Fresh-water Algae.

This fragmentary treatise upon the Fresh-water Algae of this neighborhood makes no pretense at completeness. It is a nucleus of original investigations about which the author expects to group other facts in future years. In the preparation of this paper, I am greatly indebted to Professor Hitchcock, of the Kansas State Agricultural College, for valuable hints and assistance. To Rev. Francis Wolle of Bethlehem, Pennsylvania, author of "Fresh-water Algae of the United States", I owe the acknowledgment of valuable aid through the means of correspondence.

Algae are divided according to the coloring matters contained into four classes; namely the Red, or Rhodophyceae; the Olive, or Melanophyceae; the Green, or Chlorophyceae; and the Blue, or Cyanophyceae. The Melanophyceae are found only in salt-water. All my researches have been confined to the Chlorophyceae, al-

though I occasionally had the pleasure of seeing a crawling Oscillaria.

In Algae, the two principal methods of reproduction are sexual and asexual. The sexual method always results in the production of a resting-spore. Resting-spores are called by various descriptive technical names as zygospores, oöspores and hypnospores. A sexual spore is the product of the union of the cell contents of a male cell with those of a female cell to form a single cell. Asexual spores are also called by various descriptive technical names as zoöspores, zoögonidia, gonidia, and microgonidia. These are produced from the protoplasm of the mother cell without fertilization. Motile spores such as zoöspores and microgonidia have the power of voluntary motion. Asexual spores usually germinate at once.

In describing the turns of chlorophyl in Spirogyra, Wolle says that these bands wind to the right. As I am aware that there is confusion among botanists in their descriptions

of spirals, I will define my terms as I use them. A spiral is right-handed when it turns with the thread of a right-handed screw, and left-handed when it turns with the thread of a left-handed screw; or a spiral turns to the right when if held with either end towards the operator, and traced from its nearest to its farthest end, the point tracing the spiral will be seen to revolve in the direction of the hands of a watch. Nearly all the Spirogyra that I have seen have the spirals turning to the left.

In my classification, I have followed Wolle's system, as laid down in the "Fresh-water Algae of the United States."

Beginning with the class Chlorophyceae, and the order Confervoideae, I found nothing until I came to the genus Oedogonium. I was enabled to see one of these plants producing zoöspores, one from a cell. The filaments were 10-12 μ in diameter and the zoöspore 20 × 25 μ after escaping. I failed to discover anything further in the life history of this plant, and it

is not included in this paper. In the family Conferveae and the genus Draparnaldia, I succeeded in making some very interesting observations upon one species. With the help of Mr. Wolle, I was enabled to trace out one species under the genus Stigeoclonium. Passing on to the family Oithophoraceae and the genus Conferva, I made considerable investigations upon one species with homospora forms. I think this was Conferva floccosa, Ag; but, because its methods of reproduction were not fully determined, it is omitted. Of the genus Vaucheria, I have seen but the two species described in their proper places. The next order, in which the greater part of my work was done, is the Zygosporeae. Of the family Conjugateae, and the genus Spirogyra, I was enabled to trace out and describe six species. I think I can safely say that I saw a dozen species more which I did not trace out - because of not having specimens in fruit. Of Zygnema I saw

at least two species and described one. Several Desmids were seen supposed to belong to the genus Closterium, but these were not seen in fruit.

Nearly all the measurements given in the following pages are taken from my own notes. The plates were made with a camera from the objects as seen under the microscope and are magnified about 325 diameters.

Genus 16. Draparnaldia, Ag.

This genus is composed of articulate filaments very much branched. The main stem and the primary branches are composed of cells hyaline except where the zone of chlorophyl passes around the cell wall. This narrow transverse chlorophyl band is one of the distinguishing characteristics of the genus.

The cells of these nearly hyaline stems are always sterile. The stems and primary branches are furnished with bright green penicellate fasciculate branchlets, arranged either alternate or opposite. These branchlets are composed of fertile cells somewhat swollen and one to several terminal hyaline cells elongated into a bristle. The plant is soft and slippery to the touch being enveloped in a gelatinous covering. It grows in running spring water and the winter season seems to be conducive to its prosperity.

Draparnaldia reproduces by zoöspores, the protoplasm of each fertile cell boring its way through the cell wall, and escaping becomes a motile spore. This attaches itself to some object and immediately begins to grow elongating itself and dividing and subdividing until another articulate filament is formed.

I found this plant in a spring which comes out of the bluffs 1½ miles south east of Manhattan, Kansas. The water was highly charged with calcium carbonate.

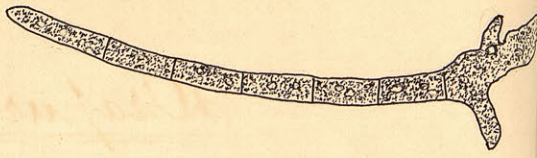


Fig. 1.

