Randhawa's Notes on Botany.

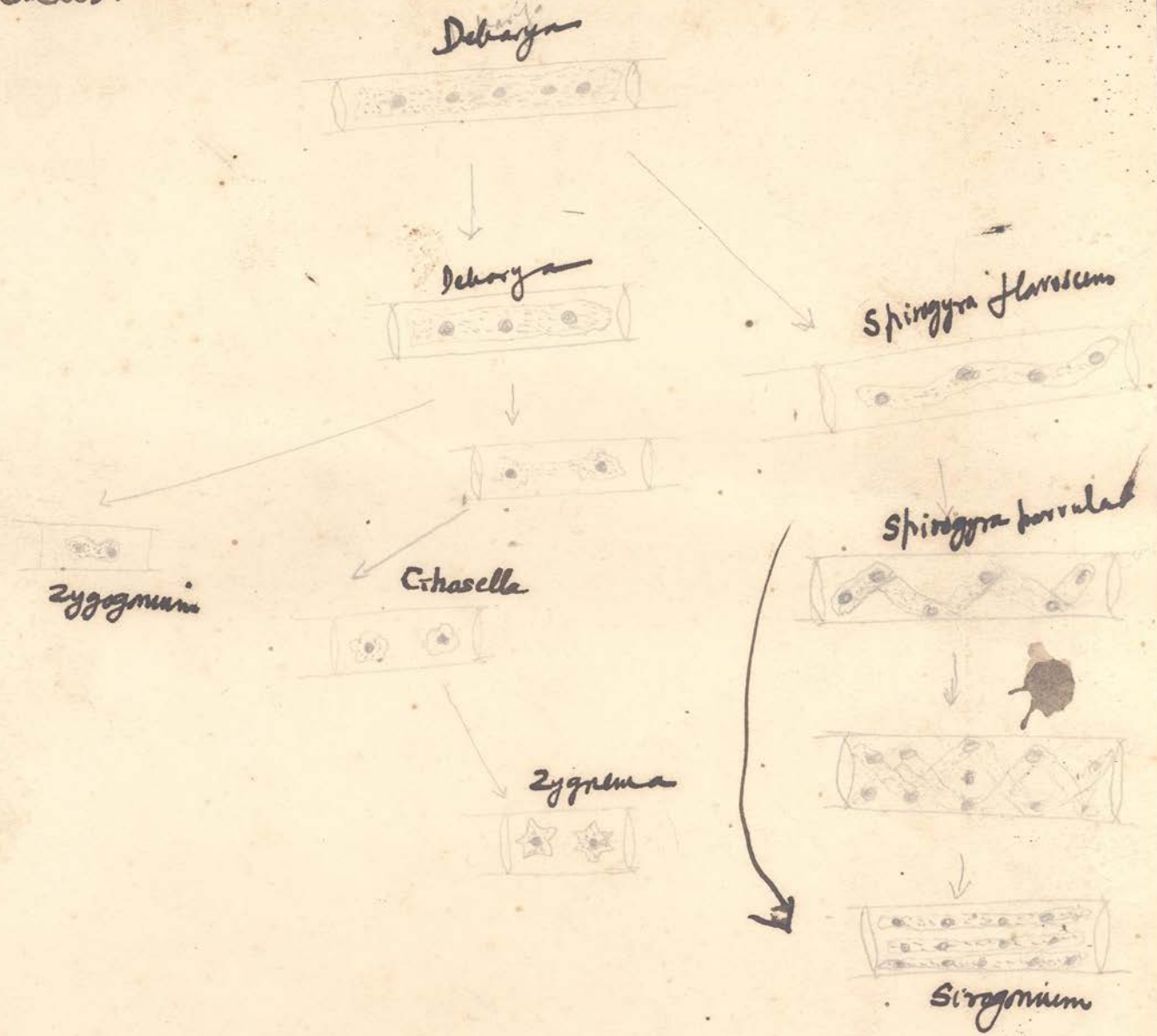
by Dr. M.S. Randhawa.

From V.C. Dr. M.S. Ramanna 31.1.72

Evolution of Chloroplasts

in

Zygnemales.



EVOLUTION OF CHLOROPLASTS IN ZYGNEMALES

DEBARYA

NOUGEOTIA

SPIROGYRA FLAVESCENS

ZYGNEMOPSIS

S. PARVULA

ZYGNEMA

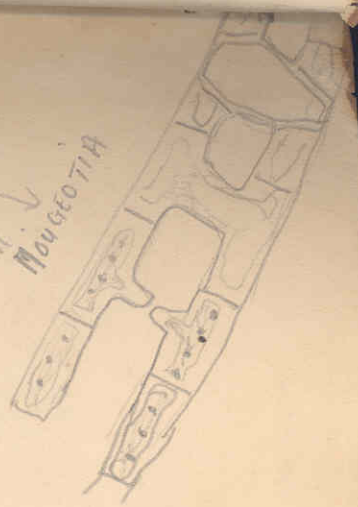
SIROGONIUM

اسکو بس برسٹل بوڈ پیرئریس گریس

اور انک گریڈیس

Debarya and others

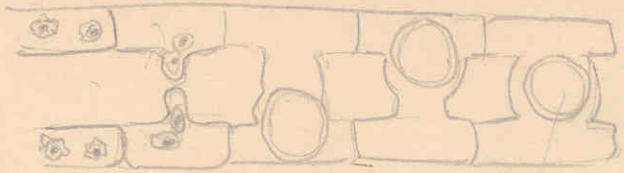
Zygnemopsis

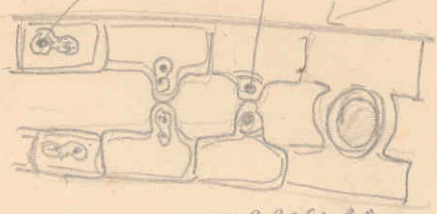


MOUGEOTIA

Zygnema Collinsianum

Zygnema heliosporum





ZYGOGONIUM

SPIROGYRA

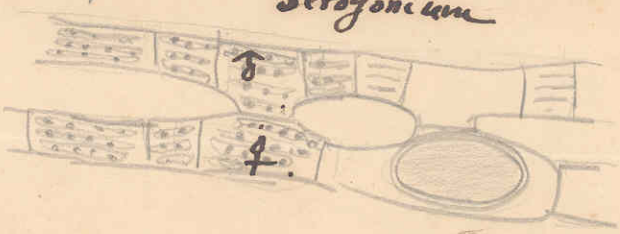
Spirogyra

Anisogamous species of Zygnema

ANISOGAMOUS SPECIES OF ZYGNEMA.

Sirogonium

SIROGONIUM

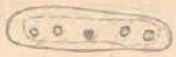


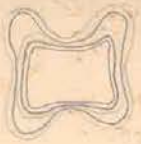
Inter-relationships & Evolution
of the Genera of Conjugatae :—

Desmidiaceae

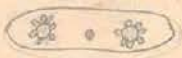
Penium

I



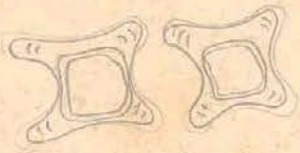


Cylindrocystis



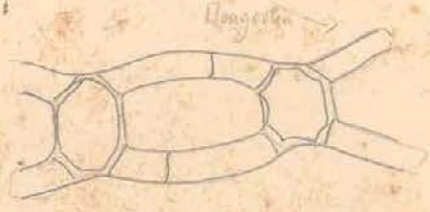
Spirotaenia

Desmidiaceae

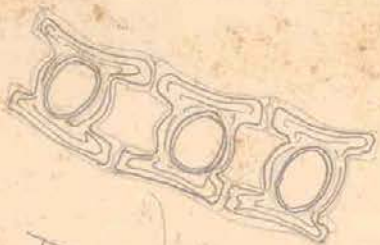


II

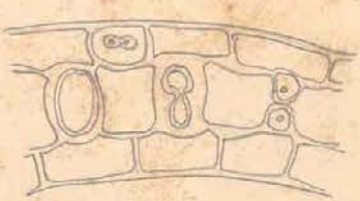
Mougeotia



Chlorella

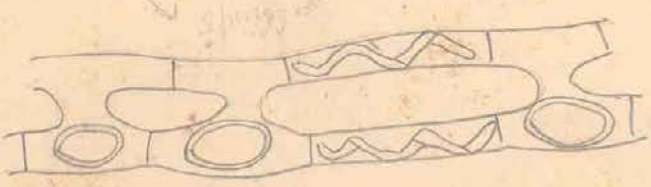


Zygogonium



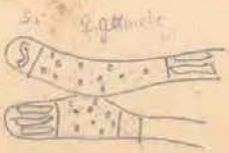
Zygogonium ripening of zygospores

Spirogyra



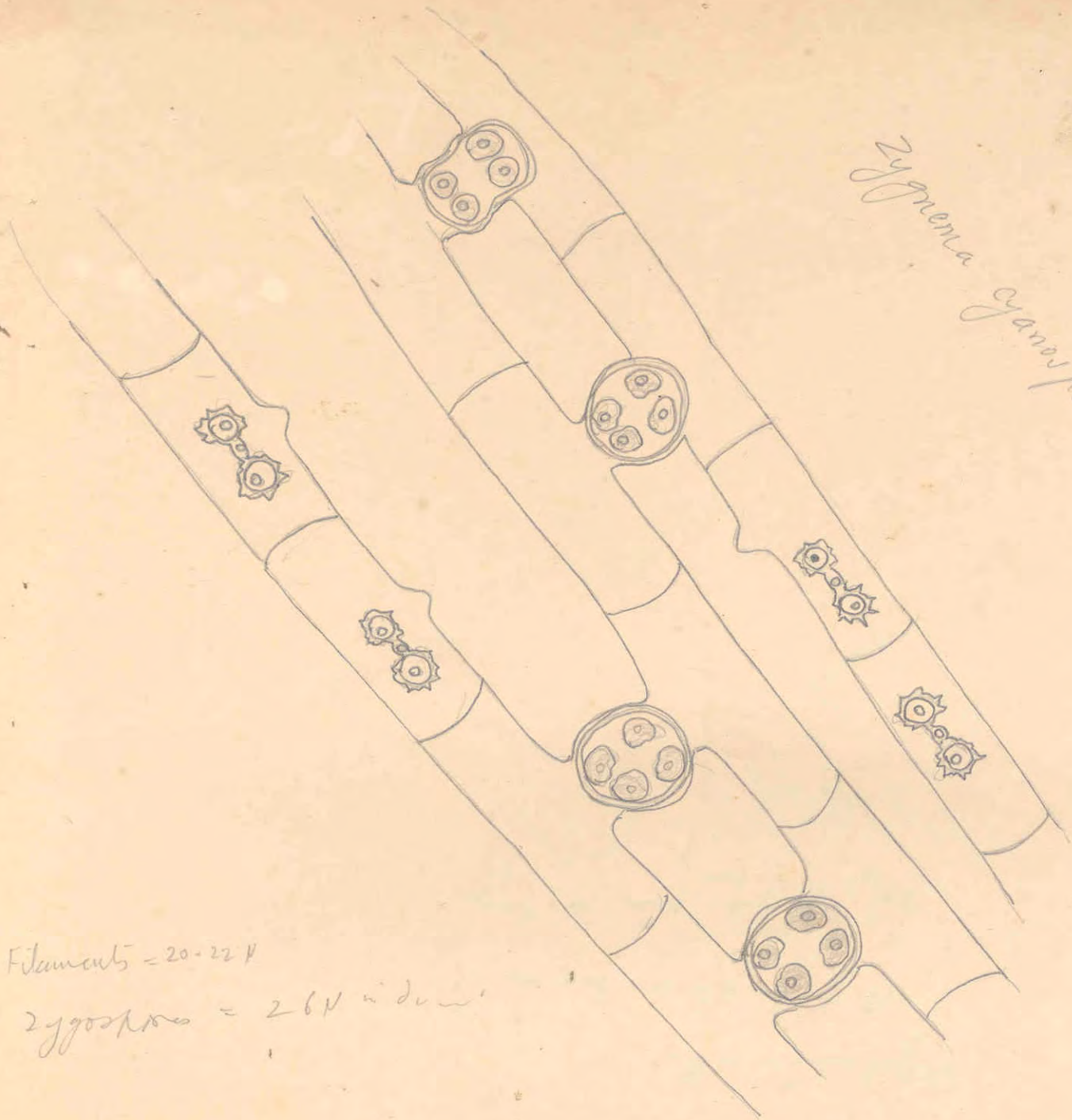
Sirogonium

Sirogonium Egg-nucleus



Pyrenoid

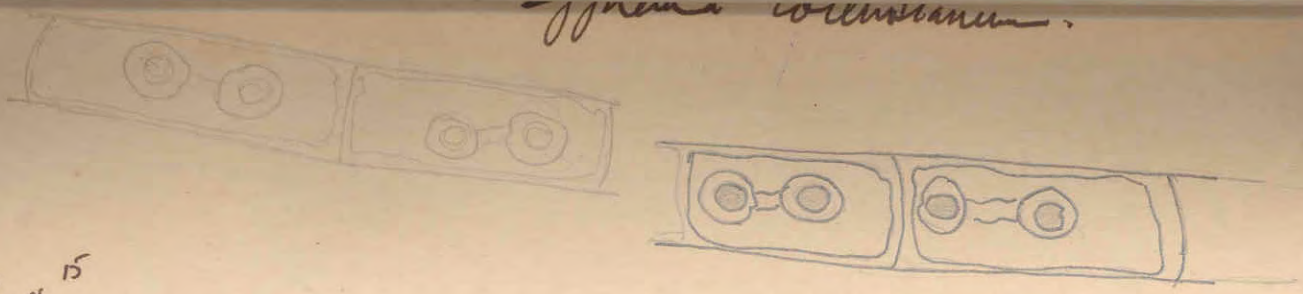
Placoderm Desmids



Zygnema cyanosporum. Cleve

Filaments = 20 - 22 µ

zygospores = 26 µ in diam.



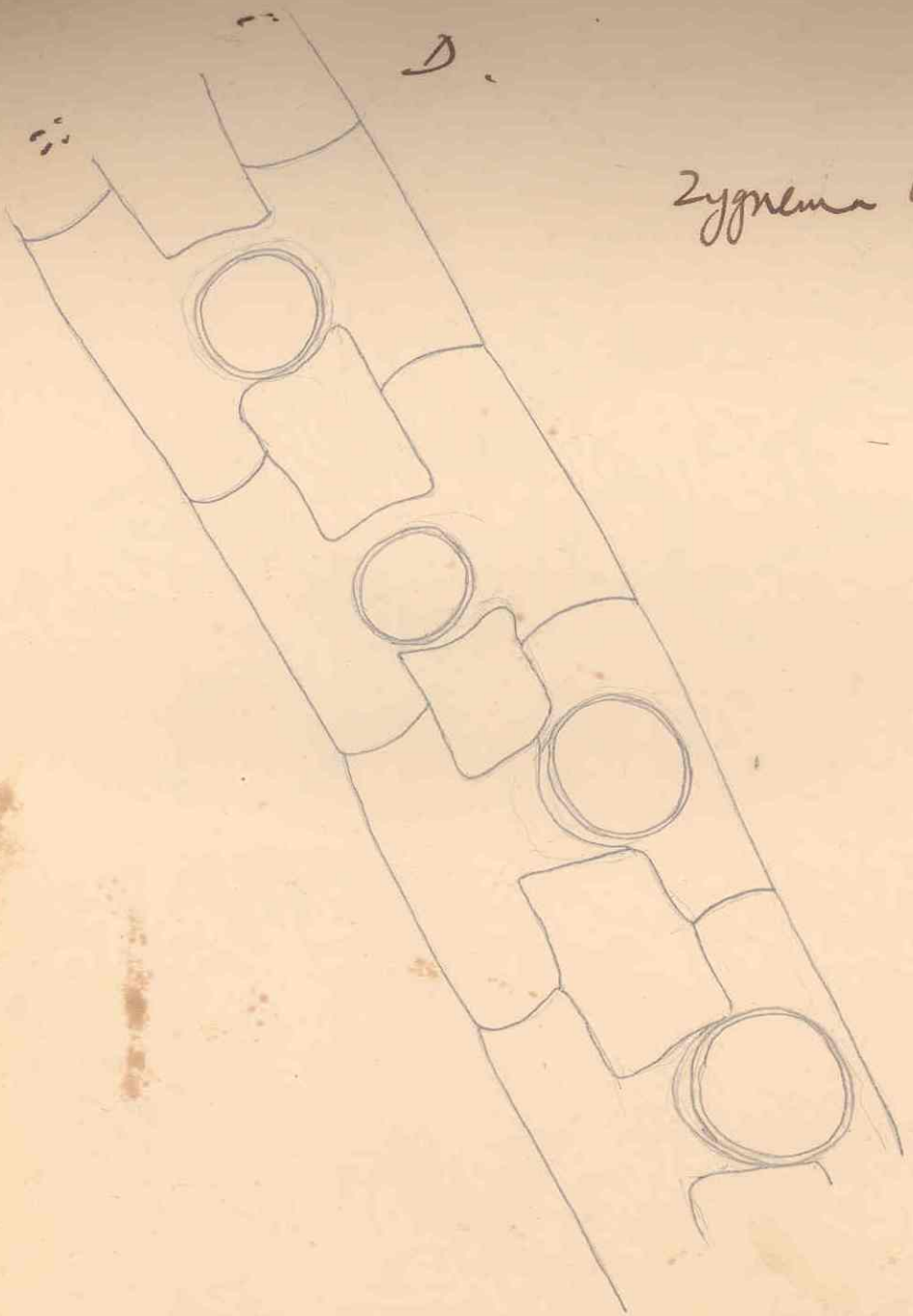
11–15

Vegetable cells

18 N – 24 N biconvex

$2\frac{1}{2}$ to $3\frac{1}{2}$ times as long.

D.



Zygnema Collinianum.

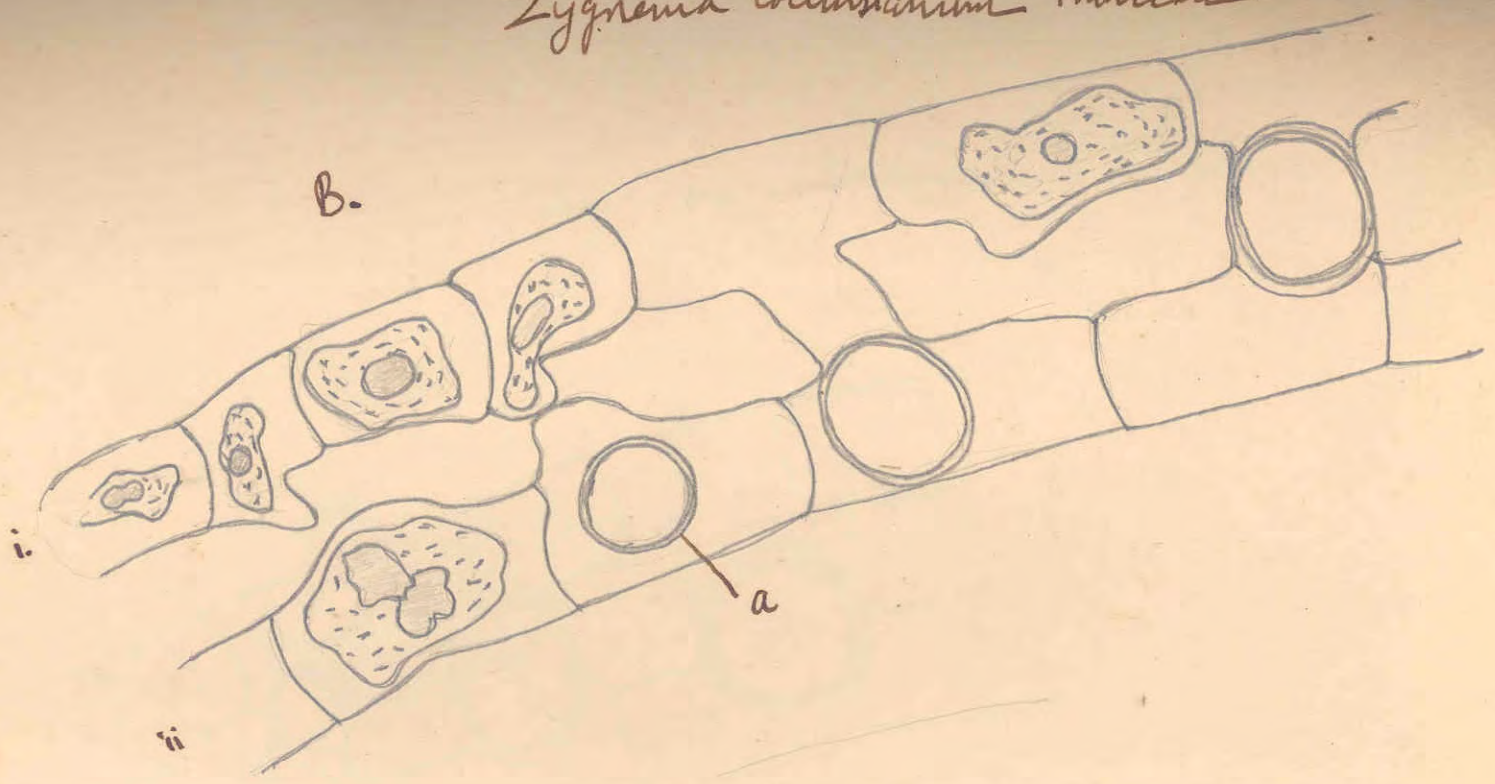
Veget. cells — 18–24 μ
br.

