt's *Algæ Exsiccatae* is of interest. Until these forms have been clearly separated by a study of the original collections it seems best to use *S. fallax* for *S. inconstans*, of which the type is P. B.-A. No. 1568. Here also belongs P. B.-A. No. 1570, Middlesex Fells, Mass., and P. B.-A. No. 1571, Wakefield, Mass.

S. floridana nov. sp.

Cellulis vegetativis 56-66 μ x 120-335 μ , dissepimentis planis; chromatophoris 4-5, subrectis vel anfractibus arctis .5; cellulis conjugatis abbreviatis, inflatis (ad 135 μ) et geniculatis; canalis conjugationis brevis et latis; zygosporis ellipticis, 75-105 μ x 95-135 μ membrana media glabra, lutea.

Vegetative cells $56-66\mu \times 120-335\mu$, end walls plane; 4-5 chromatophores, nearly straight or making a half turn; conjugating cells geniculate, shortened; fertile cells inflated up to 135μ ; conjugating tube very short and broad; zygospores ellipsoid, $75-105\mu \times 95-135\mu$ median wall smooth, yellow. Type in U. S. National Herbarium, collected by J. D. Smith, in S. W. Florida, March, 1878.

In its dimensions *S. floridana* is intermediate between *S. stictica* (Eng. Bot.) Wille and *S. ceylanica* Wittrock. In several publications the statement is made that *S. ceylanica* is intermediate between *S. stictica* and the common forms of *Spirogyra*. A study of authentic material of this species has shown that it has not intermediate characters, but with its spores having a minutely pitted median wall, it seems to be intermediate between *S. floridana* and *S. illinoiensis* Transeau, the most specialized form in the Sirogonium group of the genus.

Throughout the study of these collections the writer has been greatly assisted by Mr. Hanford Tiffany, now a teacher in the Charleston, Illinois, High School. It is a pleasure to acknowledge my indebtedness to the many collectors who have sent me specimens for study.