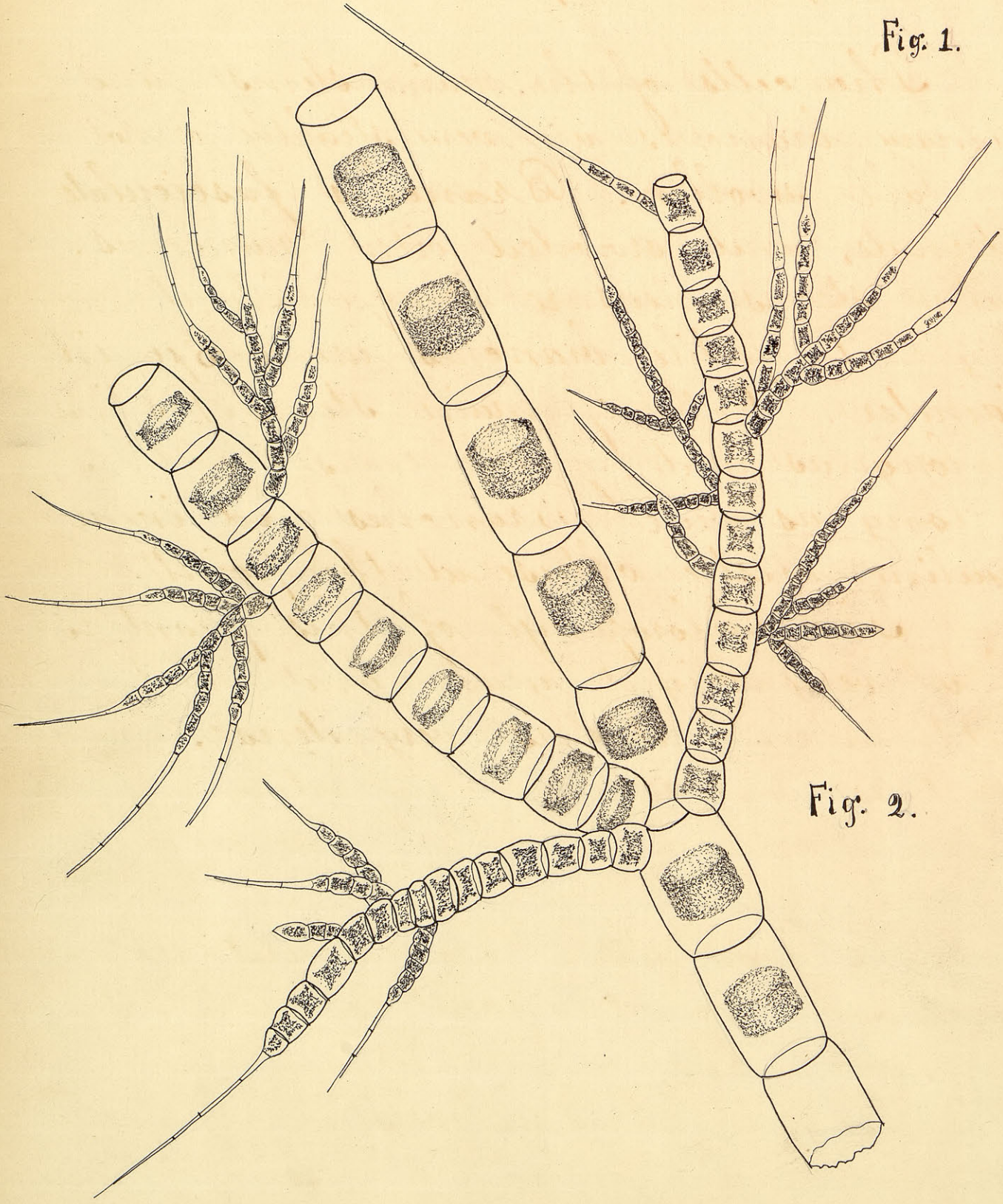


Fig. 2.

Draparnaldia plumosa, Ag.
Fig 1., Young plant; Fig 2., portion of full grown plant with fertile branch

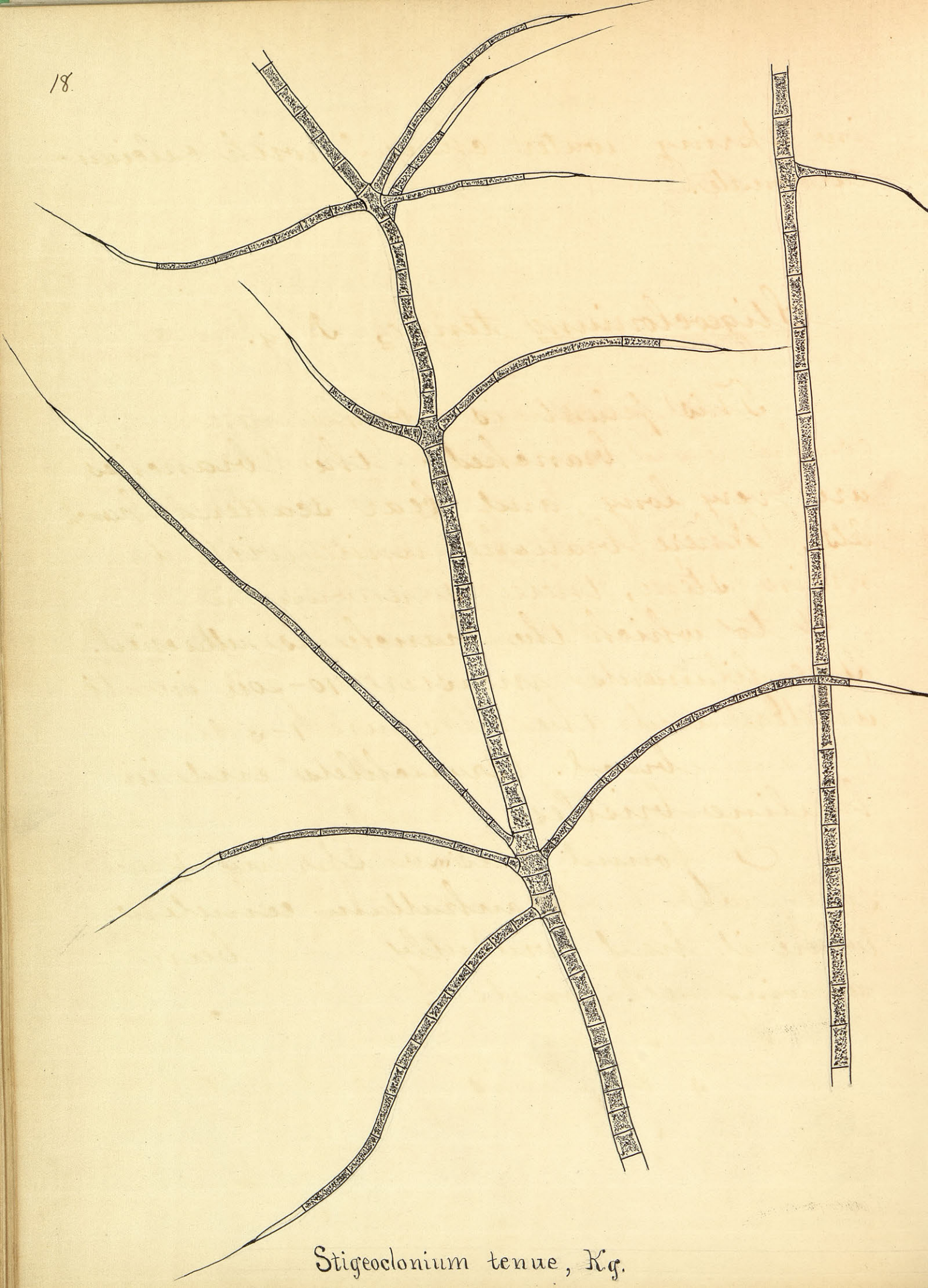
Draparnaldia plumosa, Ag.

The cells of the main stems and primary branches are very slightly or not at all swollen. Branches fasciculate, alternate, and crowded with branchlets. Main stems measure 40-60 μ in diameter, while fertile branches are 10-15 μ in diameter. Cells of main stems 1-3 times as long as wide; fertile cells 1-2½ times as long as wide. Branches end in a hyaline bristle obtuse at the point.

The chlorophyl of this plant is of a very bright green and in the fertile cells it is very dense.

Genus 17, Stigeoclonium, Kg.

This genus resembles Draparnaldia in many respects. Its chlorophyl is of the same bright green color, and its production of zoöspores is exactly like that in Draparnaldia. The filaments are articulate and simply branched, stems and branches being barely separable. The branches are not in fascicles and are attenuated ending in a colorless bristle. The cell contents of the stems have the chlorophyl arranged in transverse bands as in Draparnaldia but these bands are proportionally wider. Resting spores are developed in swelled cells of the branches one in a cell. Zoogonidia are formed by the division of the cell contents into 4-16 parts each furnished with four vibratile cilia. Zoospores are formed from the contents of a single cell, one escaping from a cell. This plant grows



Stigeoclonium tenue, Kg.

in spring water charged with calcium carbonate.

Stigeoclonium tenue, Kg.

This plant is bright green and considerably branched; the branches are very long, and bear scattered branchlets. Where branches unite with the main stem, there is always a globose cell to which the branch is attached. The filaments measure 10-20μ in diameter, and the cells are 1-3 times as long as broad. Branchlets end in hyaline bristles.

I found this in a spring ½ mile south west of Manhattan cemetery where it had evidently been growing all winter.

Genus 30. Vaucheria, D. C.

This plant is often called green felt from its habit of growth. The growing filaments mat together in a felt-like mass in shallow sluggish water holding fast to the bottom by colorless filaments. The whole colony may be picked up by taking hold of one side of the mass and lifting as you would lift a blanket by one corner. This mass of green felt becomes almost black as it grows old. In Vaucheria, the filaments are single cells greatly elongated and more or less branching. The chlorophyl is evenly distributed throughout the space inside the cell walls, and contains many granules of starch and oil.