Zygospores = rounded

24 μ — 36 μ
in diameter

Zygnema Collinsianum Transeau

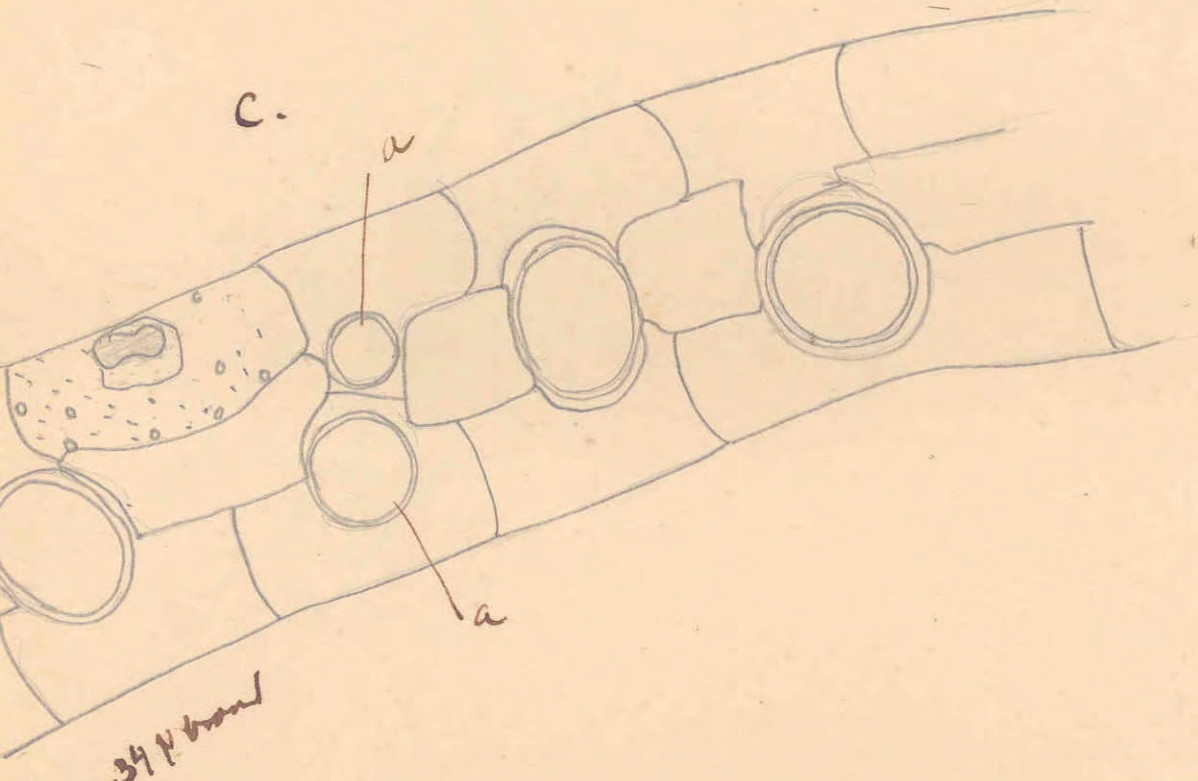
B.



30 μ x

11 | 3. 2 4 | 48 | 44 | ii

Zygnema Collinsianum. Transeau



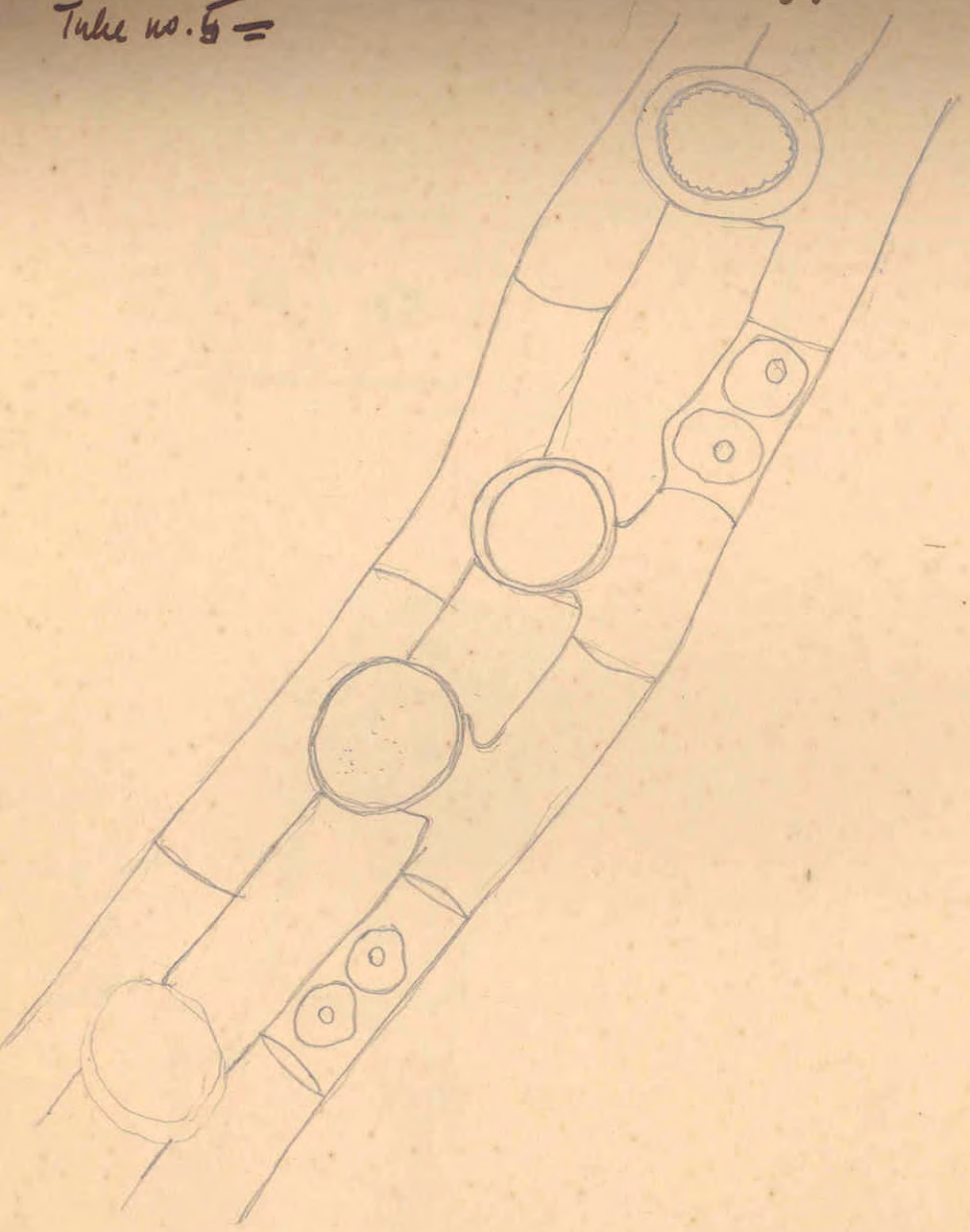
30-34 μ broad

18

Tube no. 5 =

Zygnema coeruleum. Czarda.

Sida Bacem. Rock 37



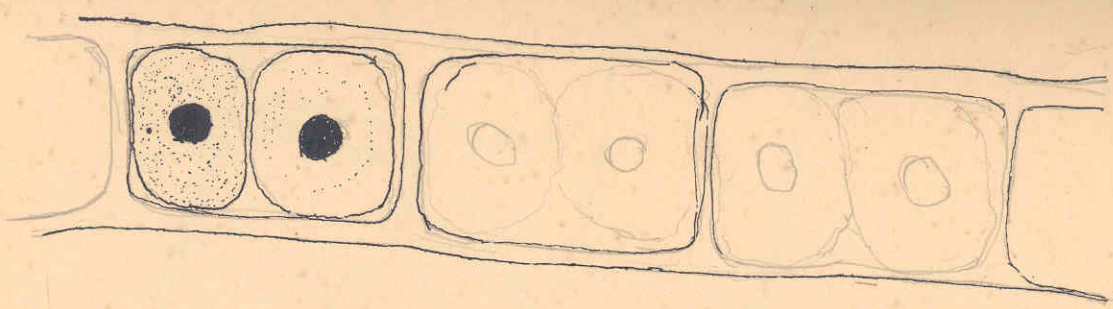
Cells = 22 – 24 V — 3 – 4 times as long

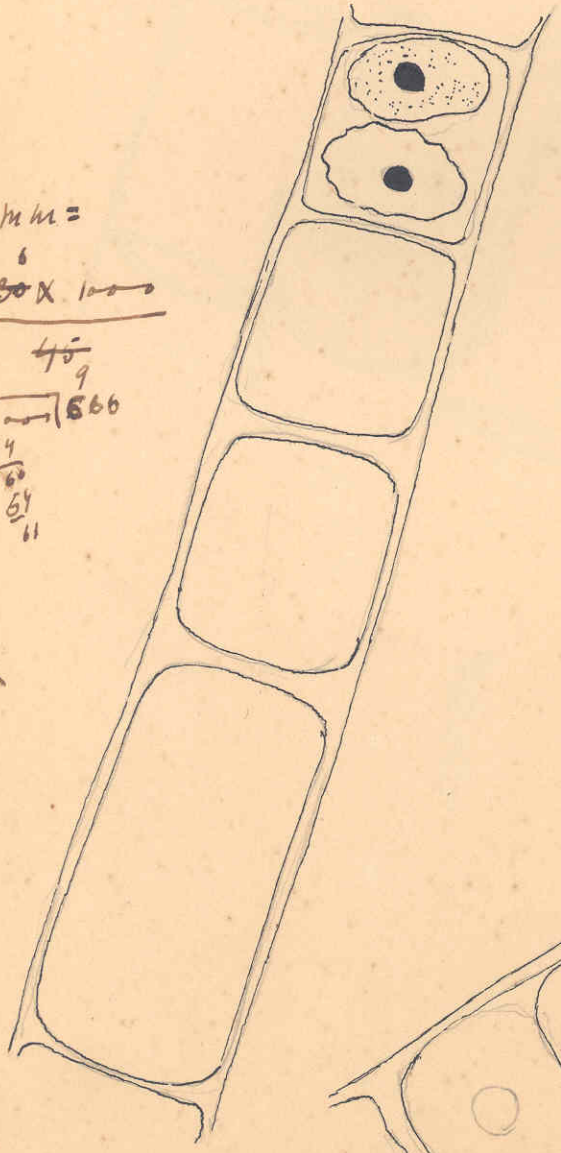
zygospores = 26 – 36 V in diam.

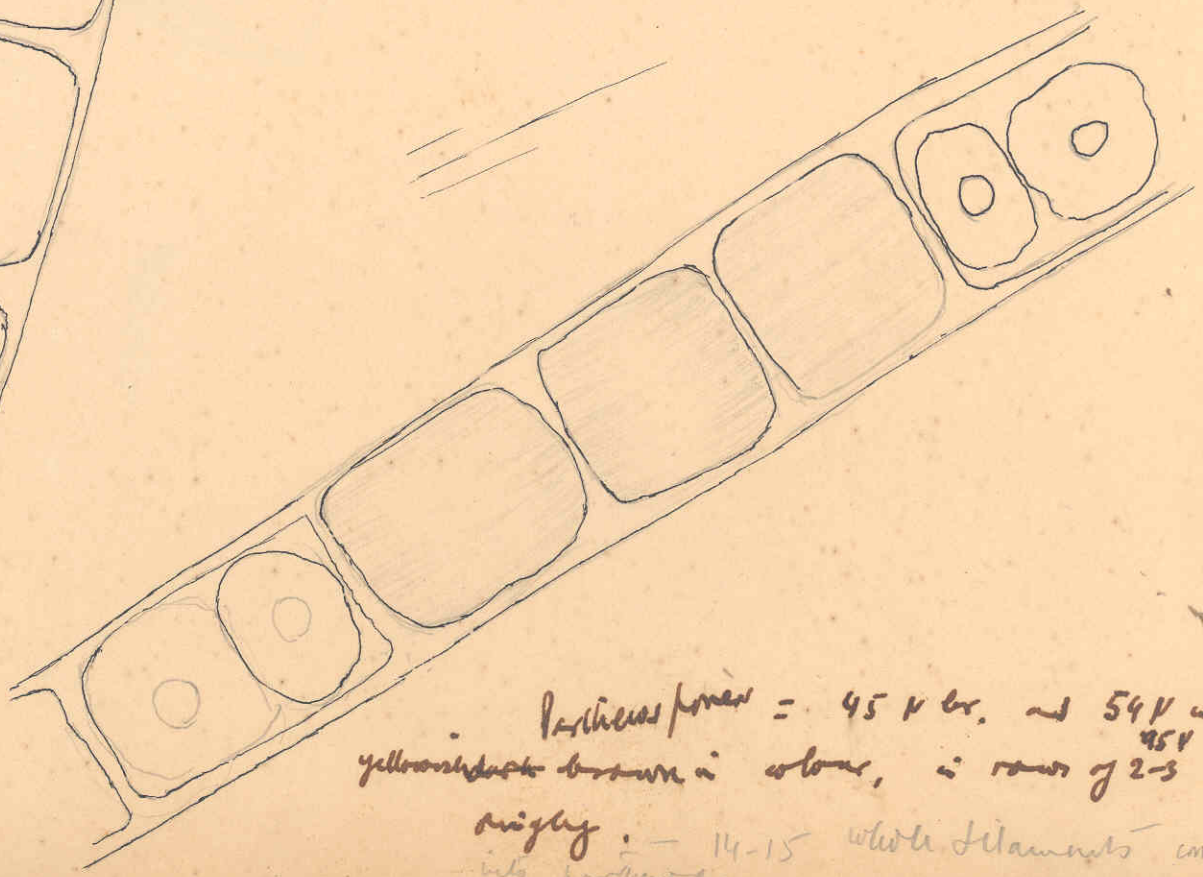
Table 57

Zygnema gigantēum. sp. nov.

Ramshaw

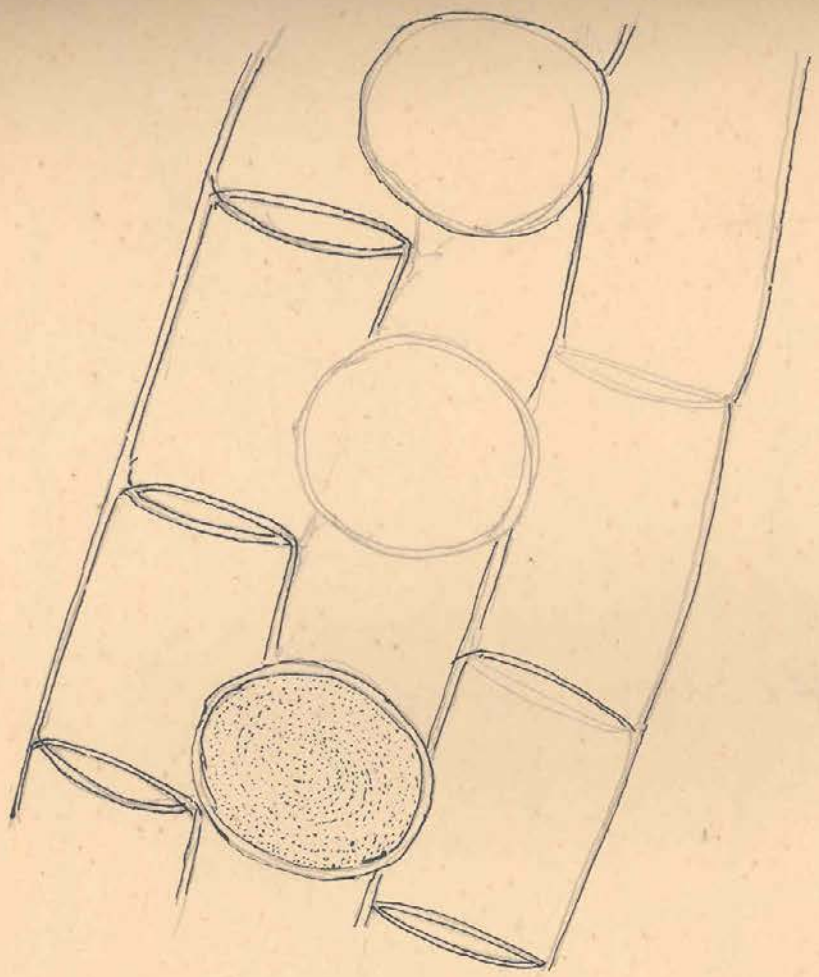




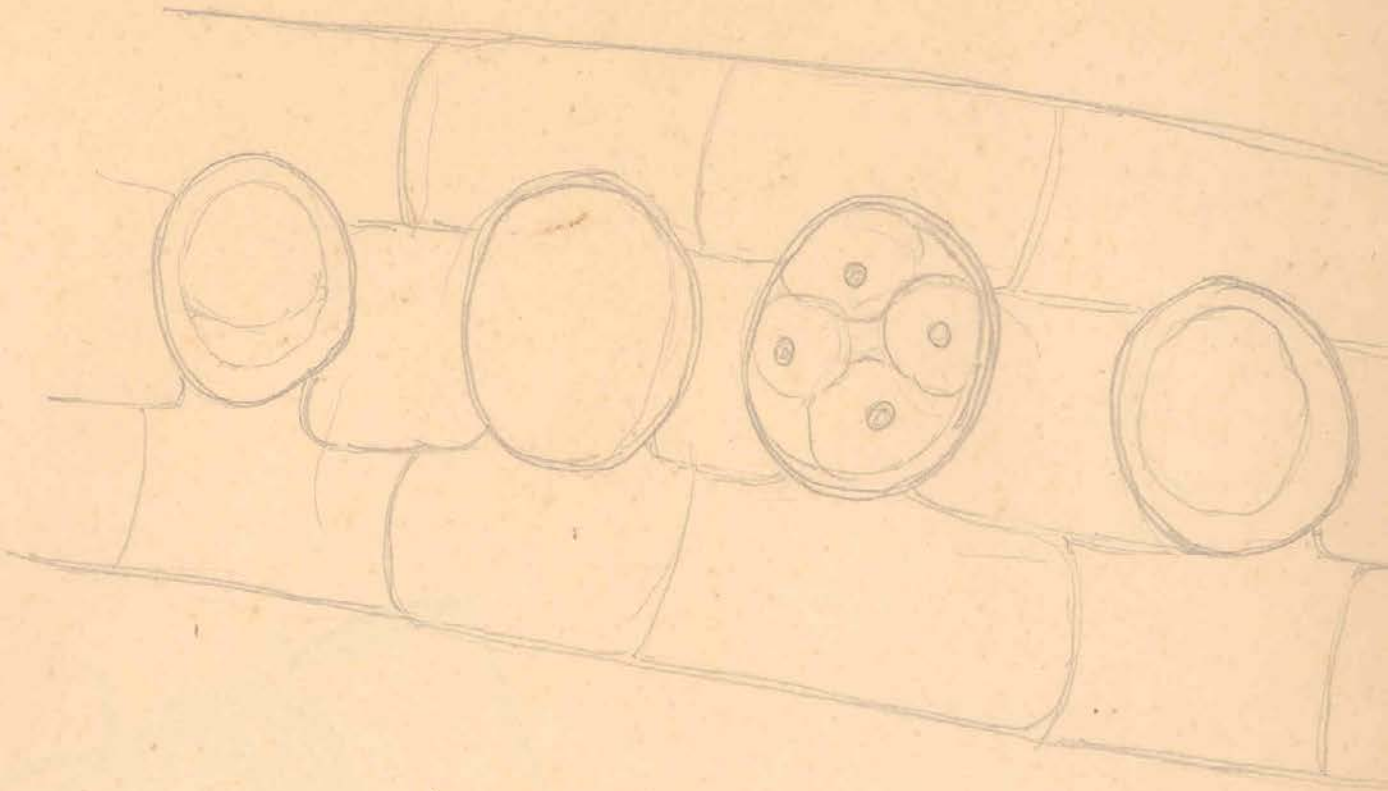


Parthenos spores = 45 μ br. and 54 μ in leng
yellowish-brown in colour, in rows of 2-3
angles. — 14-15 whole filaments convert
into parthenospores