The sexual reproduction of Vaucheria is by means of antheridia and oögonia. These are usually produced side by side on the same filament. According to Wolle [page 149] cases of dioecious

reproduction are known. In the common method, two protuberances arise near each other on a filament, or upon a short pedicel sent out of the filament for the purpose of bearing these. One of these protuberances becomes round or oval, and about as large as the diameter of the filament; the other, which is the antheridium, becomes elongated and horn-like at its upper part, the end usually being directed towards the beak of the oögonium. The horn-like extremity of the antheridium then breaks open, and the spermatozoids swim over and fecundate the female cell and an oöspore is the result. After a season of rest, the oöspore germinates by sending out a tube-like thallus which branches occasionally, and reproduces again in the same manner.

Single goöspores are ejected from terminal sporangia, which move with a rolling motion by means of attached cilia which cover their whole surface. Microgonidia are developed in the vegetative filament in large numbers. They are

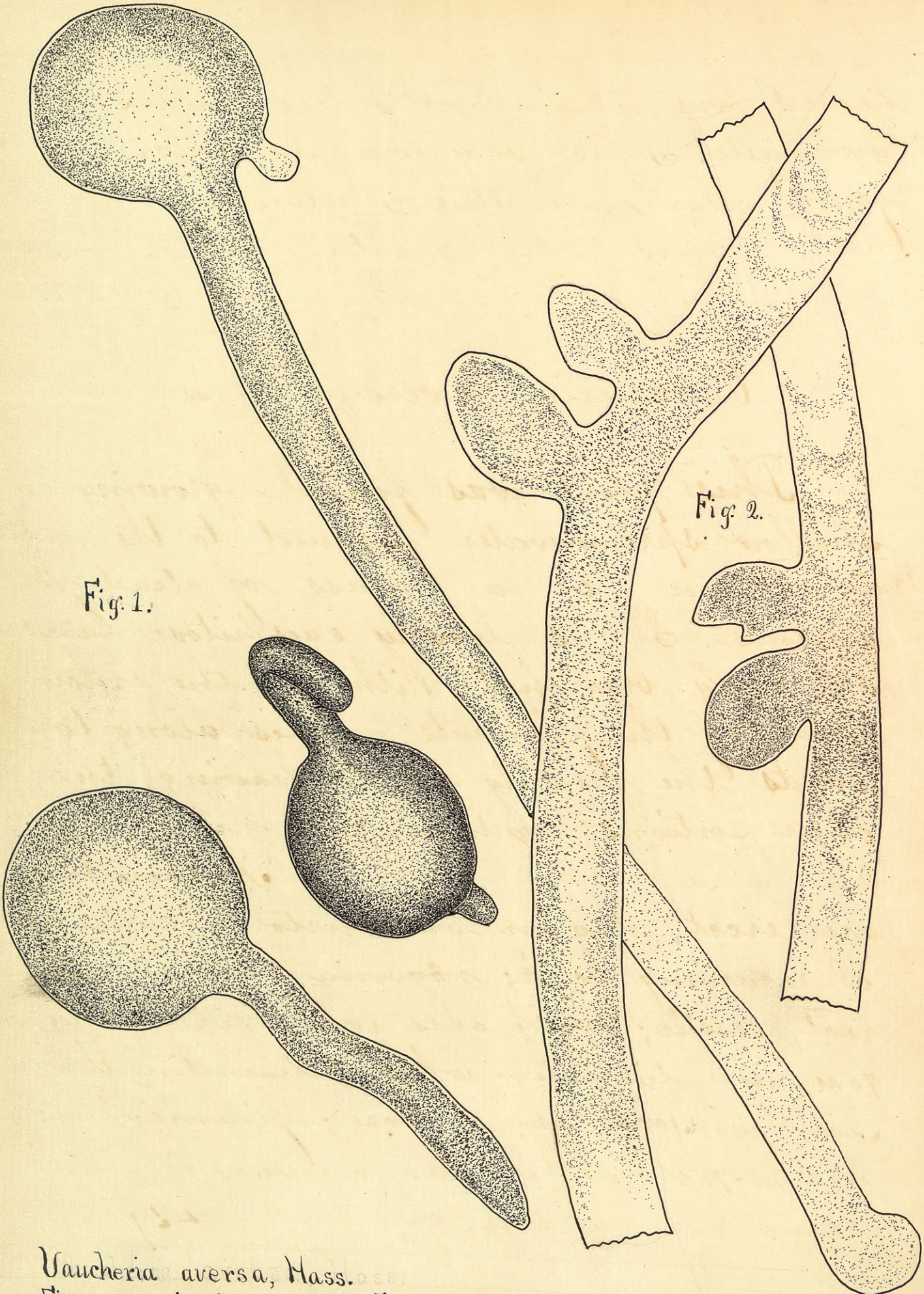


Fig. 1.

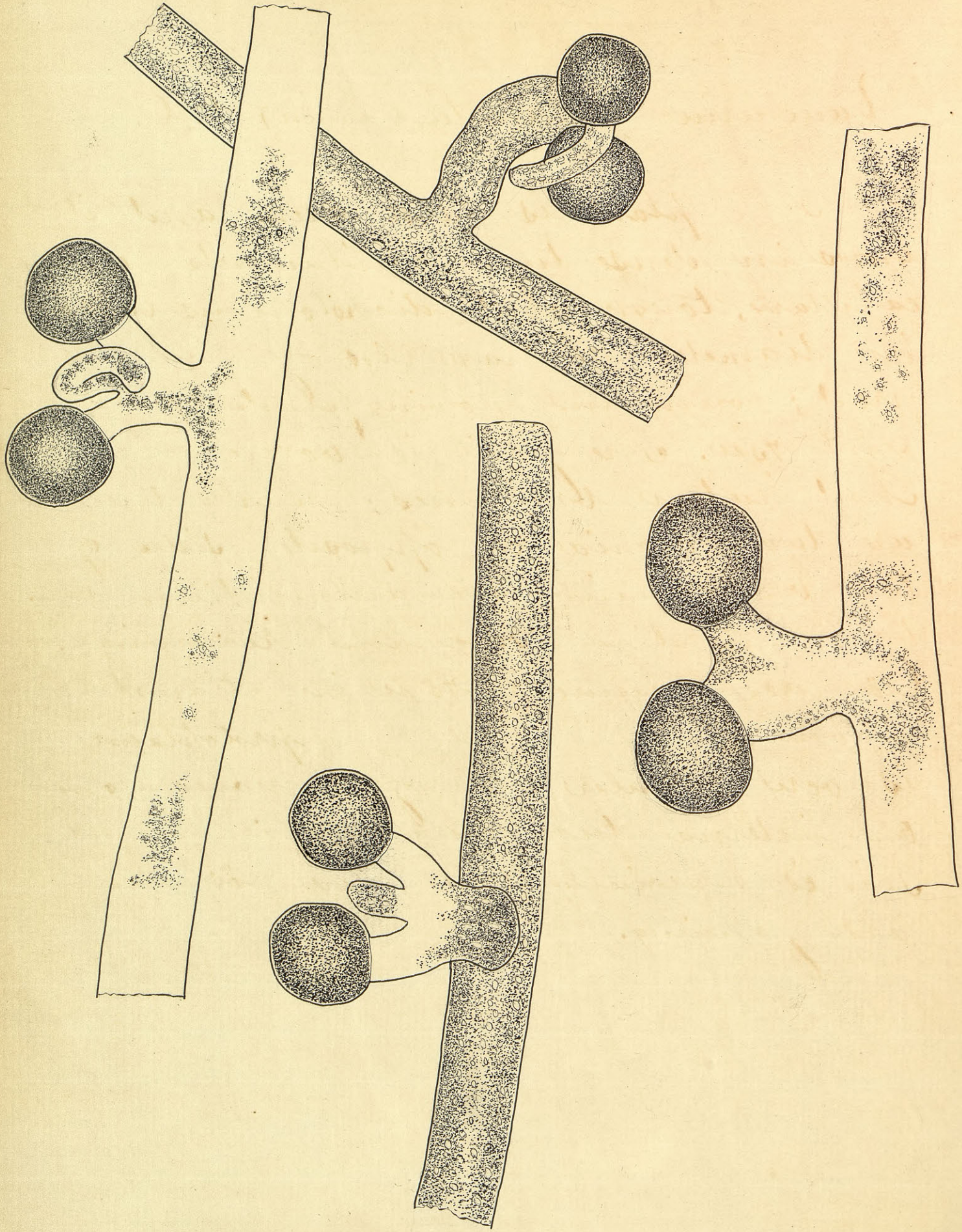
Fig. 2.

Vaucheria aversa, Hass.
Fig. 1., germinating oöspores; Fig. 2., anthendia and oögonia forming.

ejected, but remain motionless and soon germinate. This very common Alga is found near Manhattan Kansas in ditches and creeks with muddy bottoms.

Vaucheria aversa, Hass.

This plant was found growing in shallow spring-water fastened to the muddy bottom by a mass of dead filaments. It is loosely caespitose and sparingly branched. With age the chlorophyl of the filaments moves along towards the growing parts leaving the older portions hyaline. The growing portions are a very bright green. Antheridia are erect, drawn out into a cylindrical recurving beak; oögonia erect or suberect, sessile; oöspores when ripe average 75μ in diameter, when germinating they swell up to 100-115 μ, globose; filaments measure 45-75 μ in diameter. average of main stems measured 60 μ, of branches 45 μ



Vaucheria geminata (Vauch.) D.C.

Vaucheria geminata, (Vauch) D. C.

This plant is dark green, and it grows in dense tufts. Filaments are capillary, tough, and dichotomous 60-80 μ in diameter. Average size of those measured; young and growing plants 59 μ; old plants 73 μ. The fruit is borne upon short lateral branches; usually there are two oögonia on opposite sides of the branch with an antheridium between extending above and recurving. Oöspores measure 60-70 μ in diameter, globose. In this plant, the protoplasm is very granular and often moves along the internal tube to where it is needed. This is especially true where oöspores are forming.

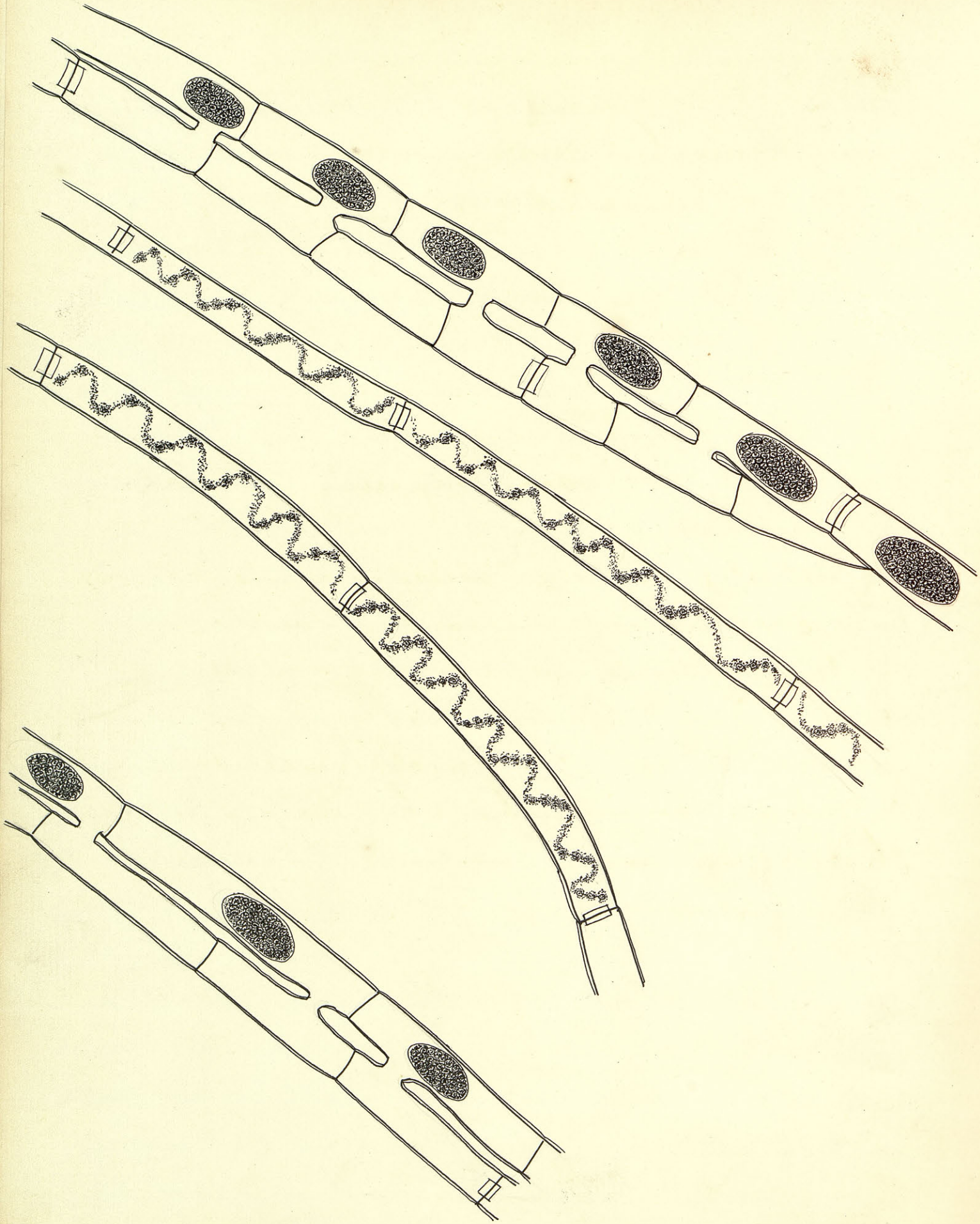
Genus, 70, Spirogyra, Link.

This genus is composed of filamentous Algae, a filament consisting of a single row of cylindrical cells closely united, end to end. The cells contain one or more parietal chlorophyl bands winding spirally to the left or right. Starchy, or amyloaceous granules are always found mixed with the chlorophyl though in some species these bodies are nearly obscured by the density of the spiral.