Tube 5. Zygnema gigantellum. Str. nov. Ramsawa



Tabe 5. IV Zygnema giganteum sp. nov.
Randaua



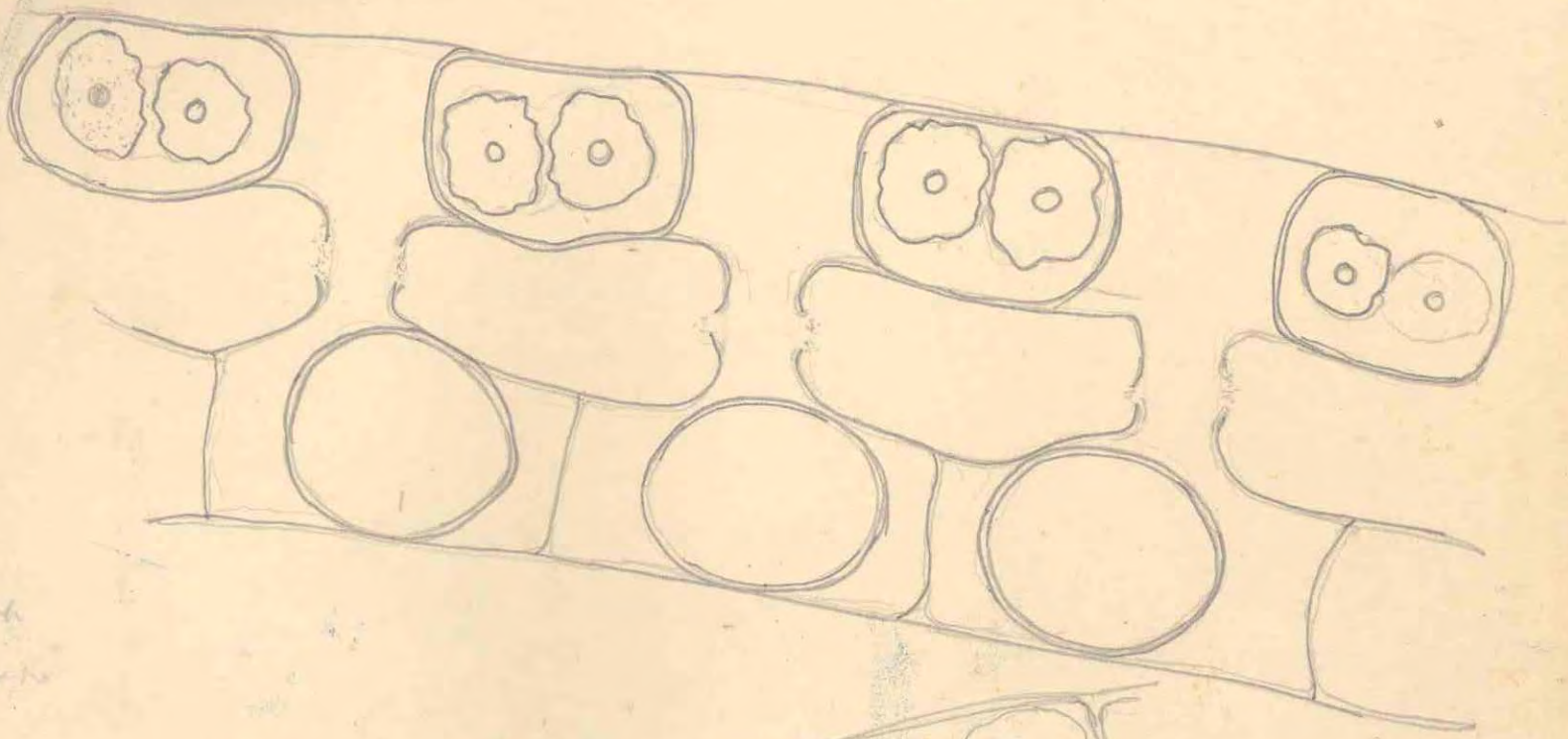
zygospores = oval.

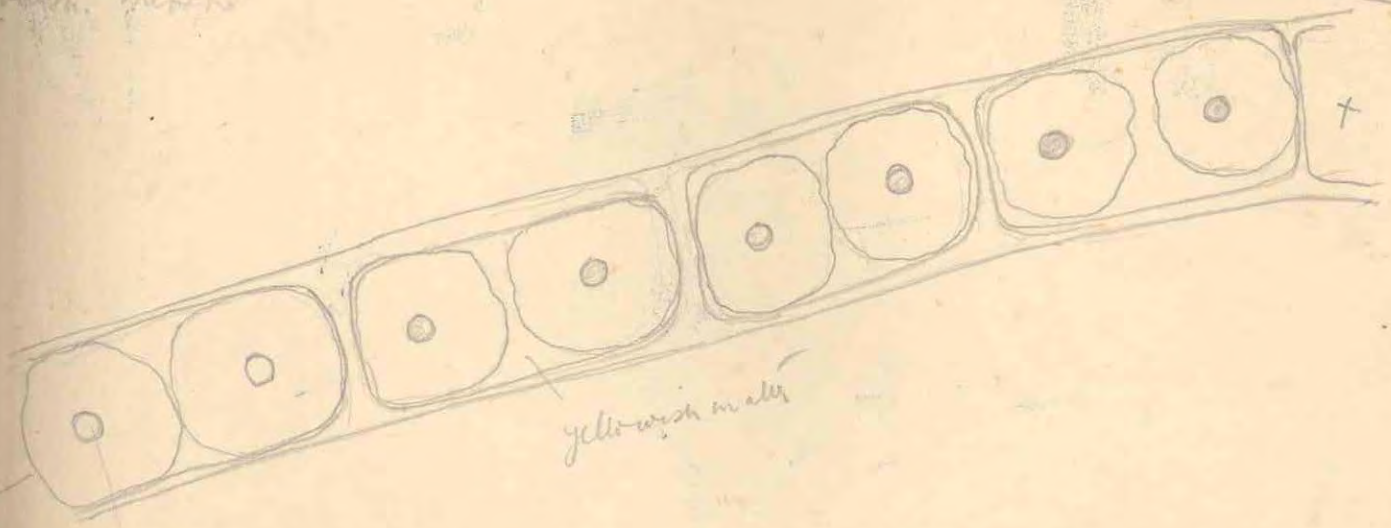
45–55 μ in breadth

70–75 μ long.

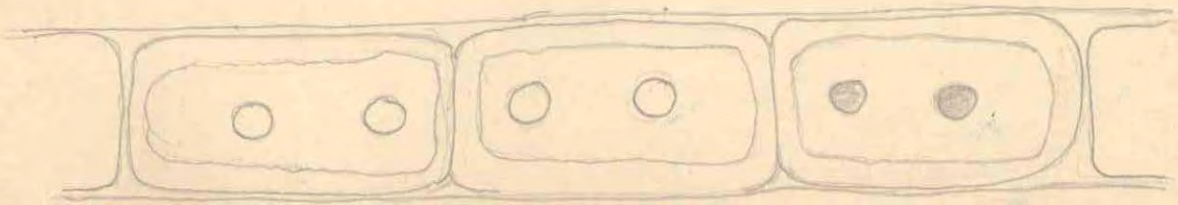
Zygnema gigantea sp. nov.

swyth bar

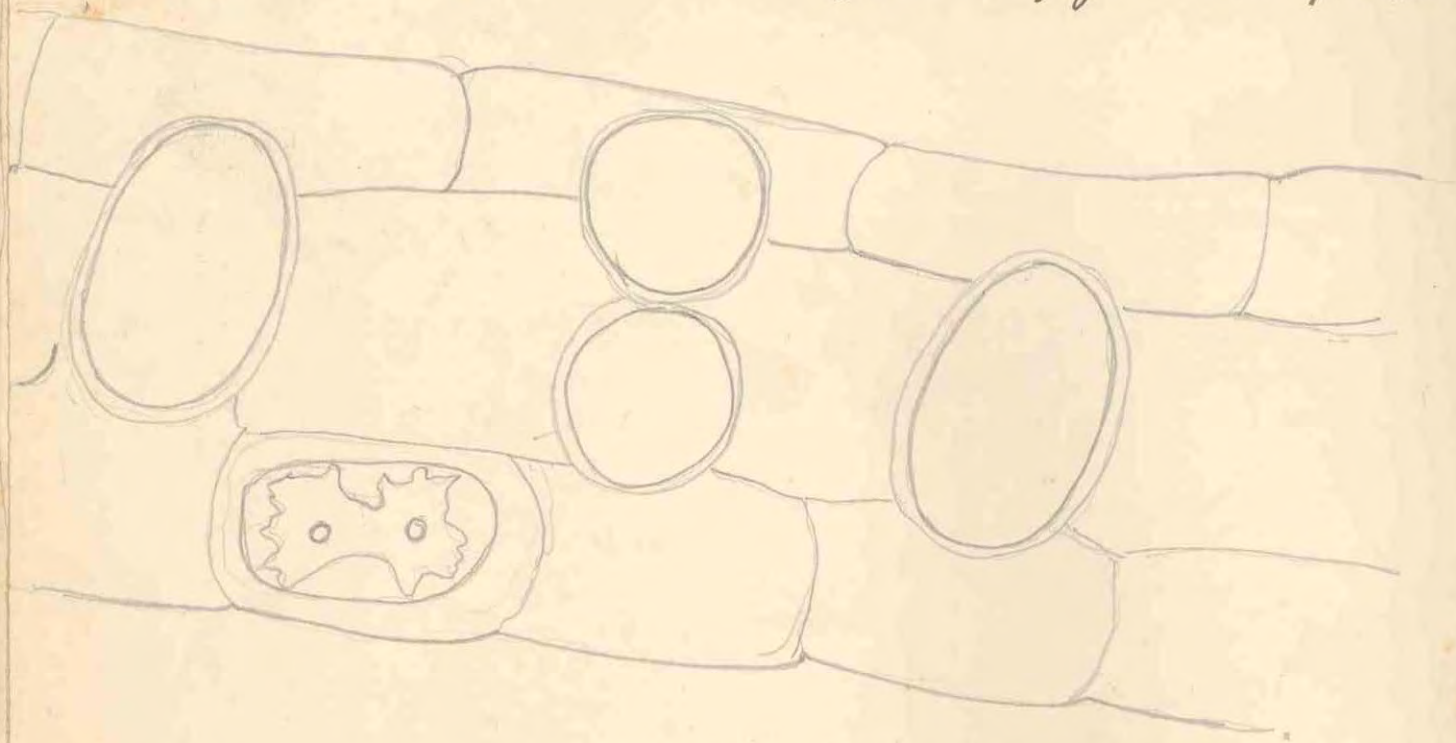




yellowish matter



Zygnema gigantenm sp. nov.



Zygospore

40 – 48 μ broad

54 – 72 μ long

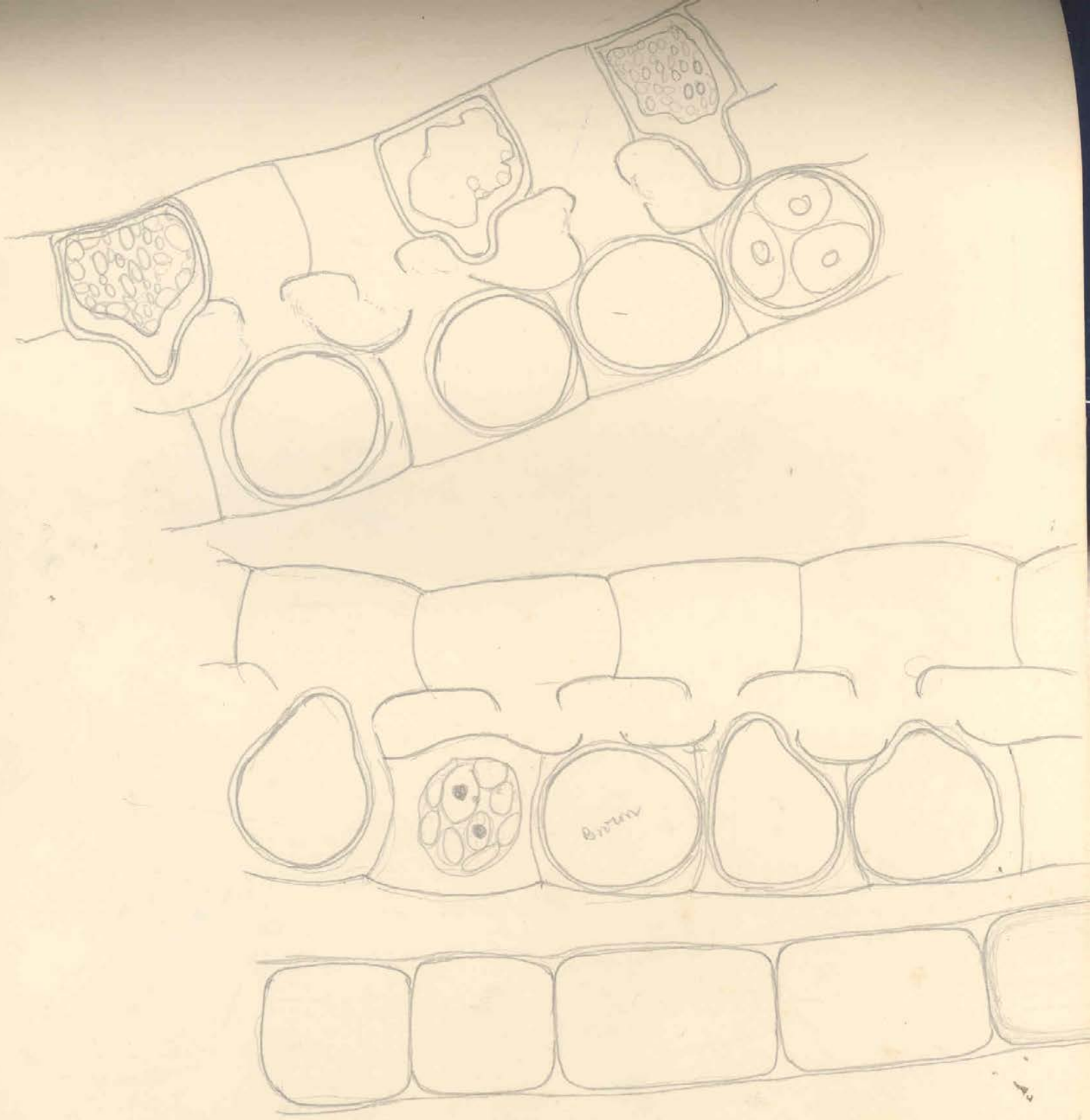
20 mm = 36 μ

Staining of mountage.

Filaments

36 μ broad

1½ to 2 times as long


Bast

Zygnema Iyengari. sp. nov.

Ramanawa.

Fig 2

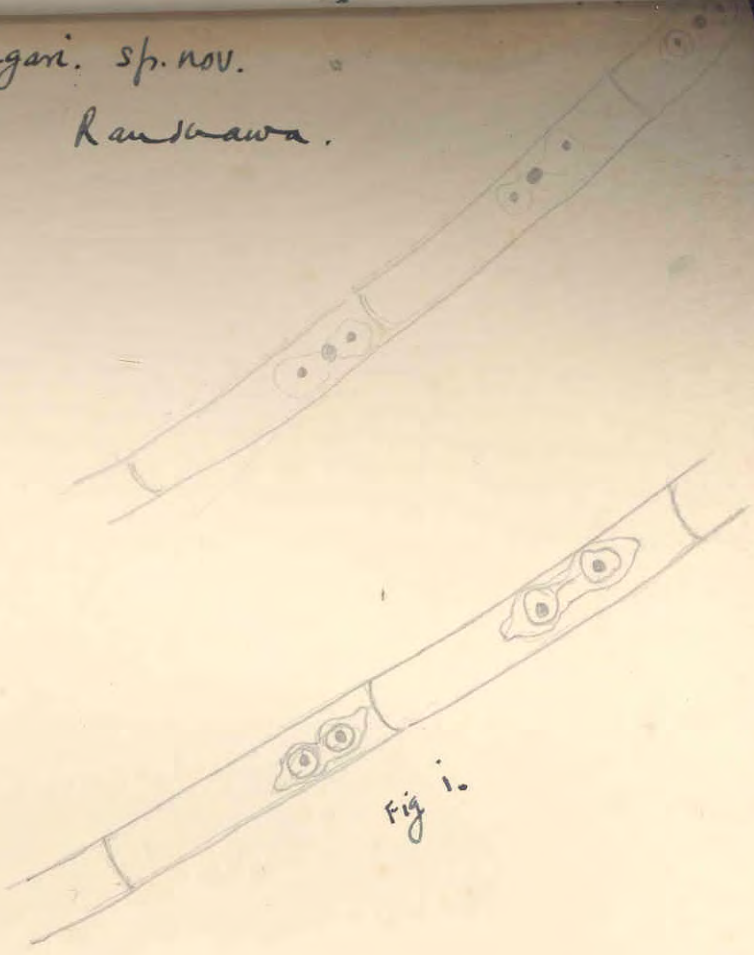
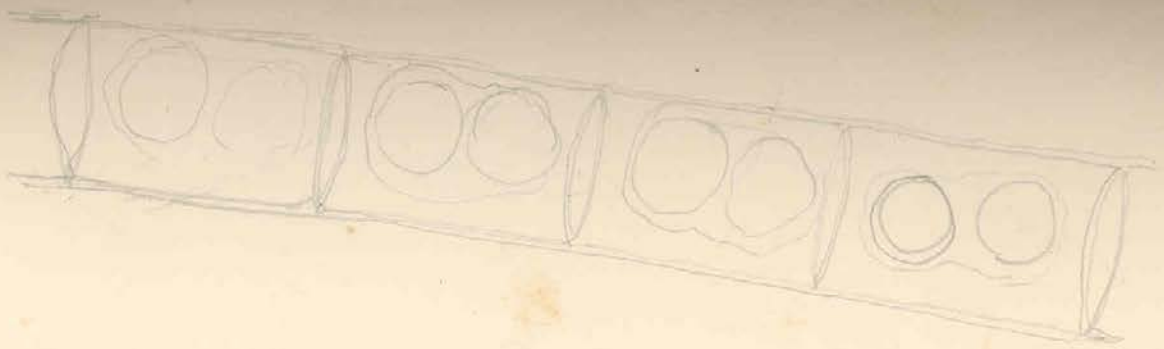


Fig 1.