The reproduction in Spirogyra is by means of zygospores which are always developed within one of the parent cells. A zygospore is formed by the union of the cell contents of two cells whether they be adjacent in the same filament or of different filaments. Copulation is either scalariform, lateral or geniculate. In scalariform copulation, two filaments lying side by side send out tubercles towards each other. These finally unite and the separating cell walls are absorbed leaving a

passage from one cell to the other. Through this passage the protoplasm of one cell passes over into the other cell and a zygospore is formed. In lateral copulation the separating end-cell walls of two adjacent cells of the same filament are absorbed and the cell contents are united in one of the cells. In geniculate copulation, two filaments lying near each other become swollen and bent at their articulations in knee-like forms. Two of these "knees" come together and the cell contents of the cells of one filament pass over into the other two cells forming zygospores as in the scalariform method, or the cell contents of the adjacent cells of each "knee" unite forming a zygospore in each filament.

The length of cells is variable in the same species, but the width is a nearly constant characteristic. To determine the species it is necessary to observe manner of conjugation, width and length of cells and whether their ends are replicate or not, number and form of spirals, and size and shape of zygospores.

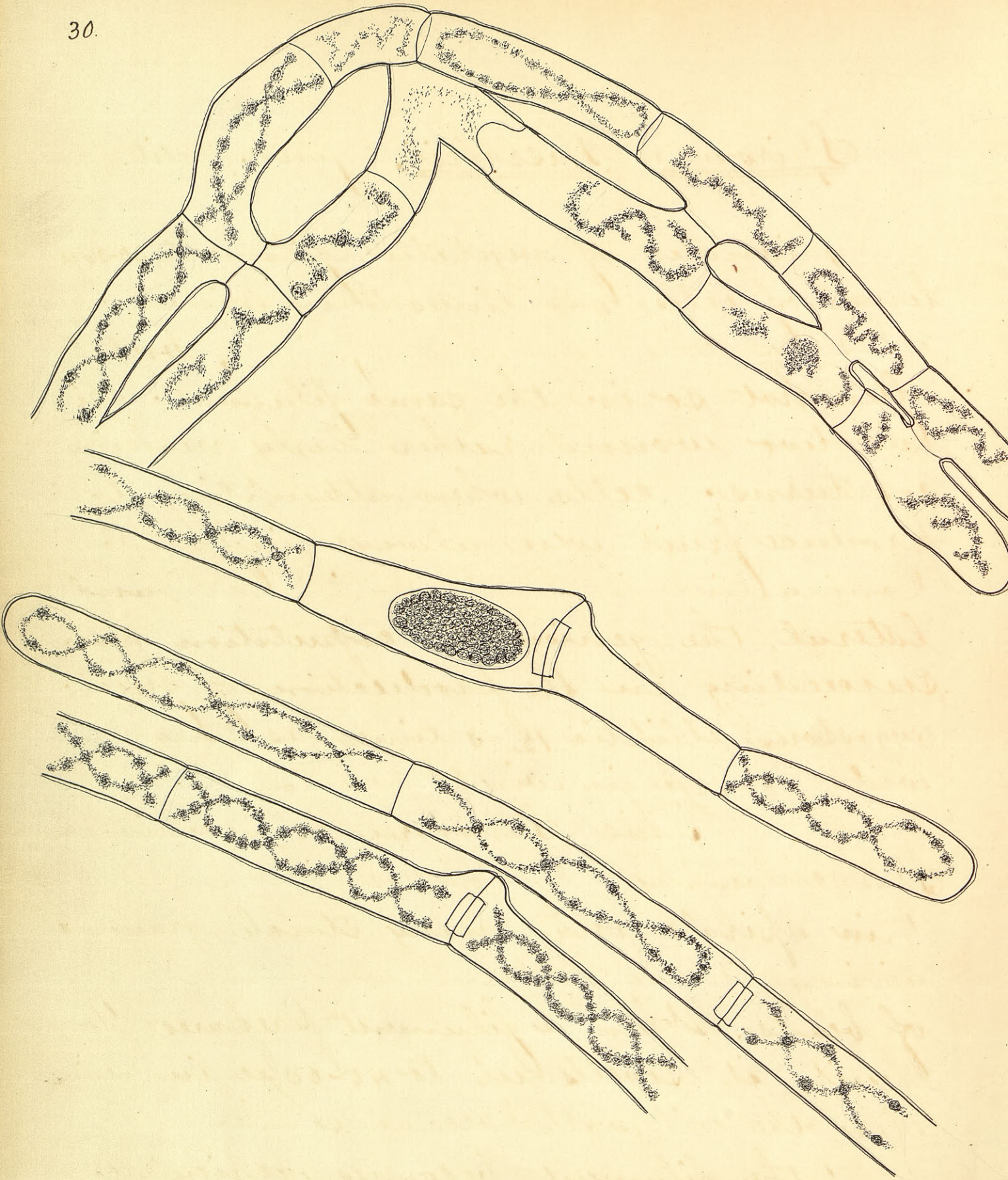


Spirogyra Weberi, Kg., Var. genuina, Kirch.

All the following species except Spirogyra Jurgensii were determined from a collection made April 2d, 1892 from a creek flowing through the Kansas State Agricultural College farm.

Spirogyra Weberi, Kg.
Var. Gemina, Kirch.

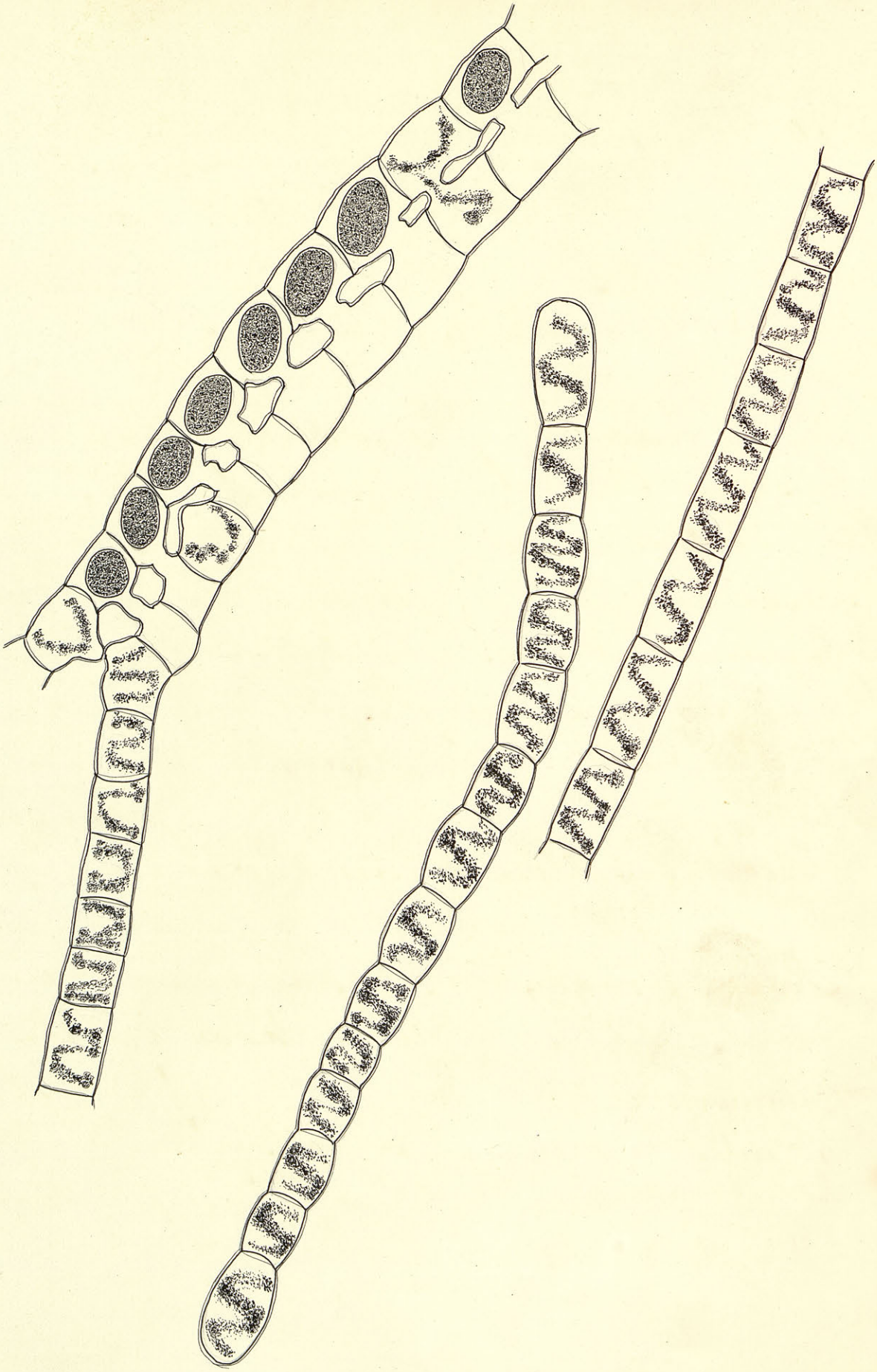
Diameter of vegetative filaments 23-27μ cells 5-12 times as long as wide; some ends replicate, others not; spiral always single making 4-8 left-handed turns not laxly wound; fructiferous cells not inflated; conjugation scalariform; zygospores 1½-2 times as long as wide, oval 30μ in width.



Spirogyra Hassallii, (Jenn.) Petit.

Spirogyra Hassallii, (Jenn.) Petit.

Diameter of vegetative filaments 30-36 μ length of cells 4-8 times their width; ends of cells generally replicate, but often not so in the same filament; spirals, two wound rather lazily making 2-3 turns; cells when attempting to produce fruit were always inflated. Conjugation is both geniculate and lateral, the geniculate copulation never succeeding in the production of fruit; zygospores elliptic 1½-3 times as long as wide, 40-45 μ in width, yellow at maturity. This Spirogyra is peculiar. Its chlorophyl is composed of rather thin spirals with many starch granules giving it the appearance of a string of beads. When a filament prepares to fruit, it swells up to 45-60 μ in diameter, the cell walls become semitransluent and the filament becomes geniculate at occasional articulations. It then conjugates laterally. Copulation between

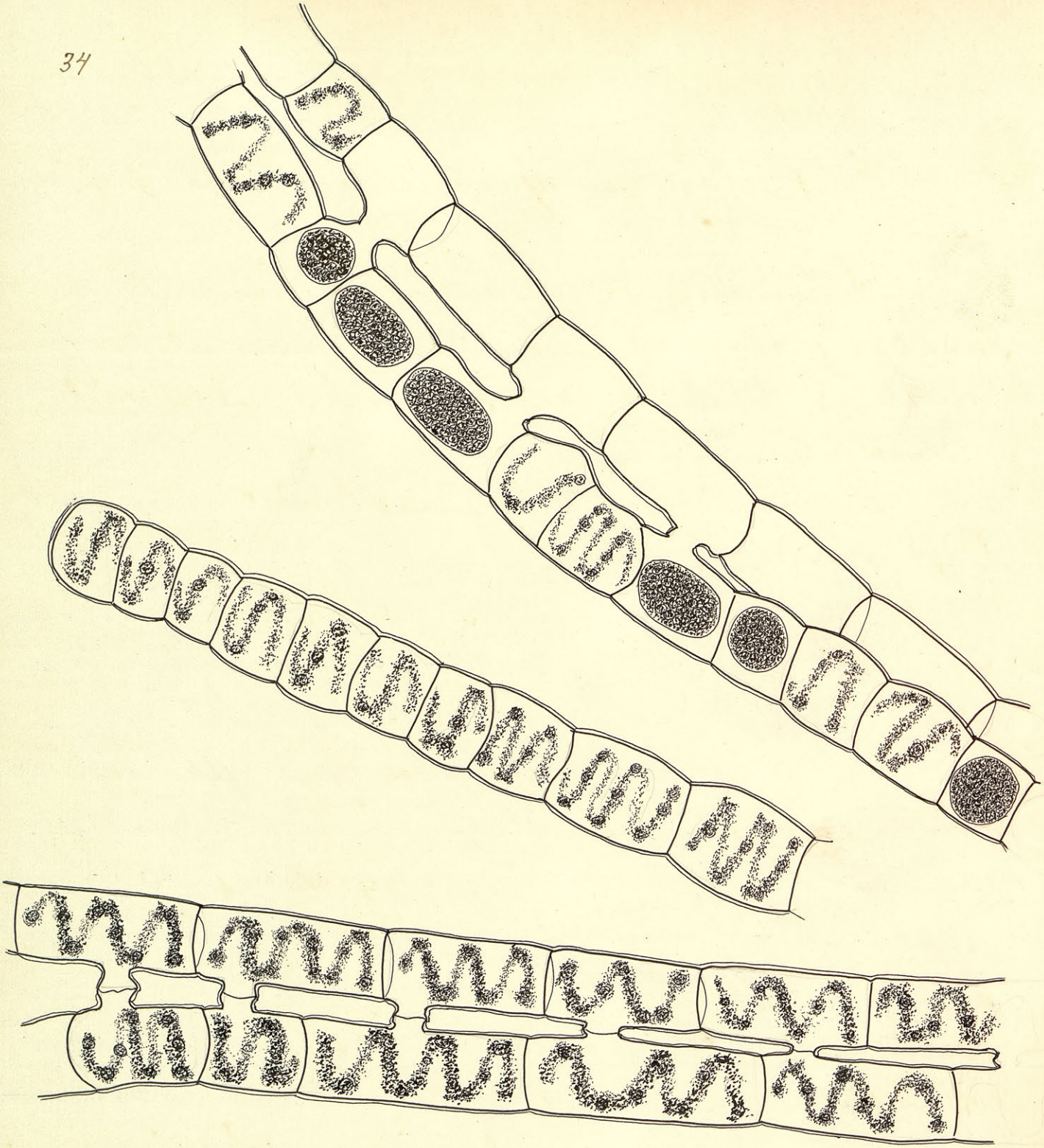


Spirogyra varians, (Hass.) Kg.

different filaments is very common but fails to produce any fruit.

Spirogyra varians, (Hass.) Kg.