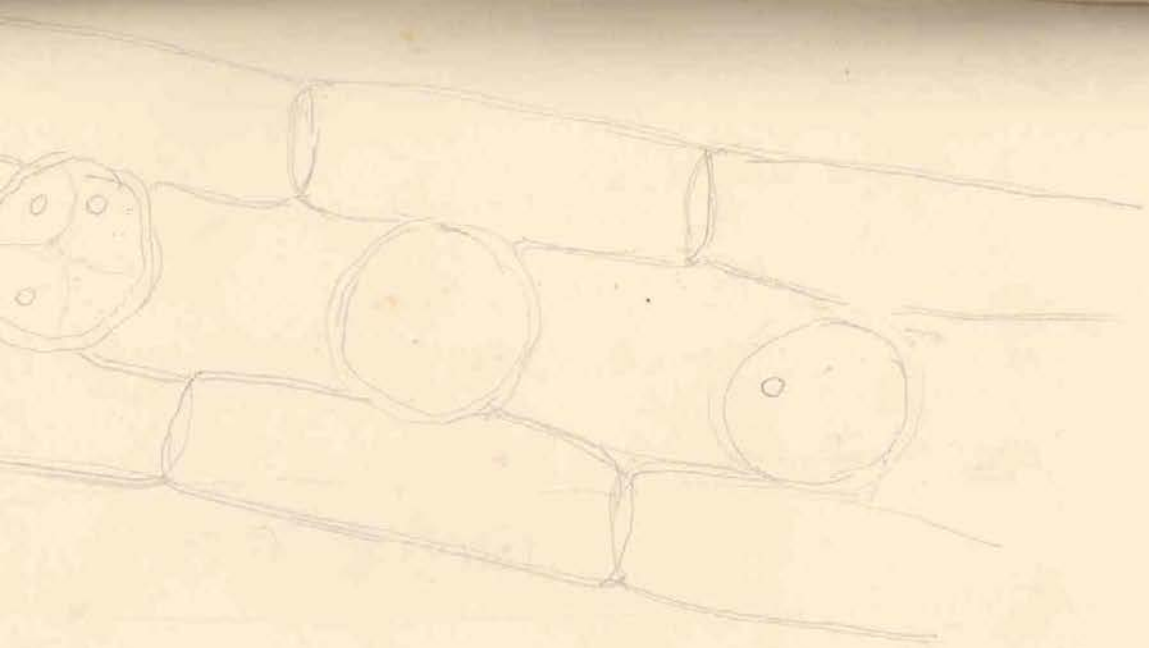
Figs.

cells = 18–20 μ br. . 5–7 times as long

zygospores = 26–30 μ long spores ob



Cells = 45 N. $1\frac{1}{2}$

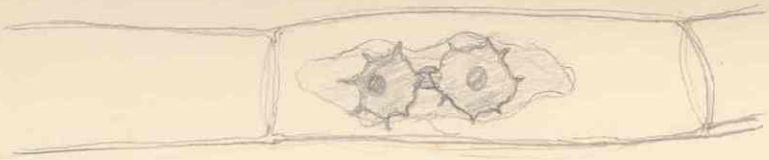


36 V.

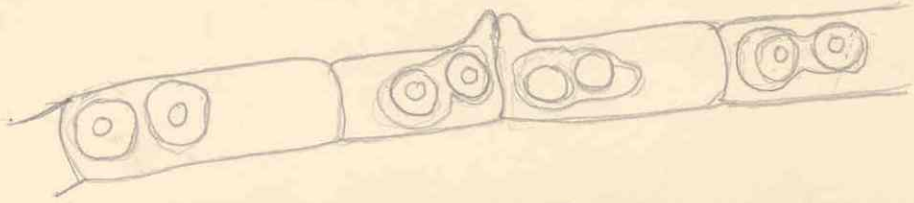
- 20 – 28 V and 3-6 Hz
– 36 – 56 V in Hamelin

Zygn[illegible] spi[illegible]

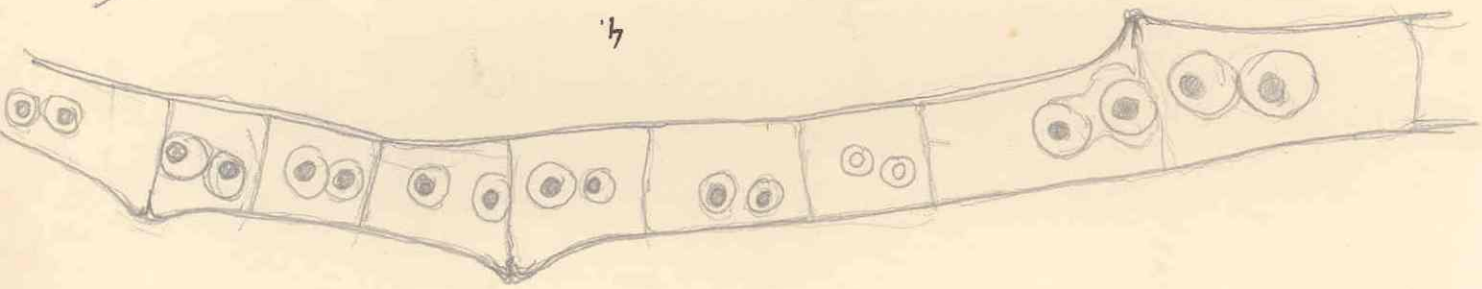
Ranchawa

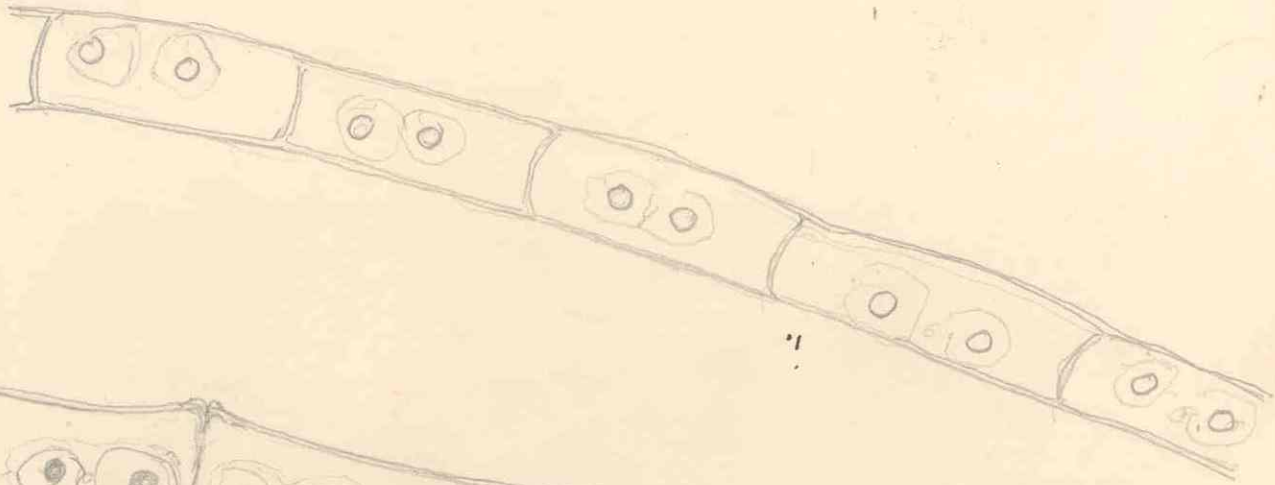


2

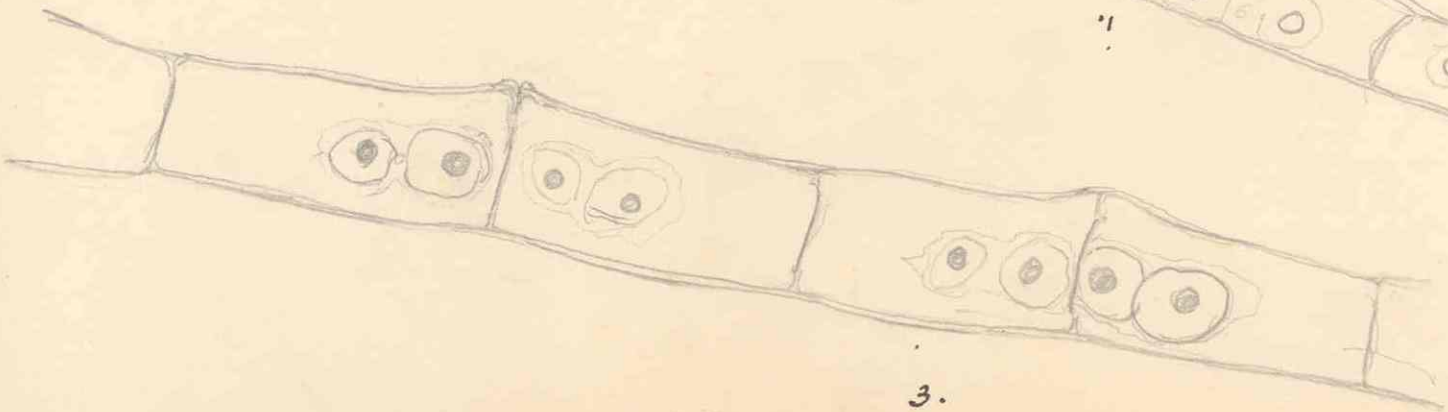


4



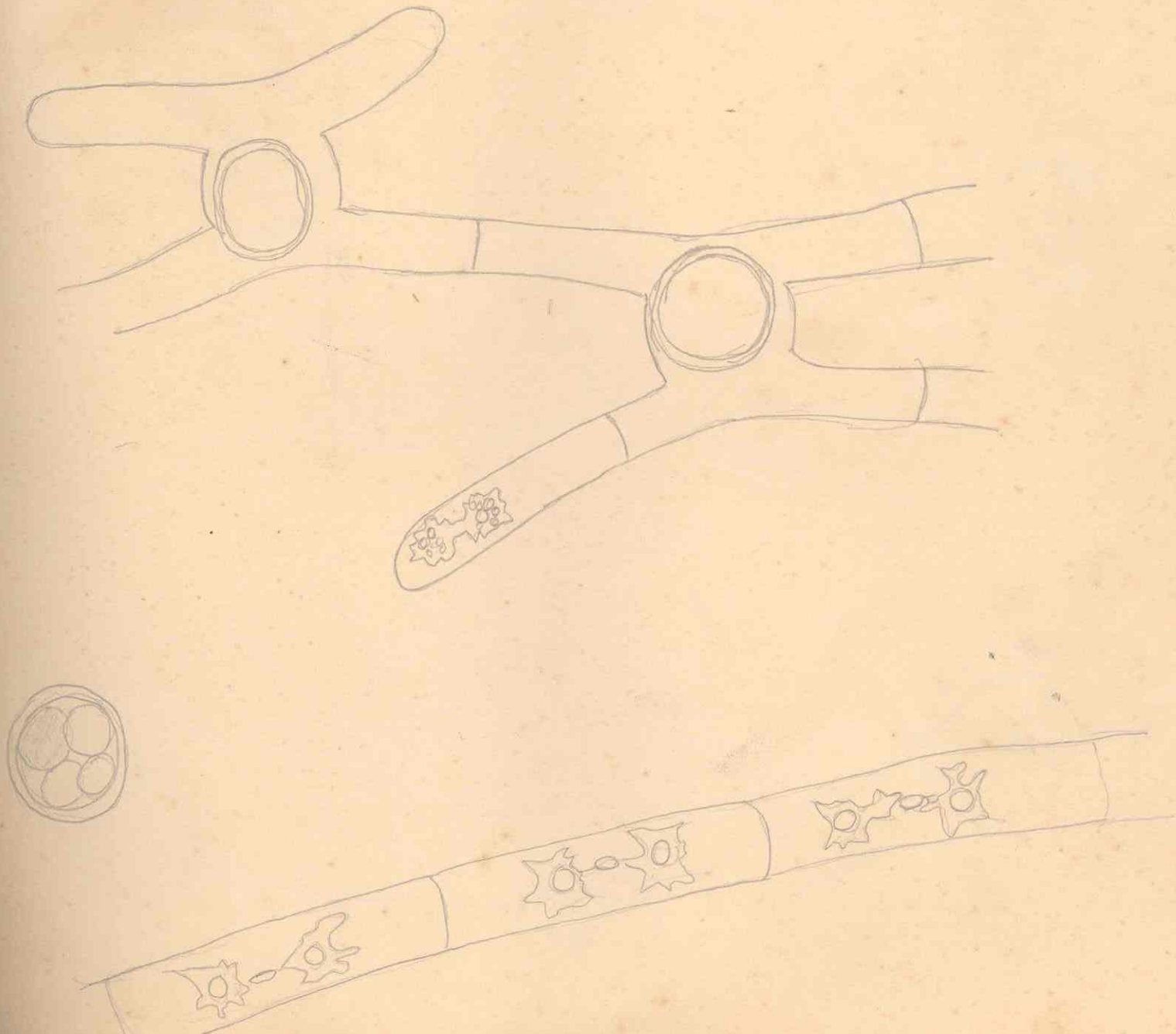


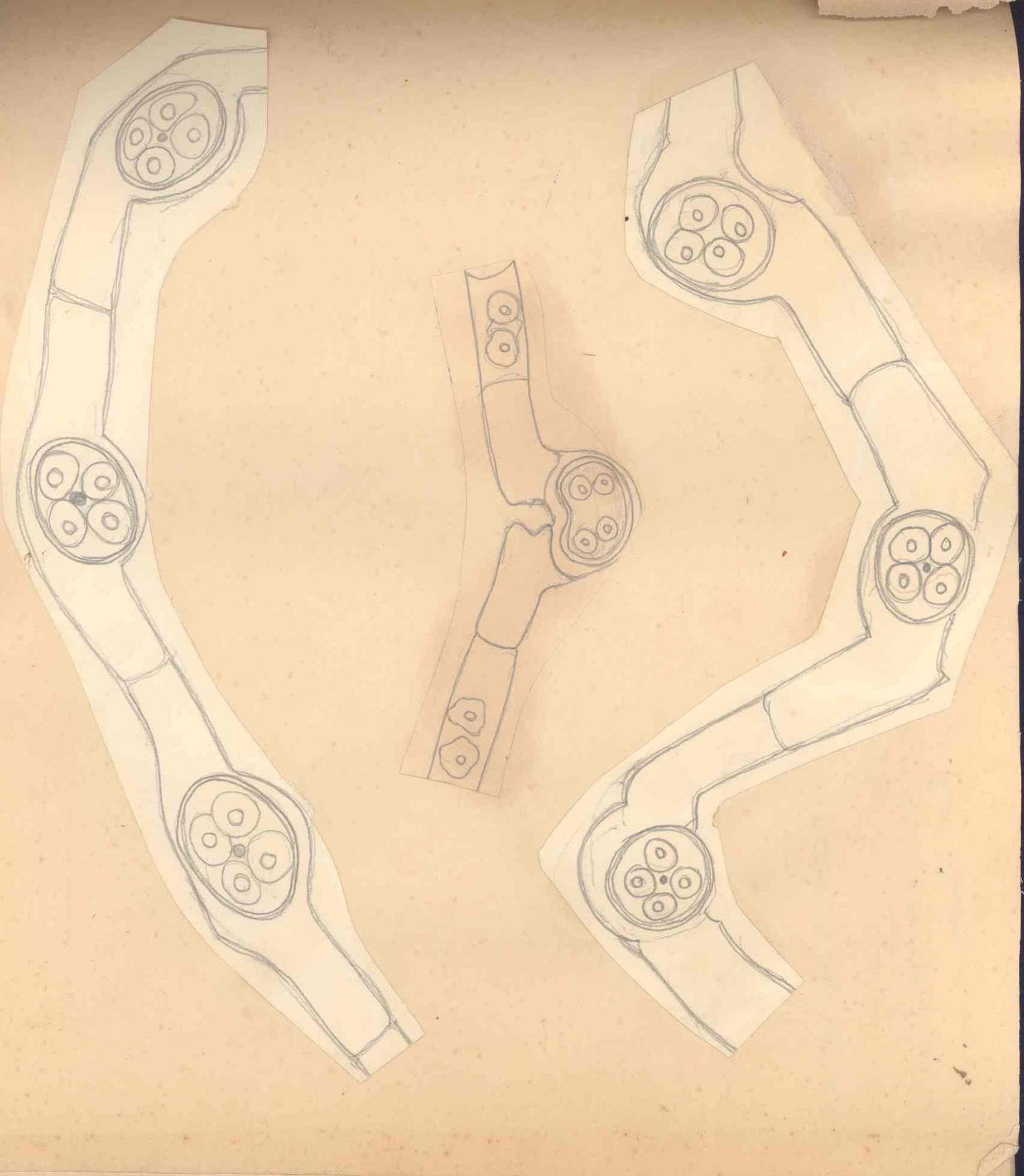
1

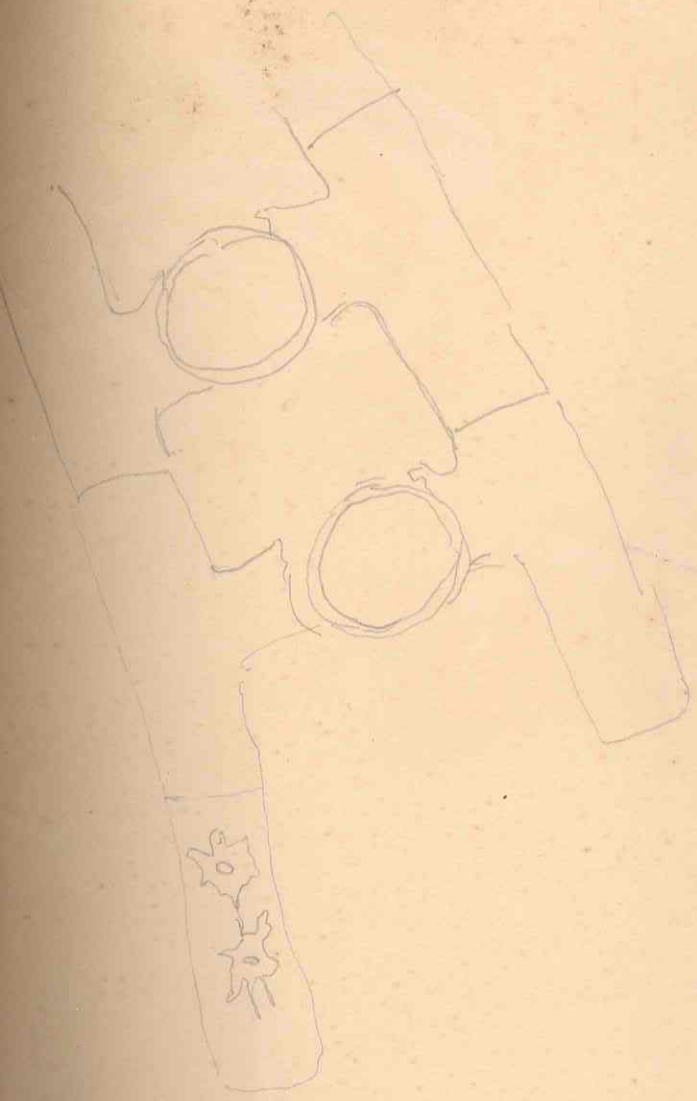


3.

Zygnema Czardae.
Fh. nov.
Lauterborn







For other [illegible]

Both layers of zygospore hyaline, exo wall as mesospore thrown, light-blue in colour.

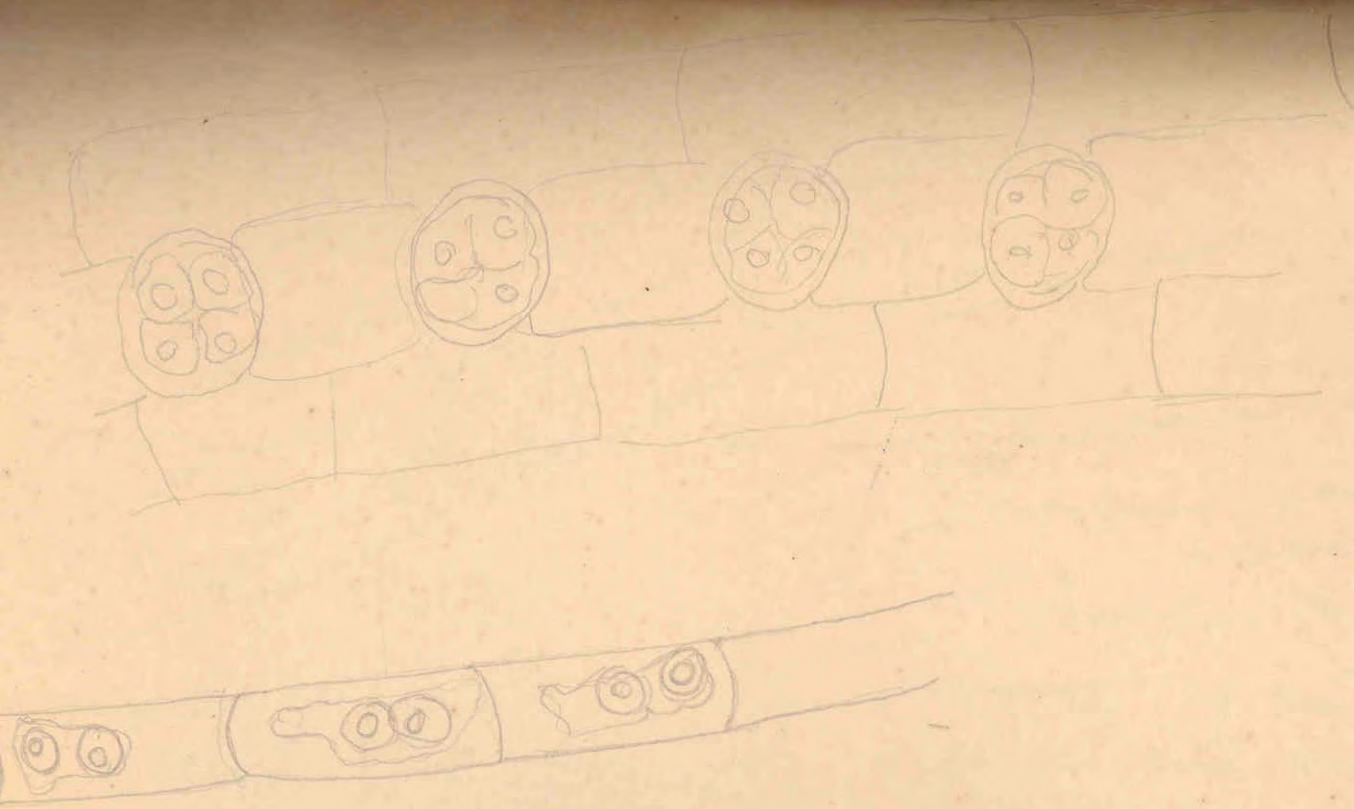
Zygospore = 28-38 μ in diam round.
15-18-22.

Veget. cells = 18 μ diam.
4-5 times as long.

16

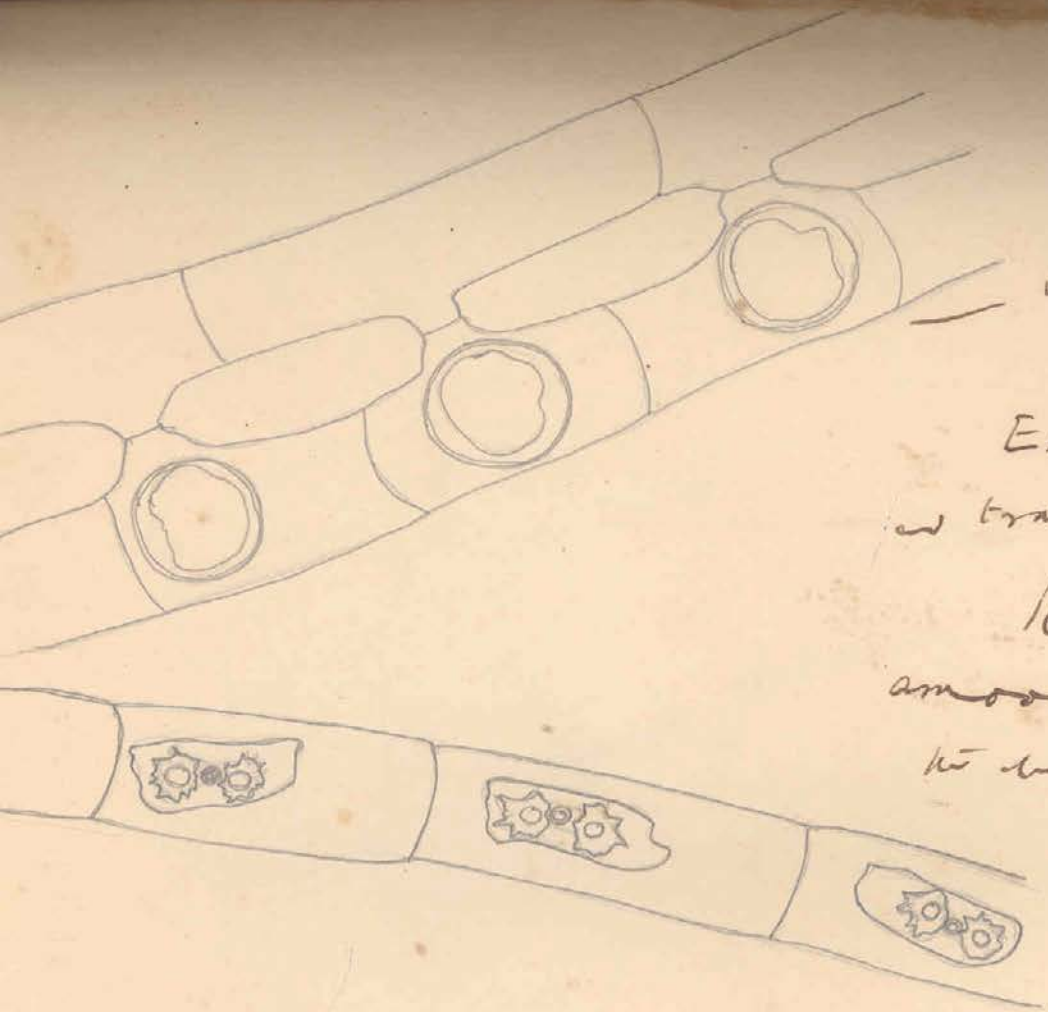
Zygmunta Czerskiego. Sp. Nov.

Randkawa



Cells = 19 Y — 25 Y hrs. 3 – 4 hrs as long

Zygotes = 32 — 36 Y di dim.



not swollen very long

Exospore smooth thin
and transparent. colorless
purplish-red.

Zygospore filled below
smooth and even, but
not the whole compressed

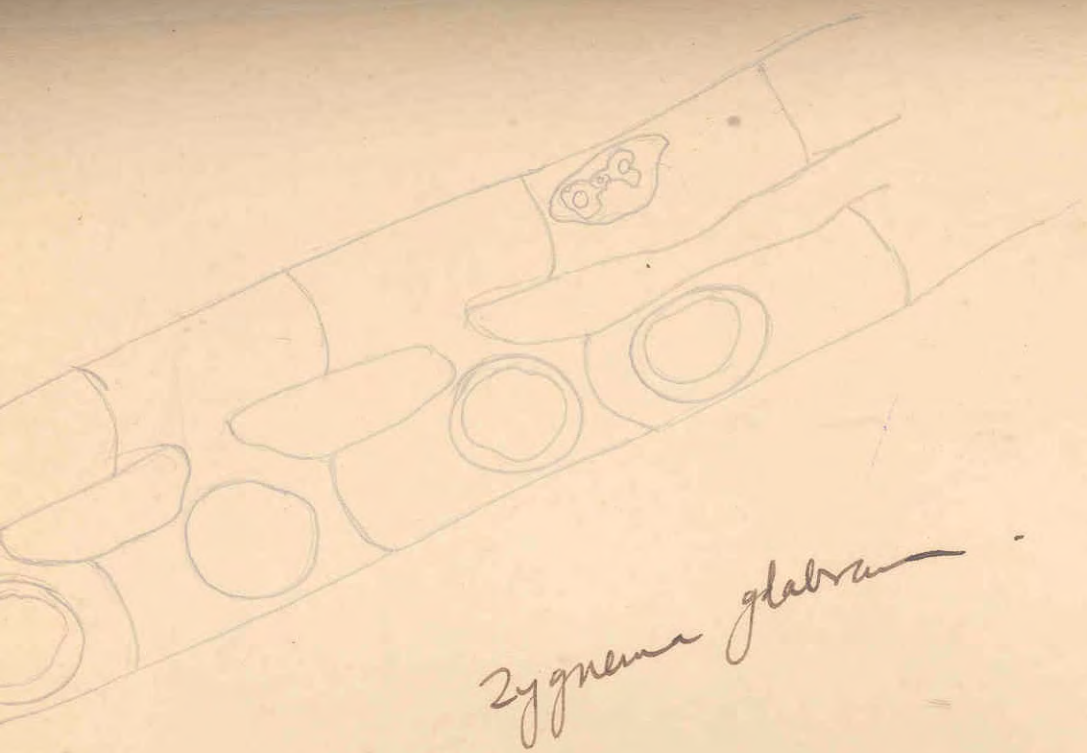
Zygnema glaberrimum Hauck.

Veget Cells = 22-24 μ broad
2 5 x as long.

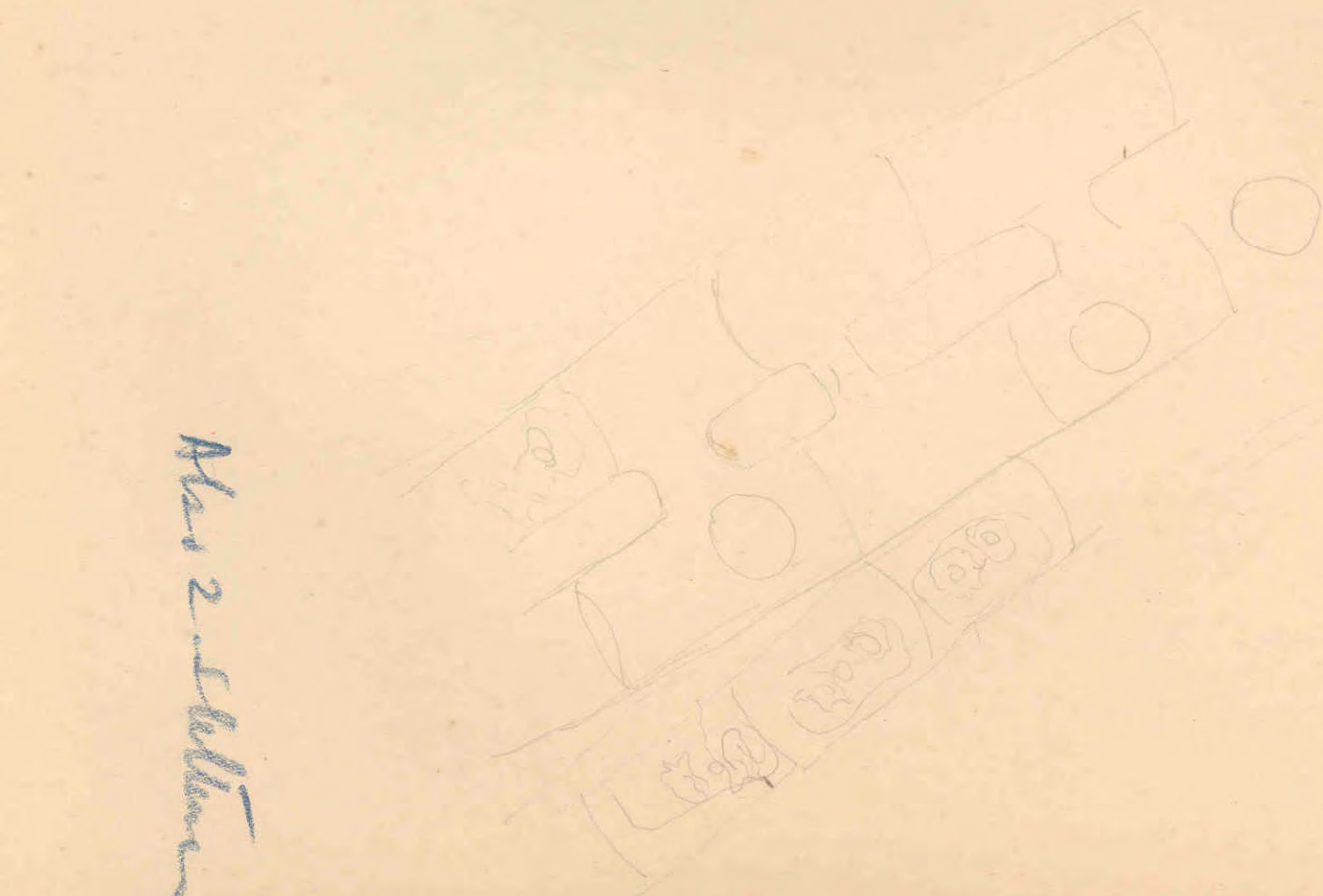
Zygospores = 24-28 μ br.
round
round and or
oblong

$n = \frac{18}{11} \times 16$

$\frac{25}{12}$ 2-3-4
$\frac{37}{33}$
$\frac{33}{46}$

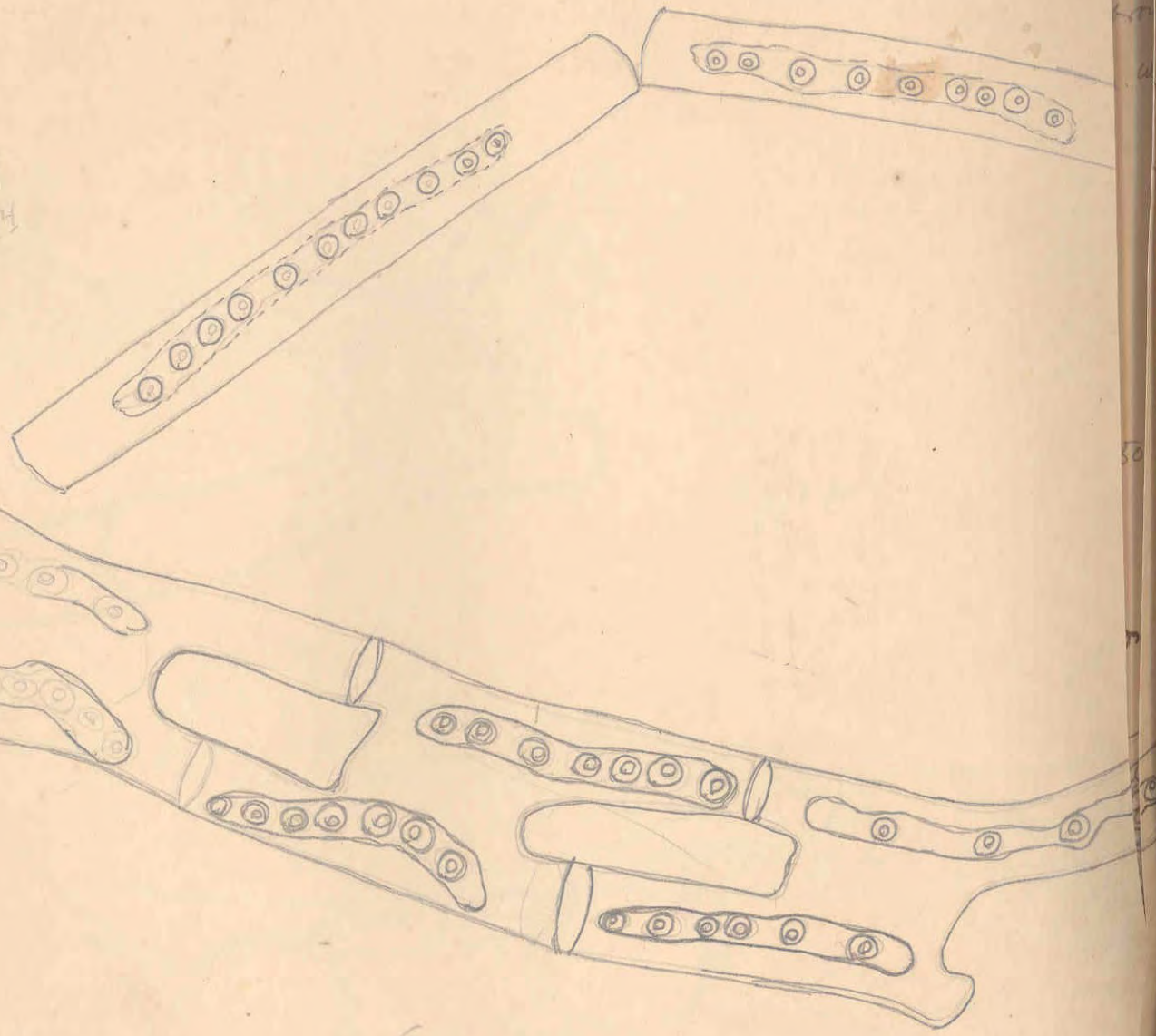


Zygnema glabrum



Atlas 2. Tafel 1

Longeola Sphaerotaphe.
Wolle.

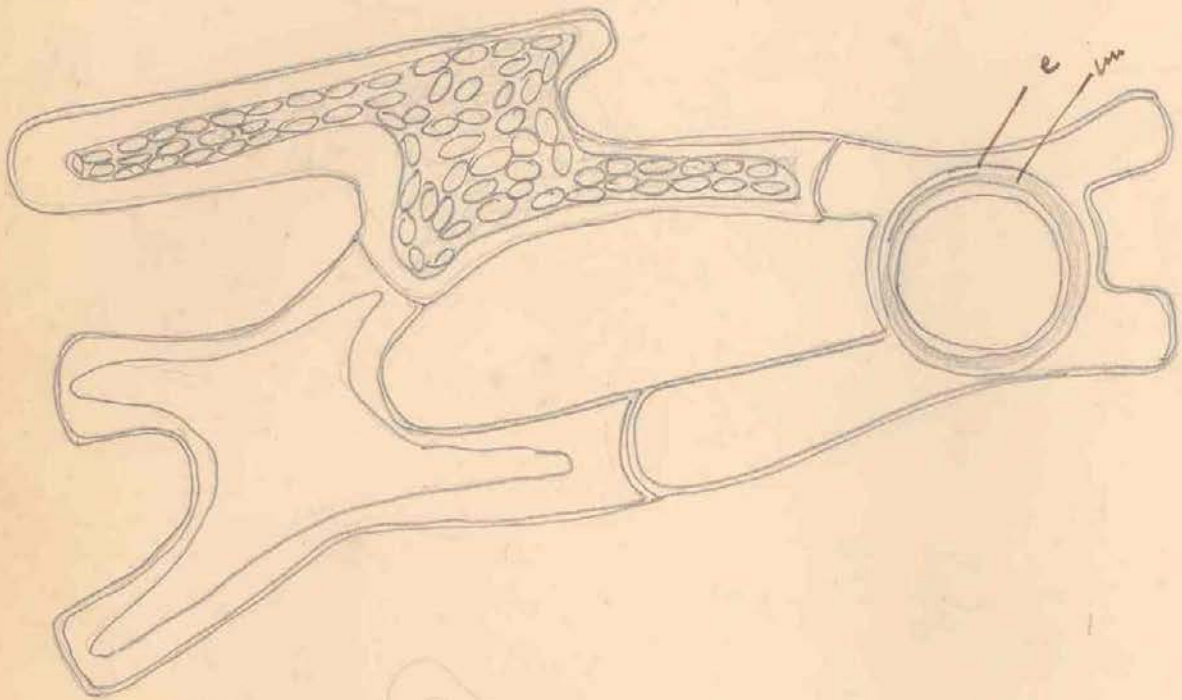


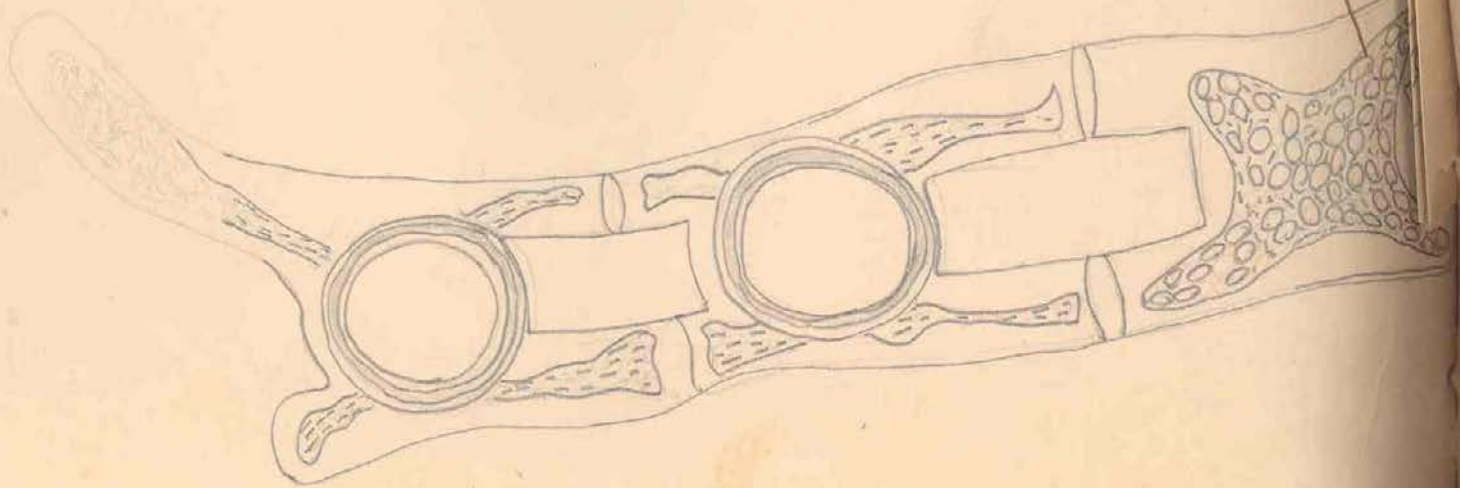
Vegetative cells = 20 – 22 μ br.
7 – 11 times as long.

18 18 15

Rougeotia sphaerocarpa

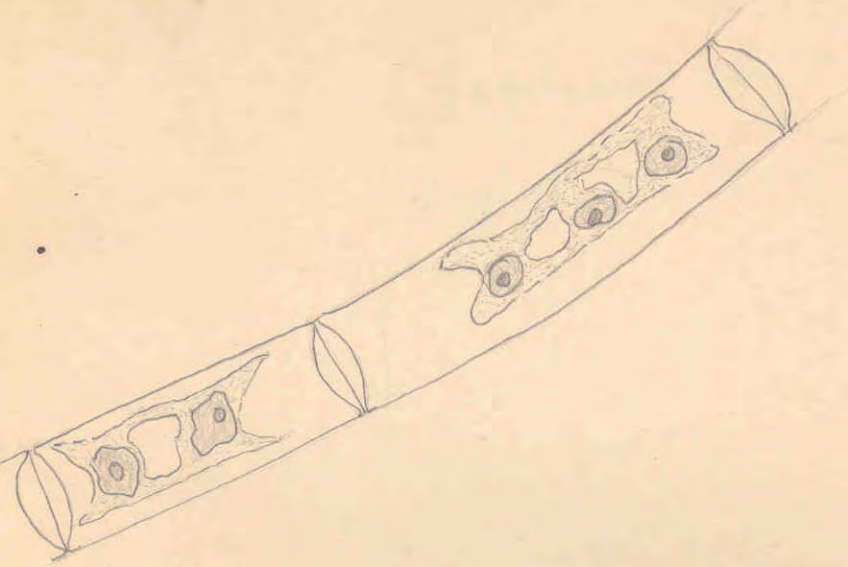
walls.





Rongerka bluedwayan.

8/p. nov.