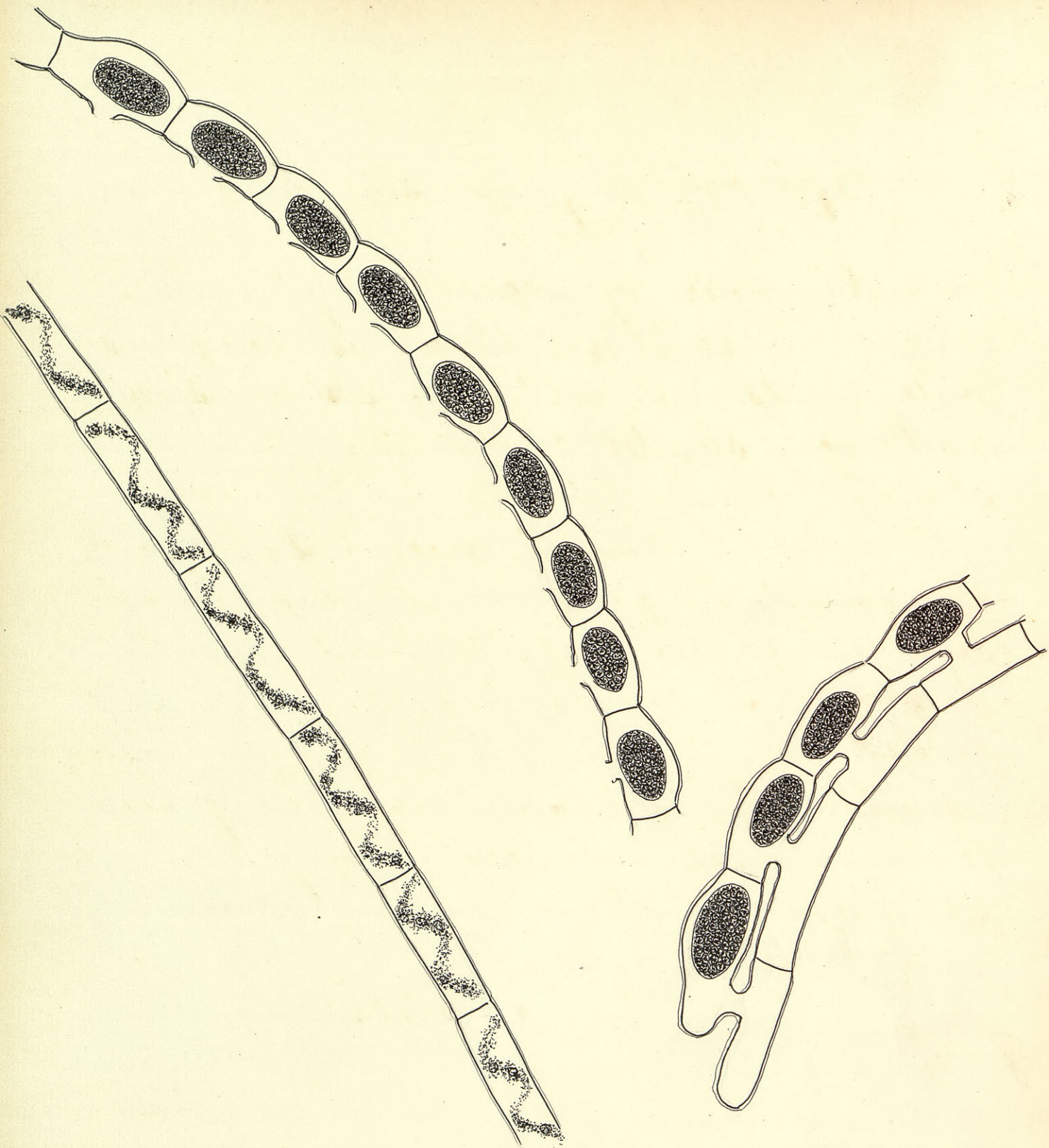
Diameter of vegetative filaments 27-32 μ cells 1½-3 times as long as wide, ends not replicate; spiral with margins more or less dentate, especially so in the growing filament, large describing 1½-3 turns; conjugating cells much swollen on conjugating side, but nearly straight on outer side. Cells of vegetative filaments are sometimes much swollen where there is no sign of conjugation. Zygospores are of various shapes, oval, elliptic, or round, changing with the position they have in the cell, polymorphic; average size of spores 30 x 40 μ, Fruited early in April.



Spirogyra quinina (Ag.) Kg.

Spirogyra quinina, (Ag) Kg.

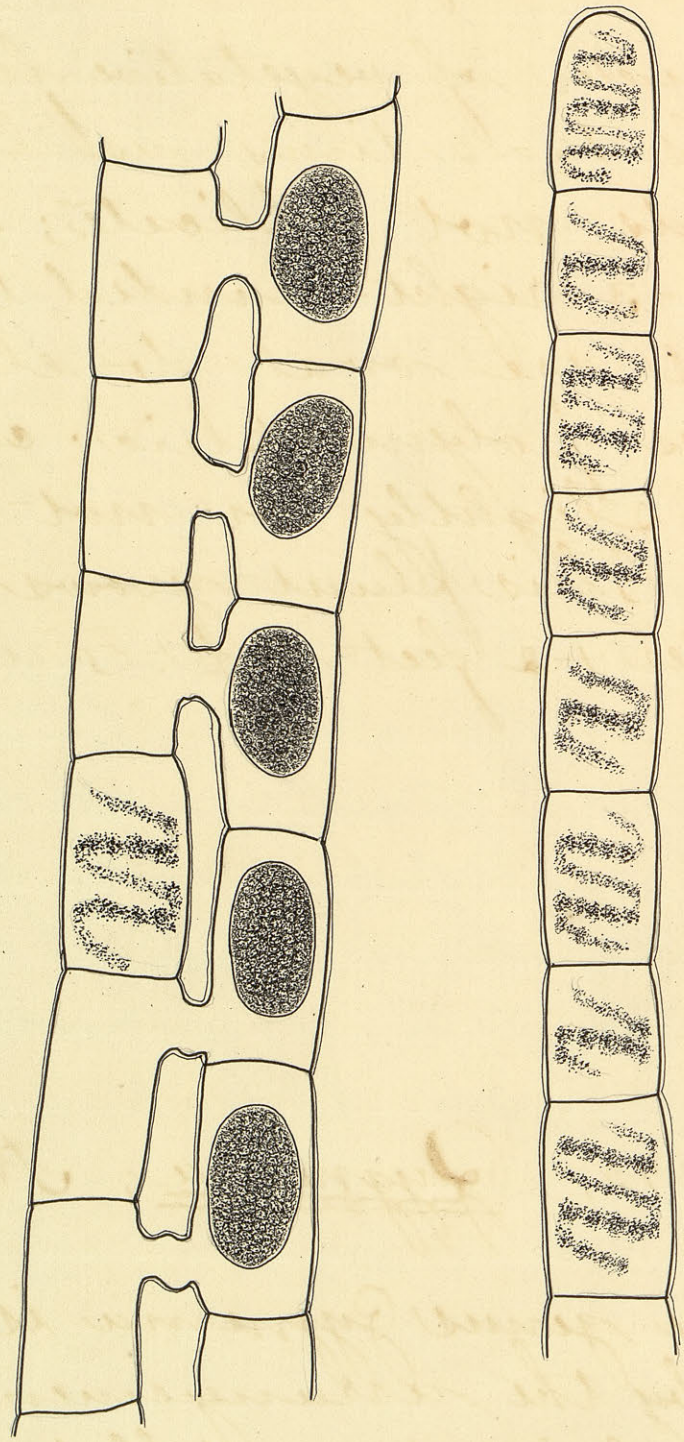
Diameter of normal filaments 36-40μ; two filaments were found conjugating that were 36μ and 40μ wide respectively. Cells of sterile filaments are 3-5 times as long as wide, of fertile ones 2-3 times as long as wide, ends not replicate; spiral single, large, with many starch grains, 1½-3 left handed turns in various stages of density. Fertile cells are scarcely or not at all swollen, sometimes sterile filaments are considerably swollen; zygospores vary much in form, some being globose, some elliptic and some cylindrical with rounded ends. This plant is of very dark green color and fruits profusely. Ripe early in April.