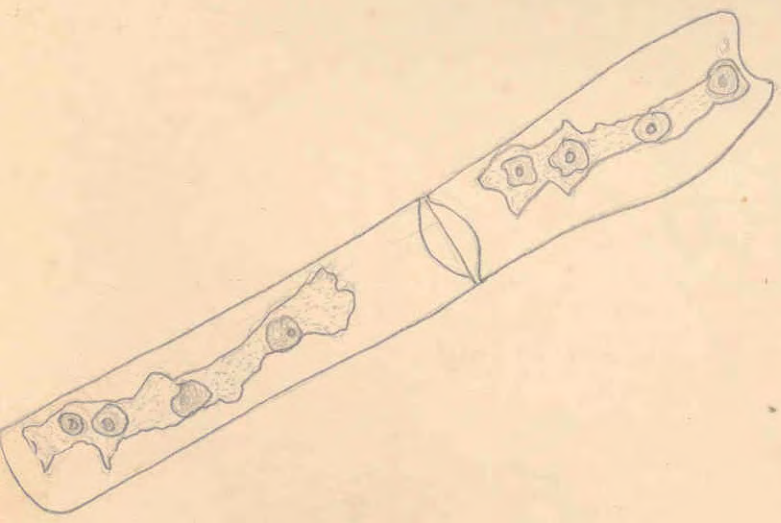


14 x 11
15
112
19
11 / 252 / 23
22
33

Cells

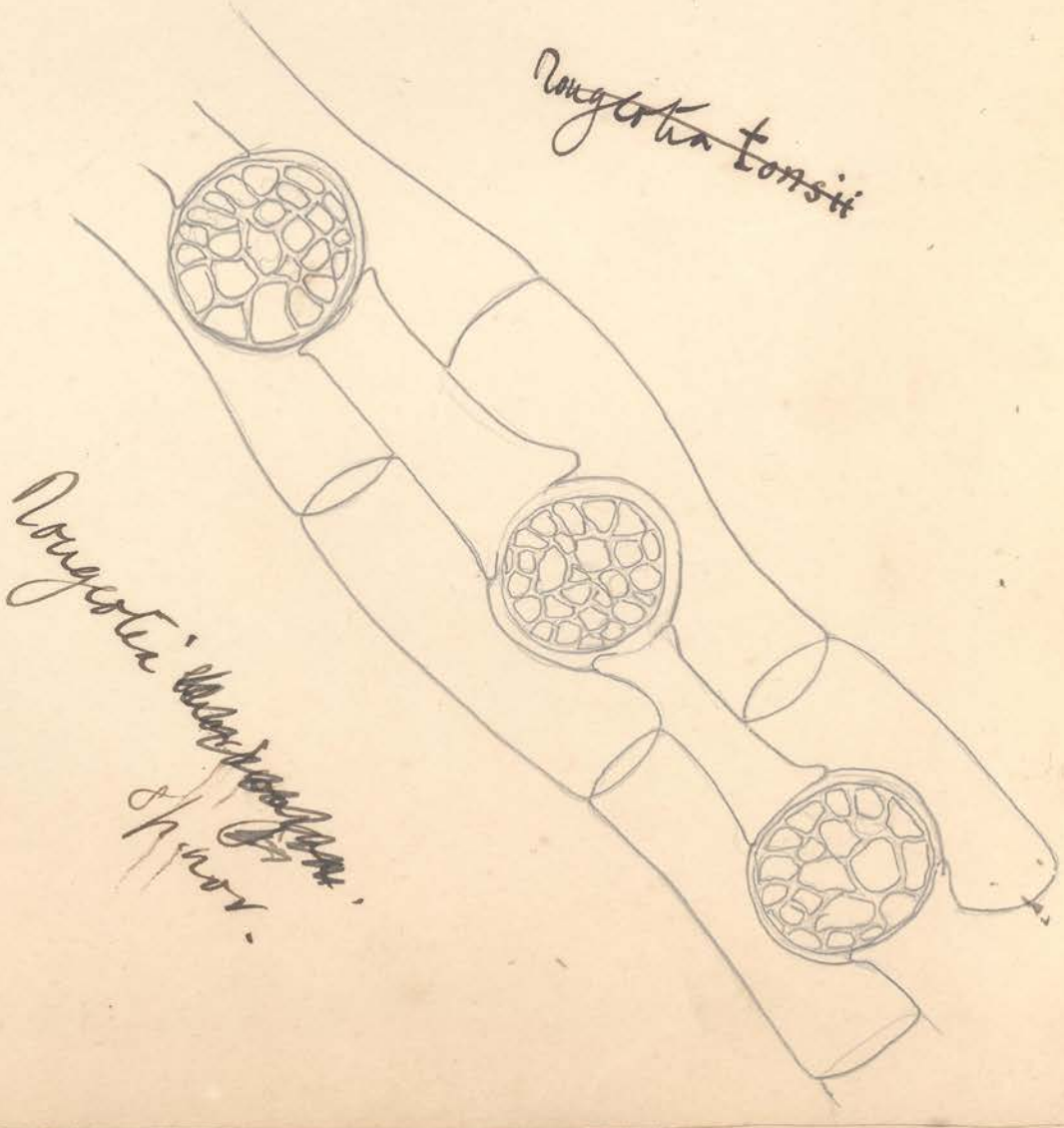
22 - 24 ⌀ brown

3 - 4 times as long.



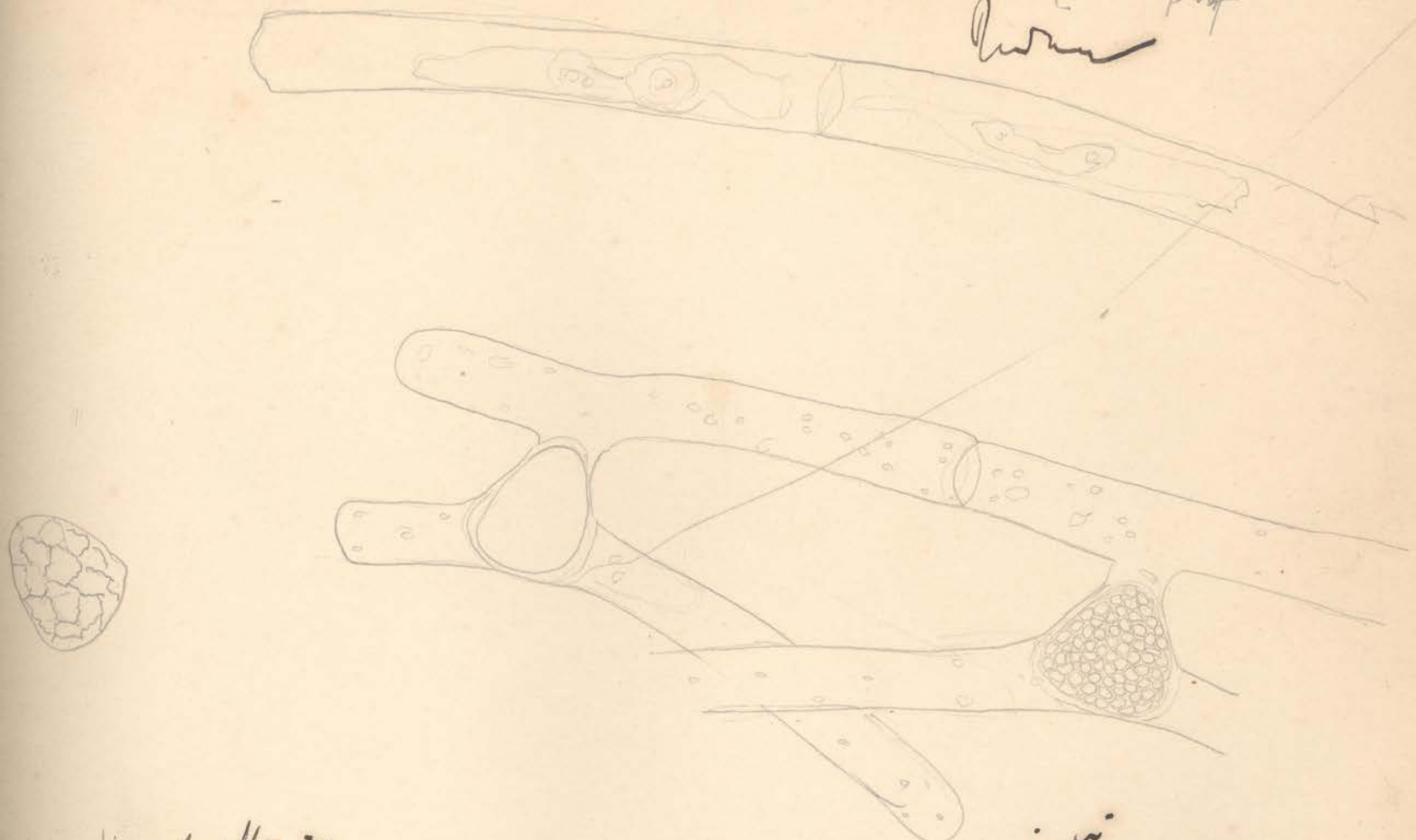
Vegetative cells = 22–24 μ br.
3–4 times as long

Zygospores = 36– 40 μ br.



Rougeotia lepus.

Sp. nov.: [illegible]



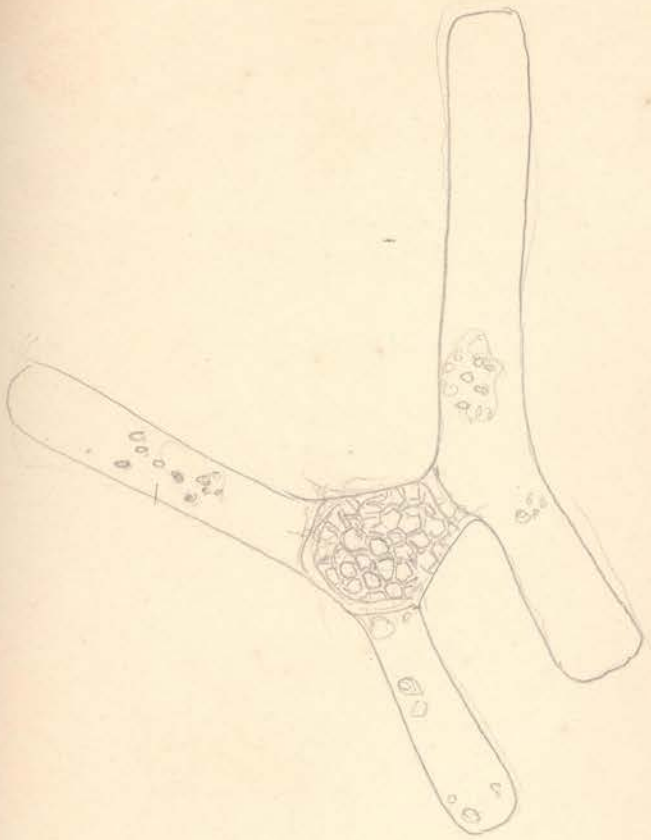
Veget. cells =

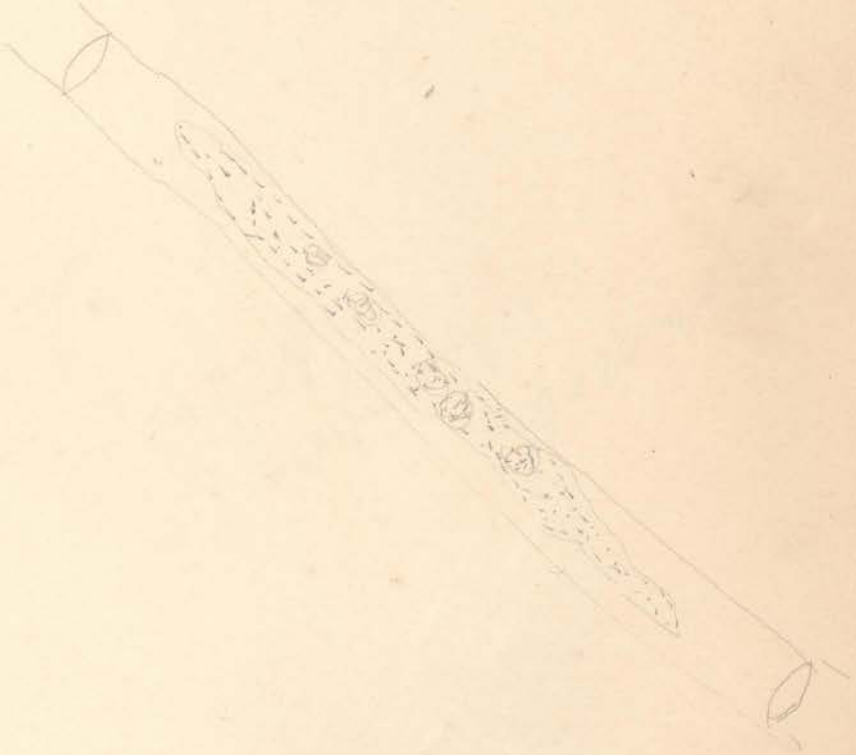
18 – 20 N br.

Differs from R. tenuis in

1. Broader size of cells.
2. Triangular shape of zygospores in reticulate thick. wall

Tongeortia lepus.

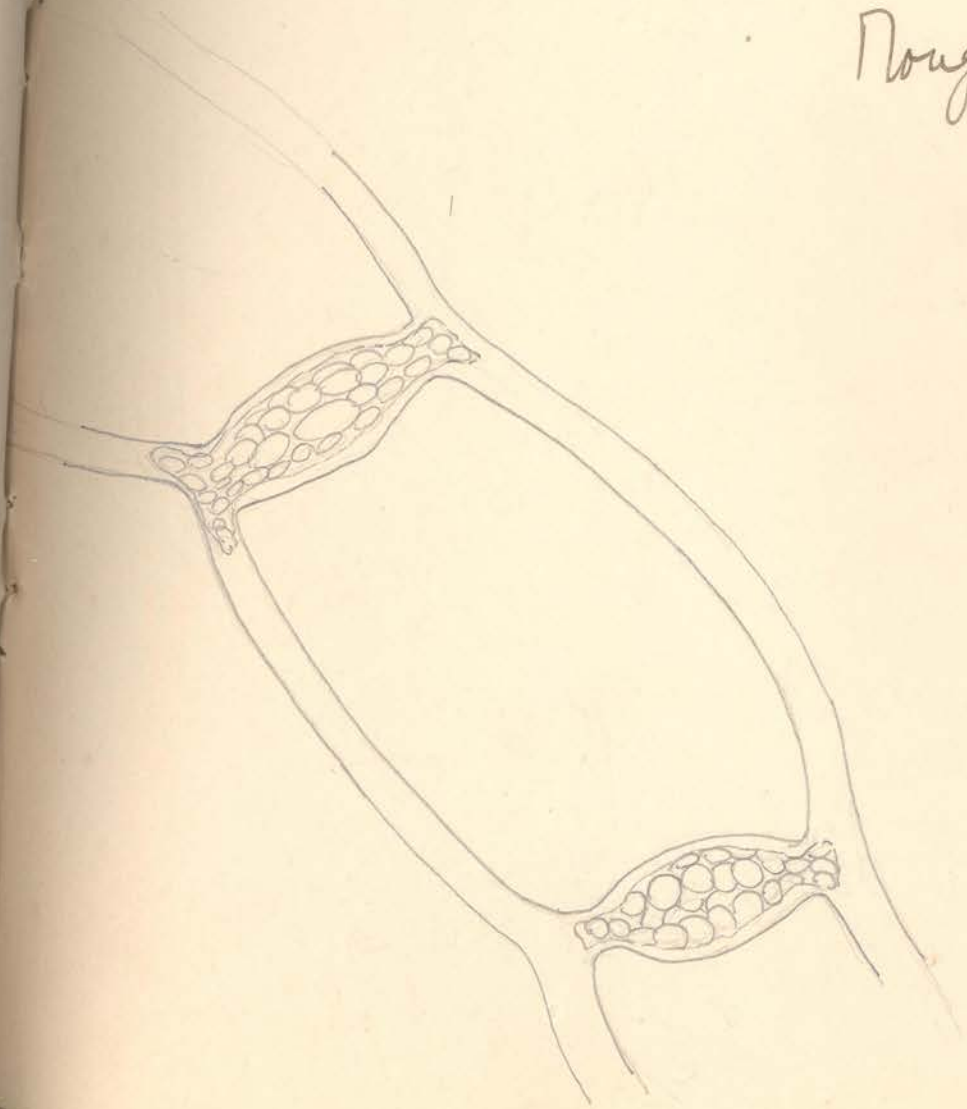


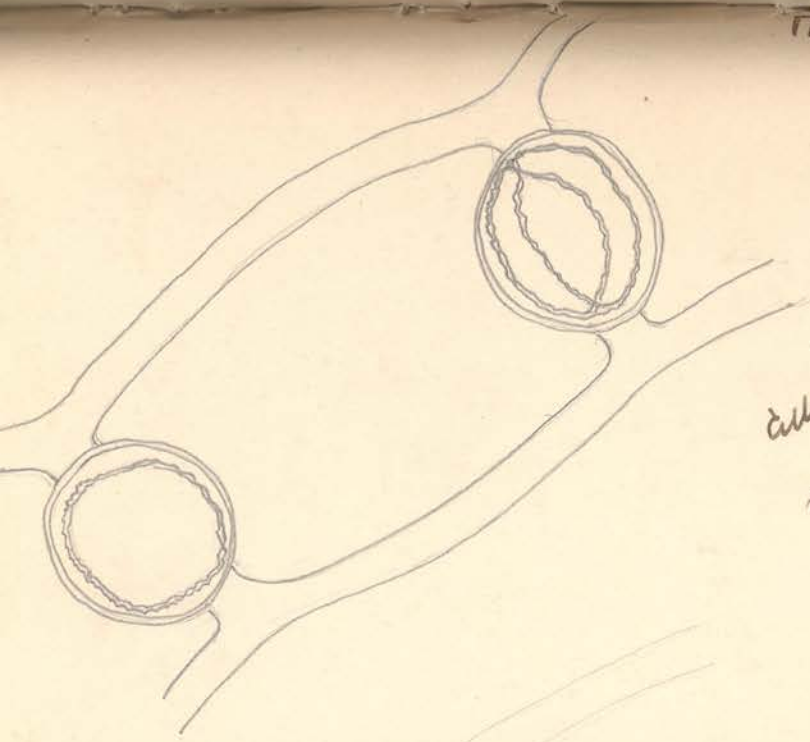


Nongrotia
reticulosporia
Lasiumm

Polygonum Jamesii

Var- alveolata





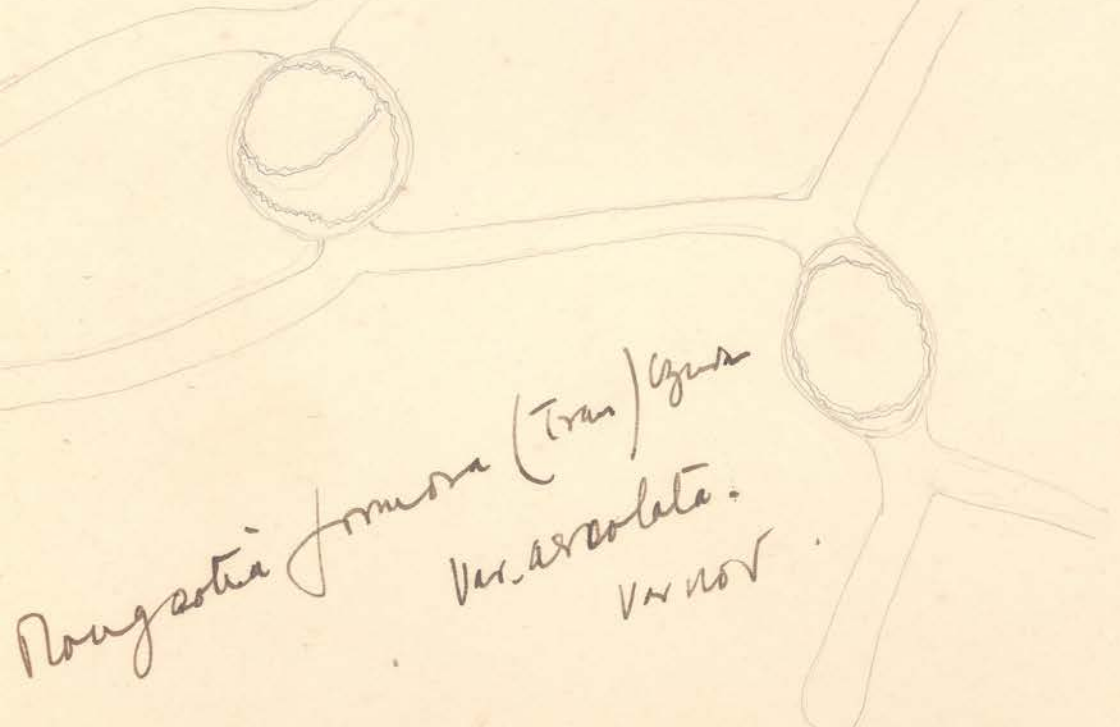
Pinguicula areolata. sp. nov.

Veget: albs = 6 – 9.8 N broad.

Cells exhibit dyctions, or nets, some of which are elongated

Zygospores = 32 – 36 N br.

32 – 42 N long.



Pinguicula Jamesii (Torr) Gray

Var. areolata.

VAR NOV

Habit. Recd with Sp. Daedalea. Leg. in a lake near Rockford; 1st. week of Dec. 88.

Rougeotia tenuis (Cleve) Witt.

Zygospores with a light blue green cover.

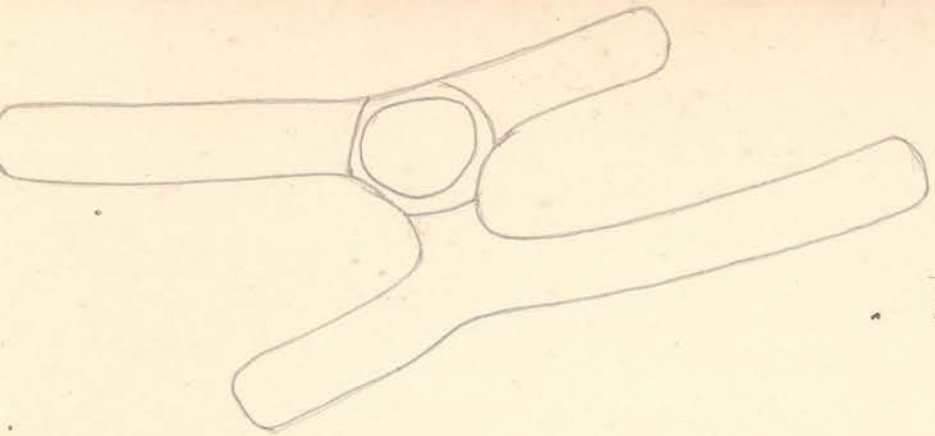
$\frac{11}{18} = \frac{18}{11} \times 18$

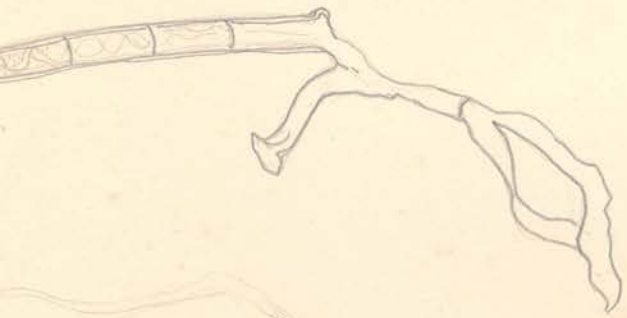
$\frac{18}{126}$

$\frac{126}{18}$

$\frac{3 \times 9}{22}$ 25

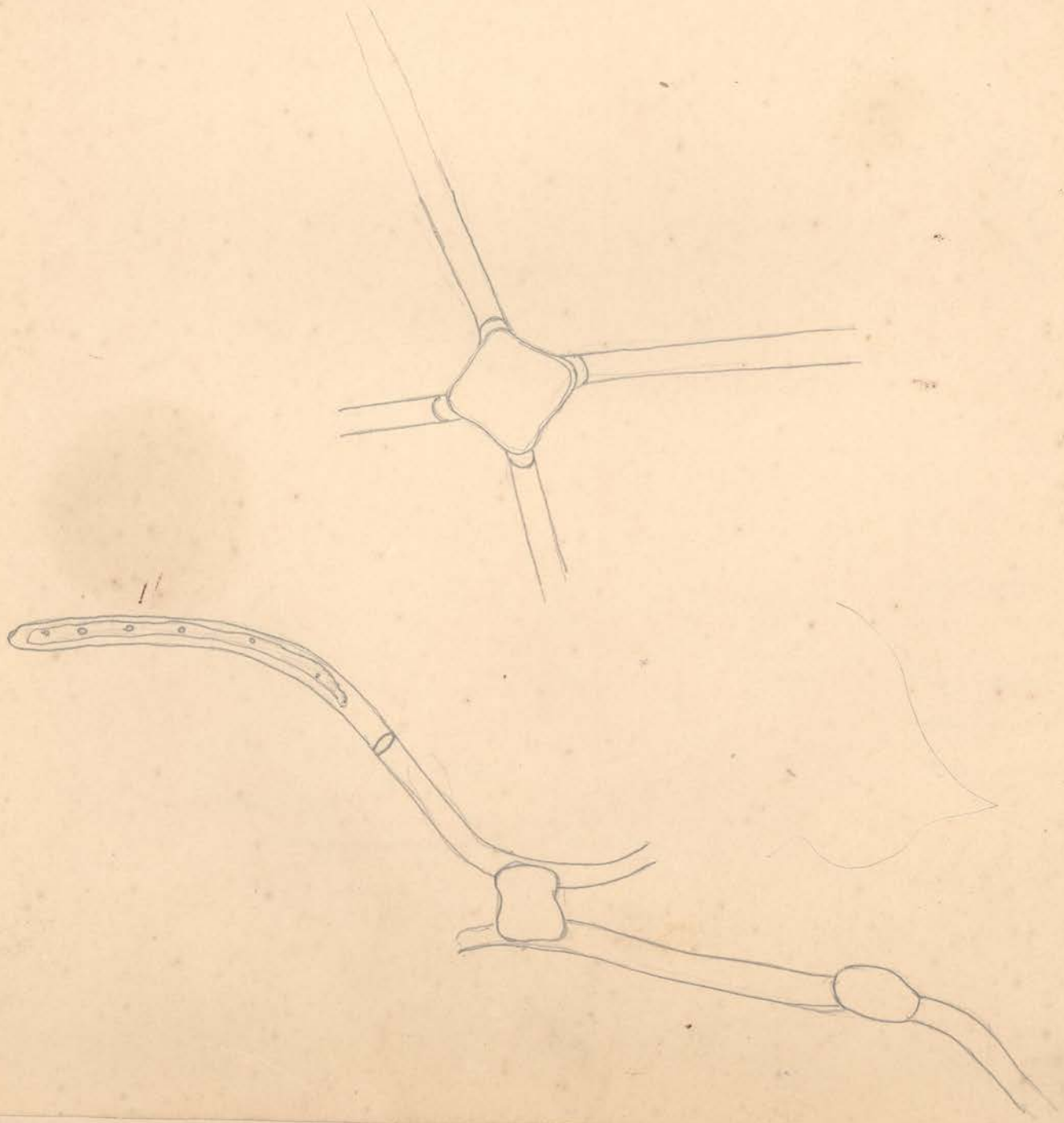
Zygospores = 28 N – 26 N.





Mougeotia viridis (Kutz). Wittrock. 1872.

Czurda — p. 89.



Tafel No. 5.

Rysch Sultanpur.
28th Nov. 38

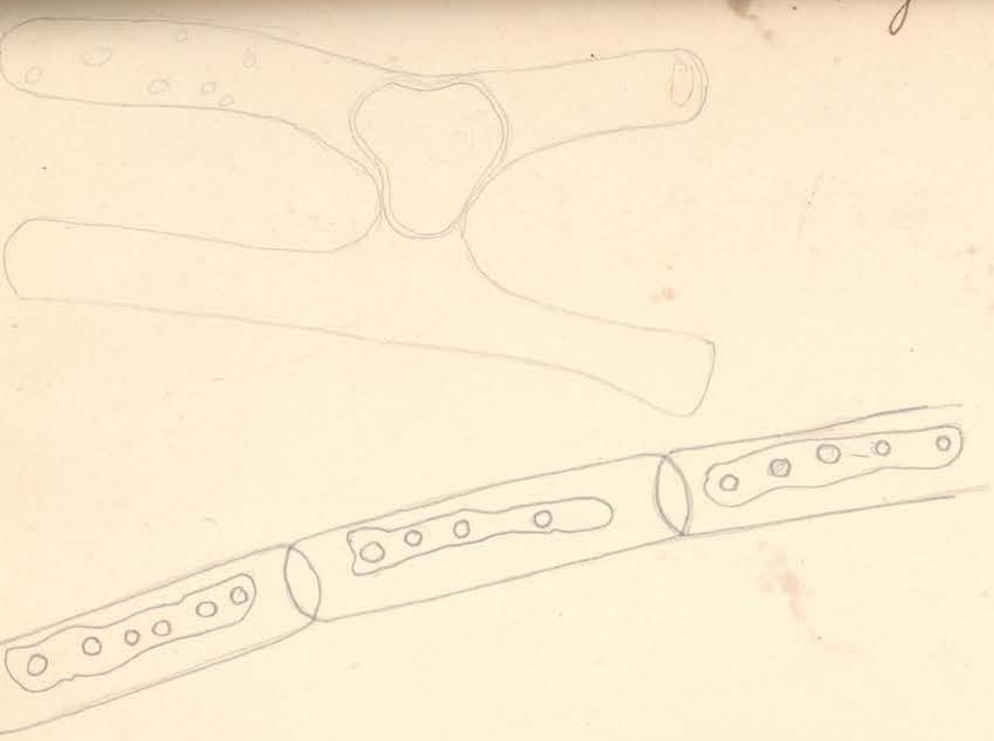
Jagdschloss Firuz.

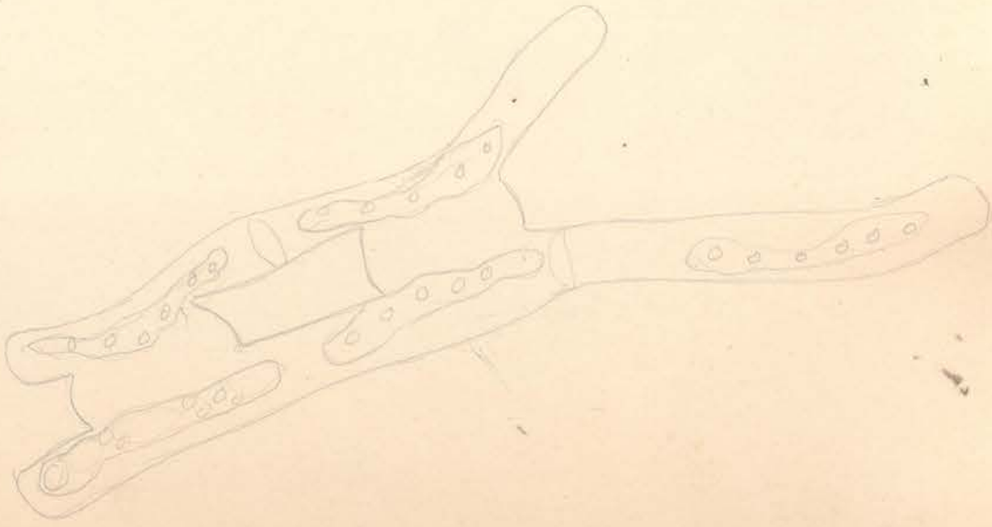
Norgate Lahore. 28.11.38.

Zeichnung
26V = 38V

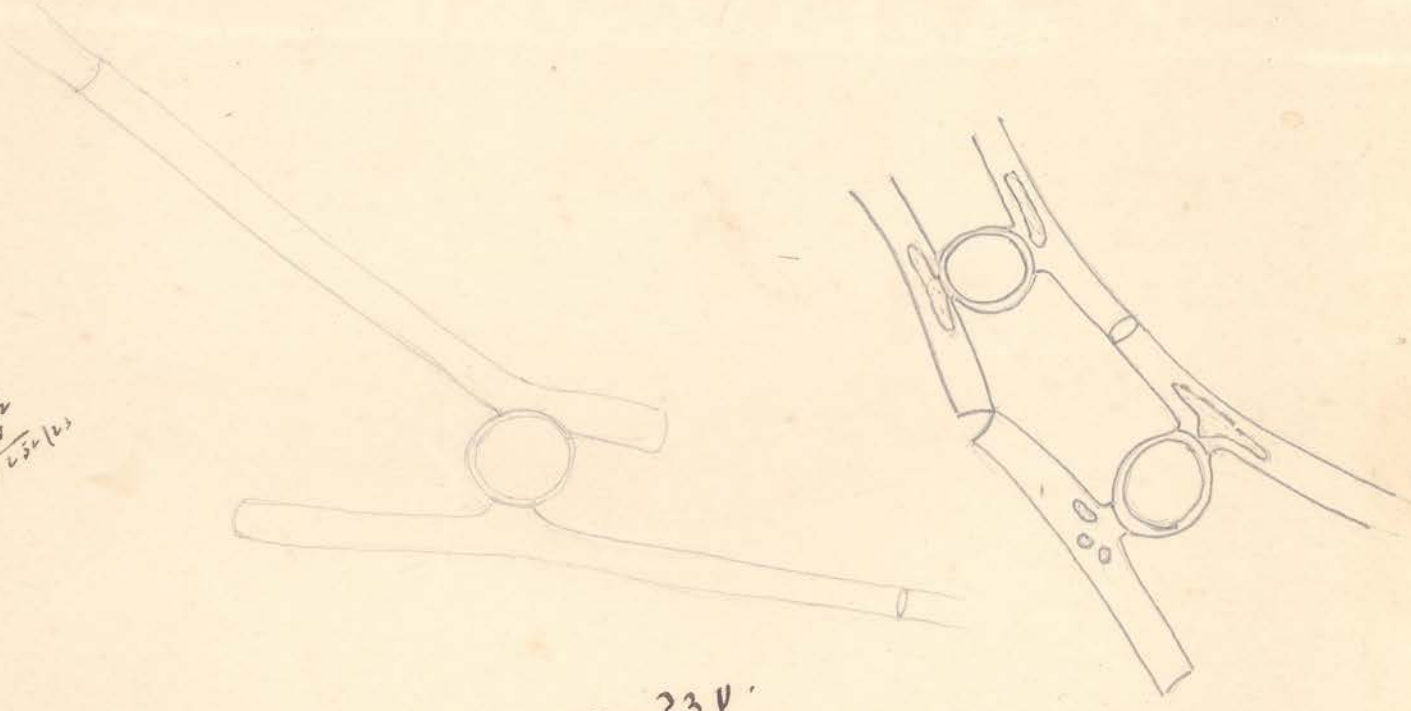
Tafel No. 6.

Bemerkungen
Firuz Lake / Kala.



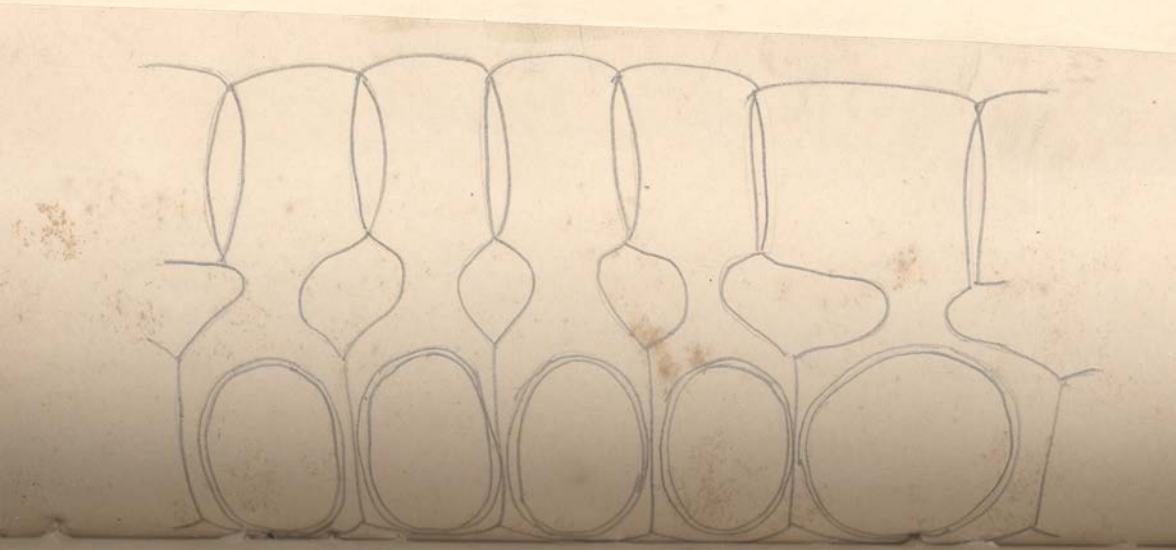


Rougeotia parvula. Hass.



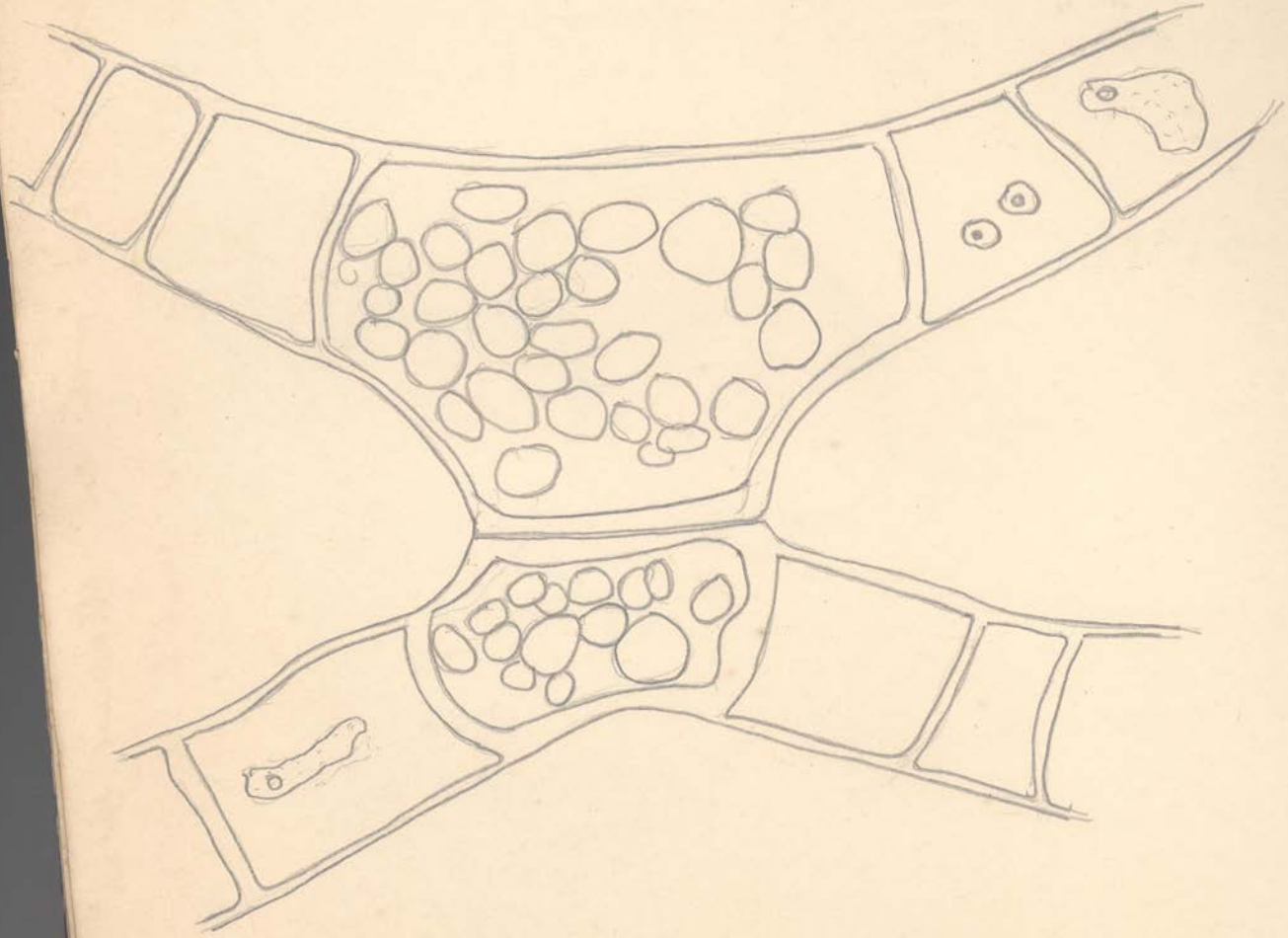
Zygospores :- 18 - 23 μ.
in diameter.

6 - 8 μ broad.



Habit – Naked with an attached spear & throwing
Instrument of Kongoda in a bundle near
1. Rajah Sultanpore. Distt. Cuttack.
25th Nov. 1936.

Sirogonium sticticum.
Kutz.



Sirogonium stictium.

Kutz.

Vegetative cells = 40 – 48 μ br.