Spirogyra Jurgensii, Kg.

Spirogyra Jurgensii, Kg.

Diameter of vegetative filaments 22½ - 27 μ; cells 1½ - 5 times as long as wide, ends not replicate; spiral single and very slender containing numerous starch grains, turns to the left; chlorophyl pale yellowish green; Zygospores are found in cells that are much swollen on the outside and nearly straight on the conjugating side, spores 28-30 μ in width 1½ to 2 times as long as wide. This plant grows in flocculent masses of very long filaments It was found in spring water 2 miles south east of Manhattan; fruited late in April.



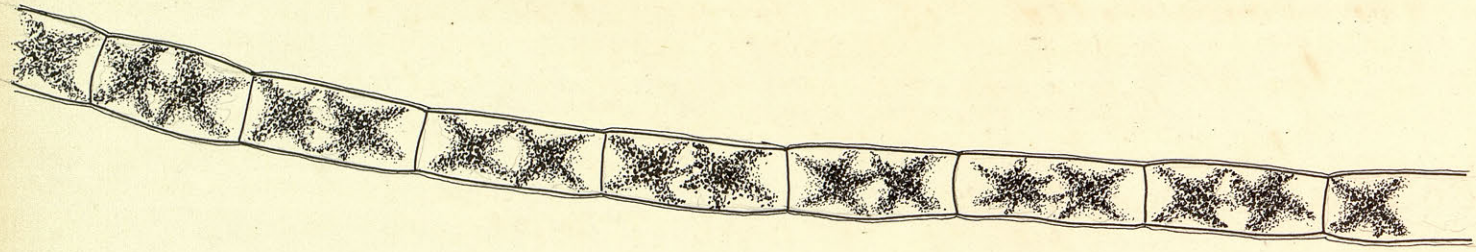
Spirogyra fusco-atra, Rab.

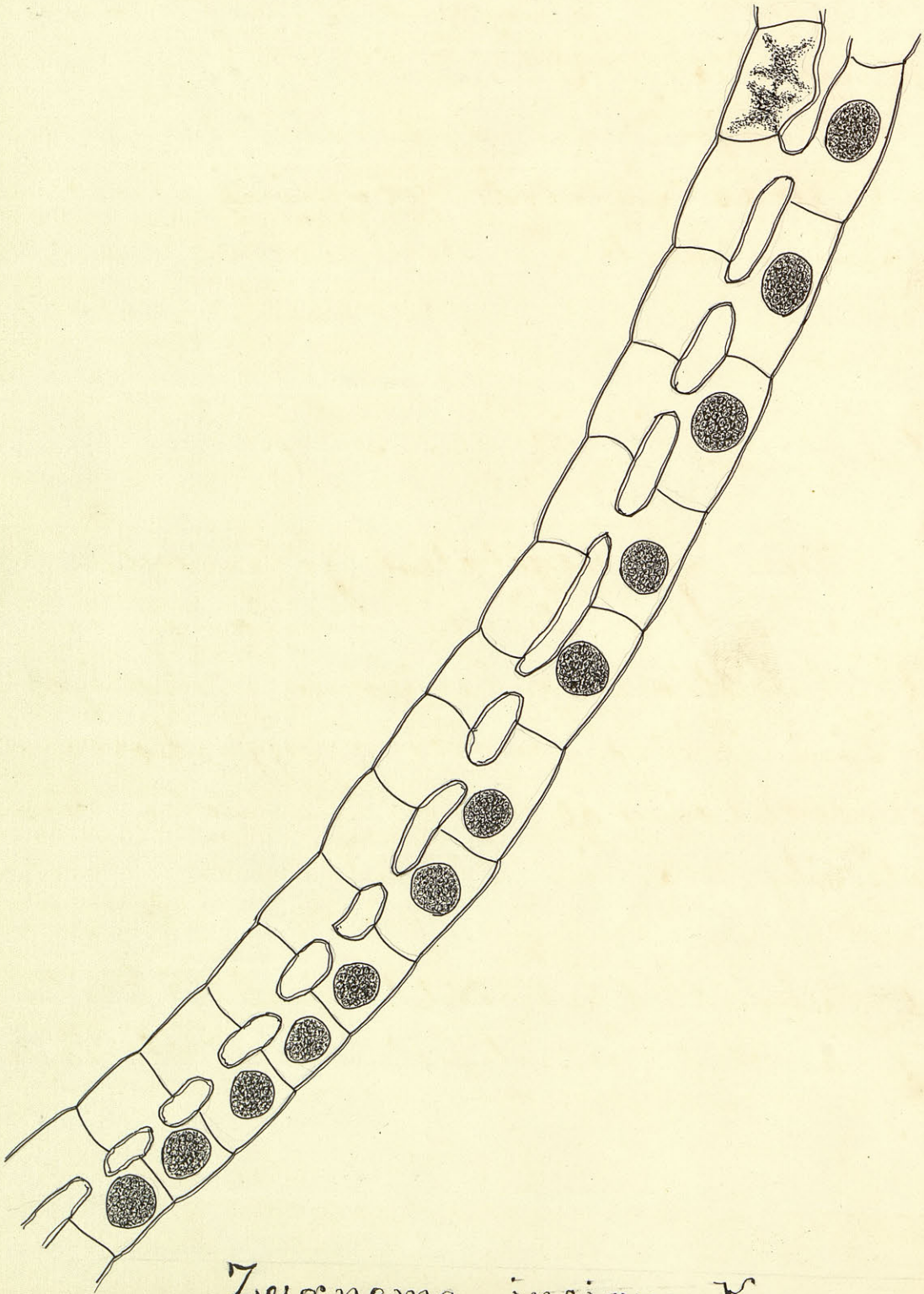
Spirogyra fusco-atra, Rab.

Diameter of vegetative filaments 45μ; cells 1½-2 times as long as wide, ends not replicate; spiral makes 2-3 right-handed turns. Zygospores are oval to elliptic, sometimes polymorphic; conjugating cells very slightly or not at all swollen. This plant grows in sluggish water 1-2 feet deep. Fruited early in April.

Genus 72, Zygnema, K'g.

The genus Zygnema is characteriged by the arrangement of its chlorophyl in two stellate masses with a starch granule in each. It reproduces by means of zygospores, and





Zygnema insigne, Kg.

the copulation is either scalariform or lateral. The cells are united end to end as in Spirogyra forming very long filaments. Cell contents outside of the chloroplyl may be said to be very granular. This is one of the most beautiful of the fresh-water Algae. It was found growing in clear slow flowing water.

Zygnema insigne, Kg.

Diameter of vegetative filaments 26-30 μ; cells 1-3 times as long as wide. Copulation scalariform, sporiferous cells slightly swollen; zygospores globose averaging 30 μ in diameter, brown at maturity. This plant often fruits profusely with no signs of conjugation. Fruited about the middle of April. This is a very beautiful and delicate plant.

Geo. L. Clothier.