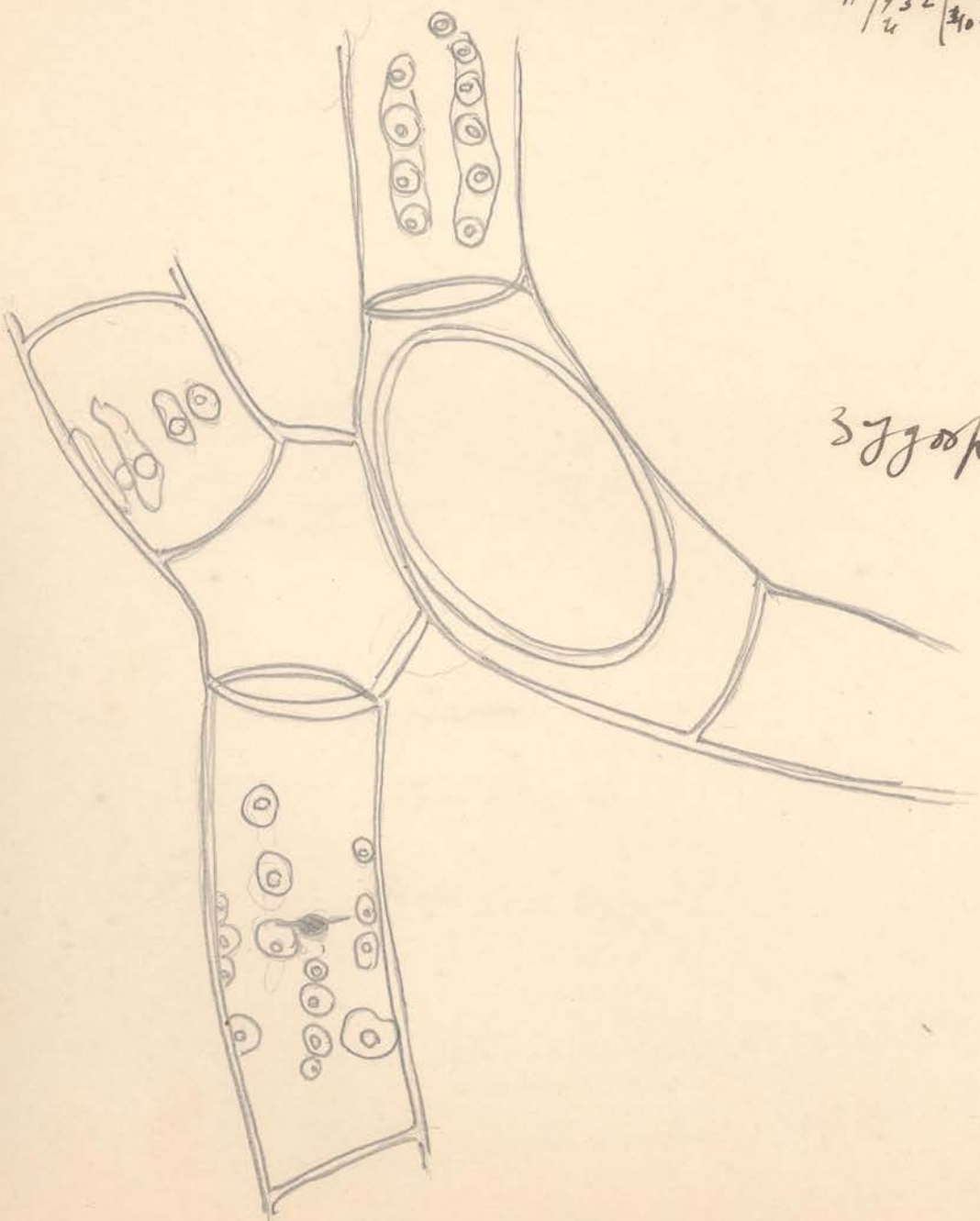
2 to 5 times as long.

24 – 28
18 18
192 224
24 48
11 / 432 / 40 11 / 504 / 46
4 44
44

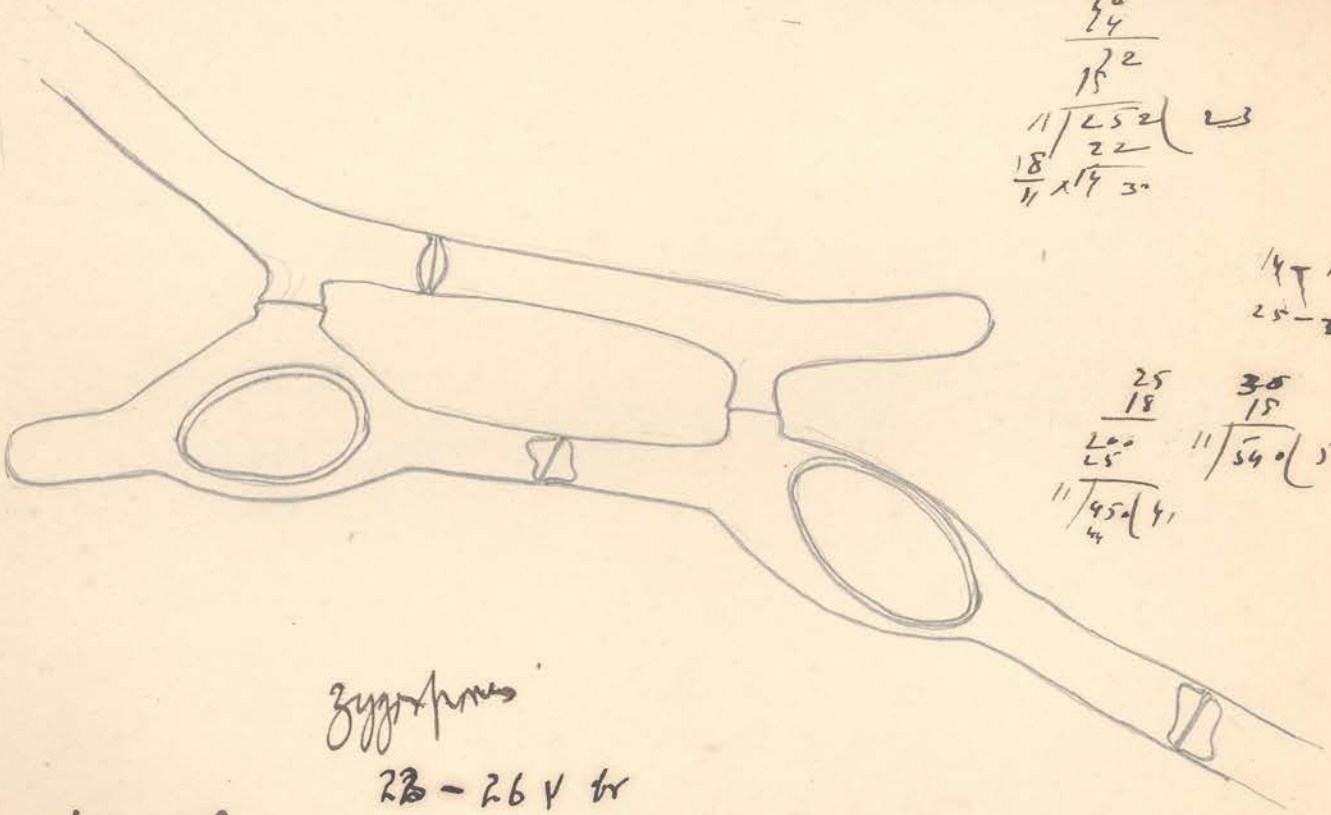
35 35
55 18
18 280
440 35
55 11 / 630 / 57
11 / 99 / 90 55
8

Zygospores = 54–60 μ br.

90 μ long.



Spirogyra undulisepta. sp. nov.



Zygospores

23 – 26 V br

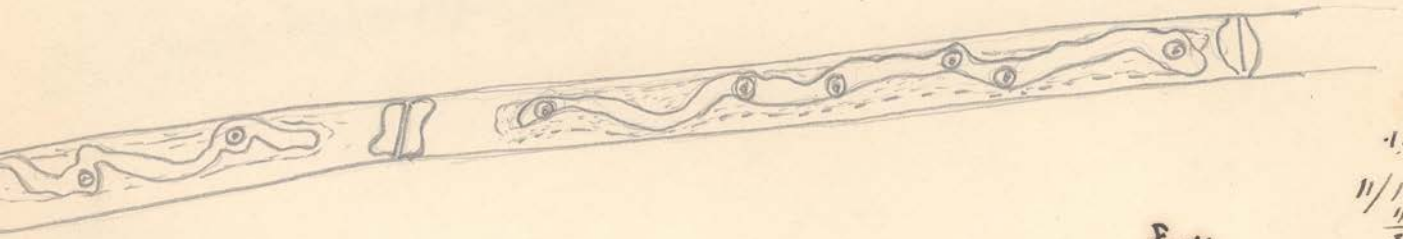
40 – 50 N long.

Cambridge Plant Pathology Lab. 1937

The septa are replicate, but replication is not common. They look like a parallelogram with its longer sides concave; and the middle lamella appears like a diagonal.

reticulate markings

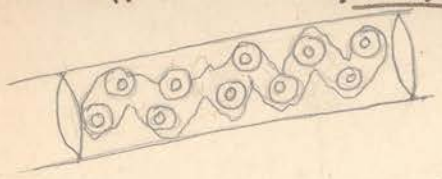
Spirogyra undulata.



8-11

cells =
13-18 in br
and 8-12 times as long.

Collected from Nashwaak Road
along with V. undulata. and
1. V. tessellata. on 20 th. March. 39. 39



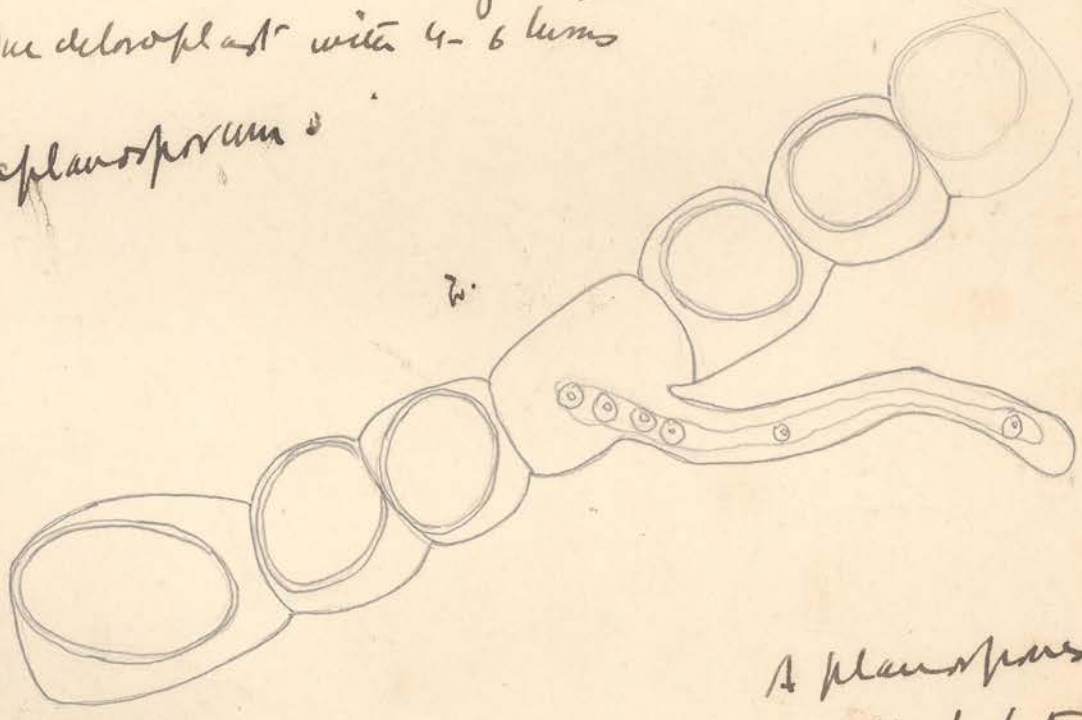
16

11 = 18/11 x 16

18
16
108
8
11/288 (26

Vegetative cells 20 μ diam 26 μ
2-4- then 8
long
One chloroplast with 4-6 lens

Sphaerozyga planosporum



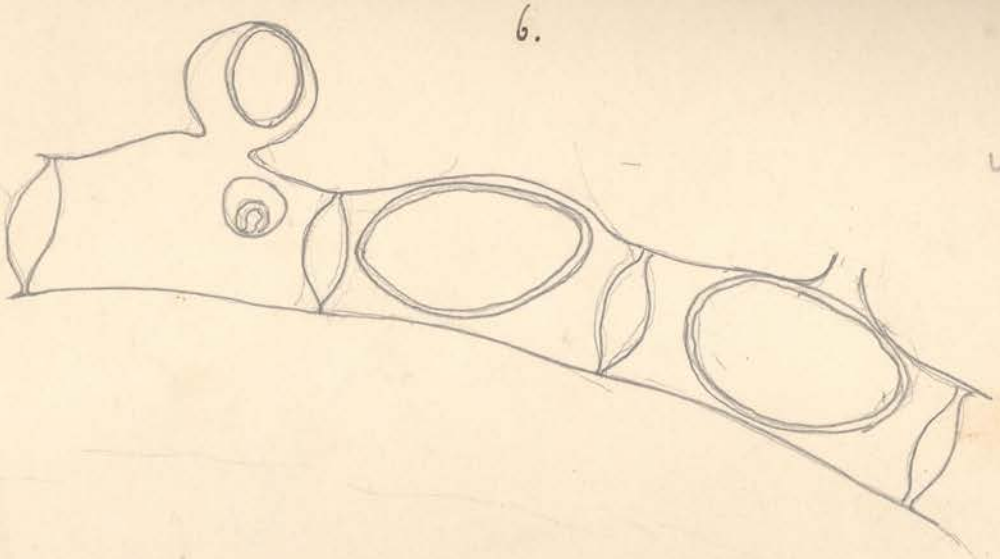
A planospore 2
rarely 5 oval
24-30 μ
brown
30—54 μ
long.

15 - 19
18 18
120 152
15 19
11/270 (24 11/332 (30
22
50

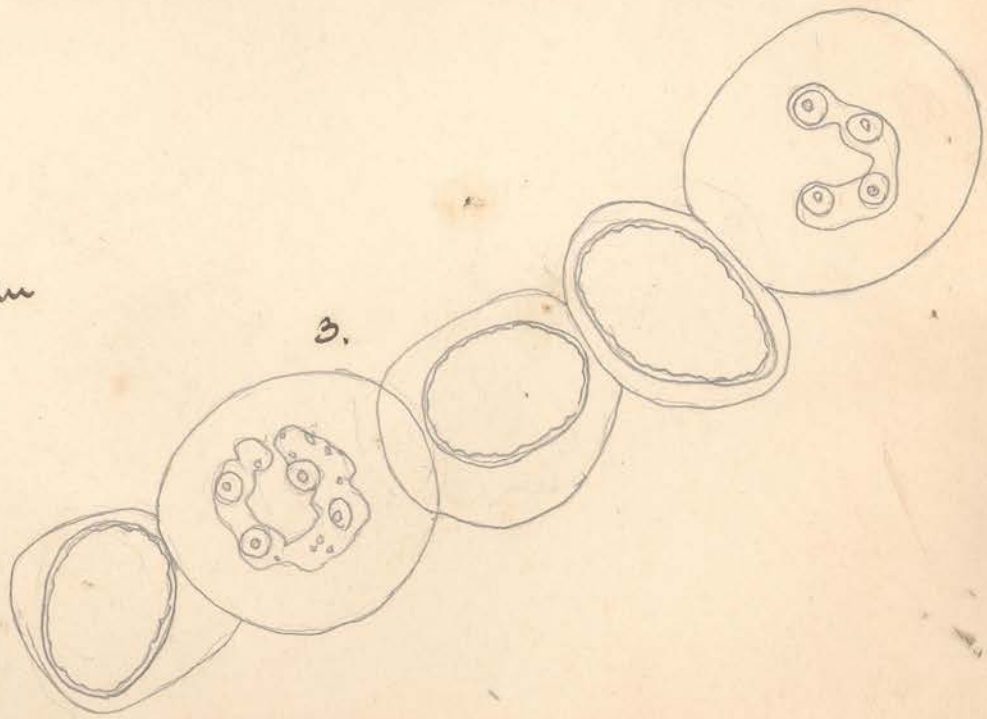
Spirogyra aplanospores.

8/4 NOV.

6.



(5)



3.

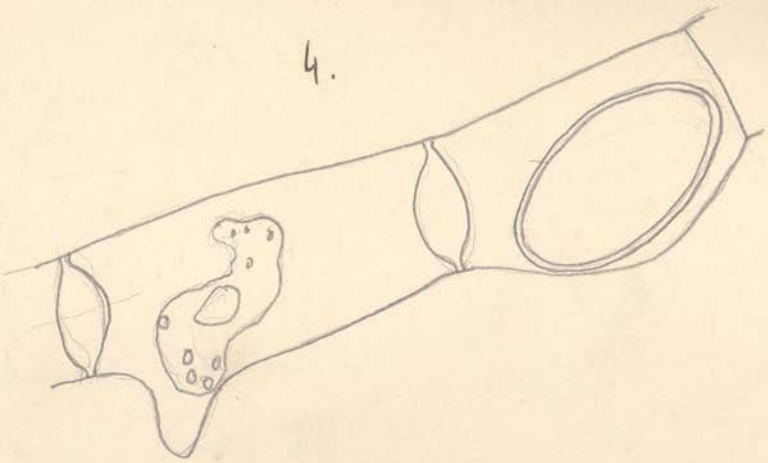
Sl. ends alls swollen

see 54 N.

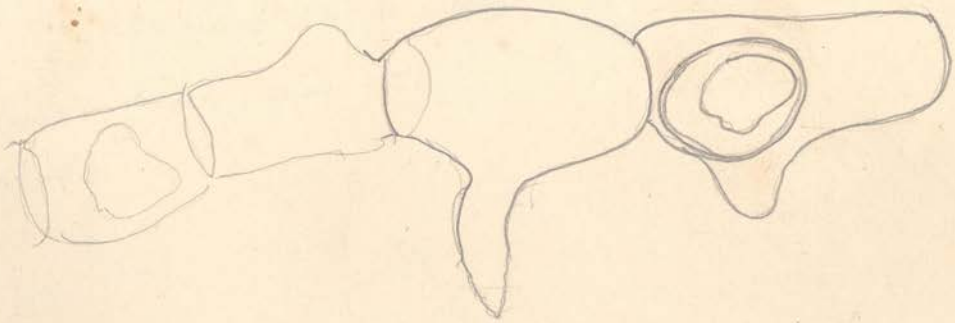
(3)

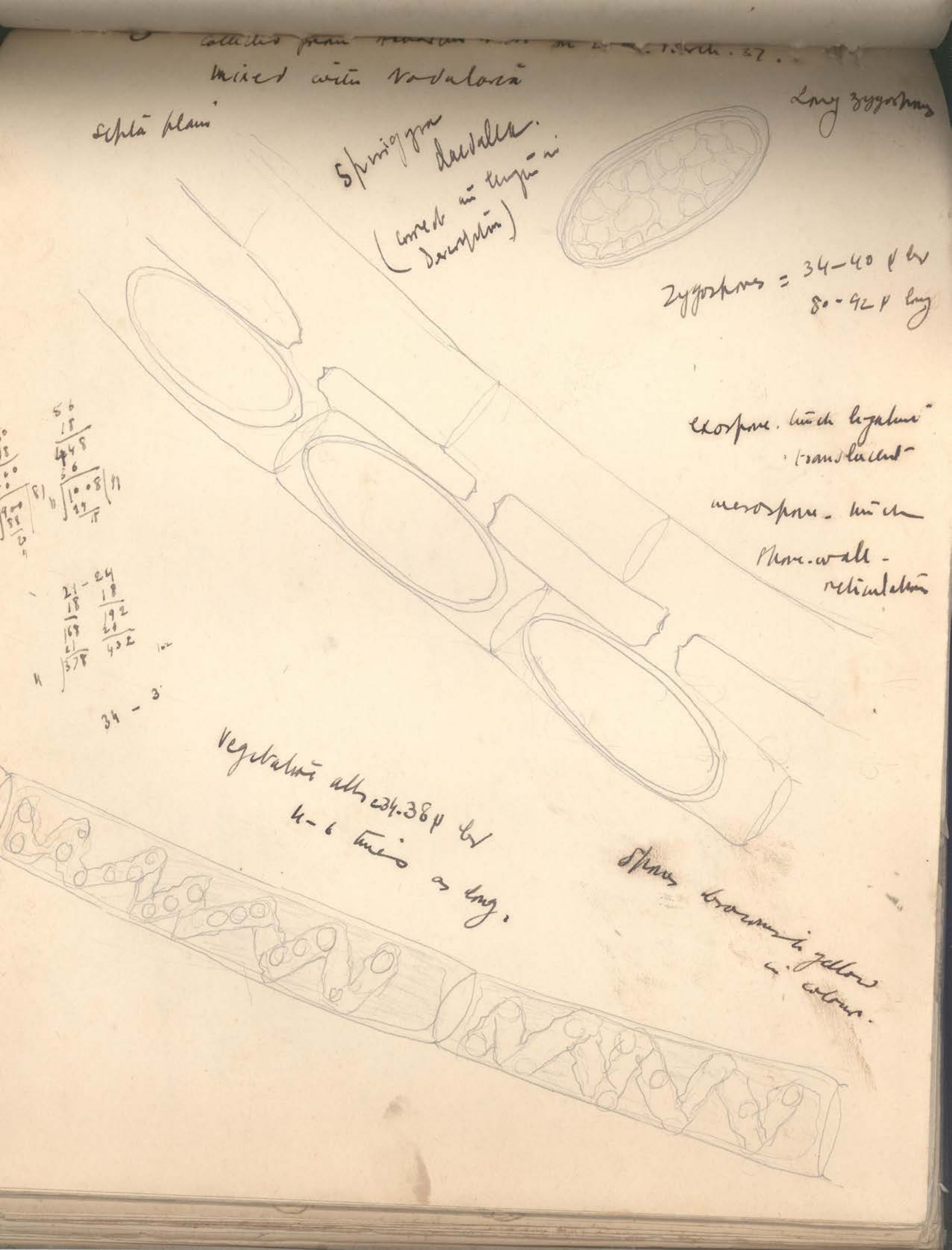
Spirogyra aplanosporum sp. nov.

4.



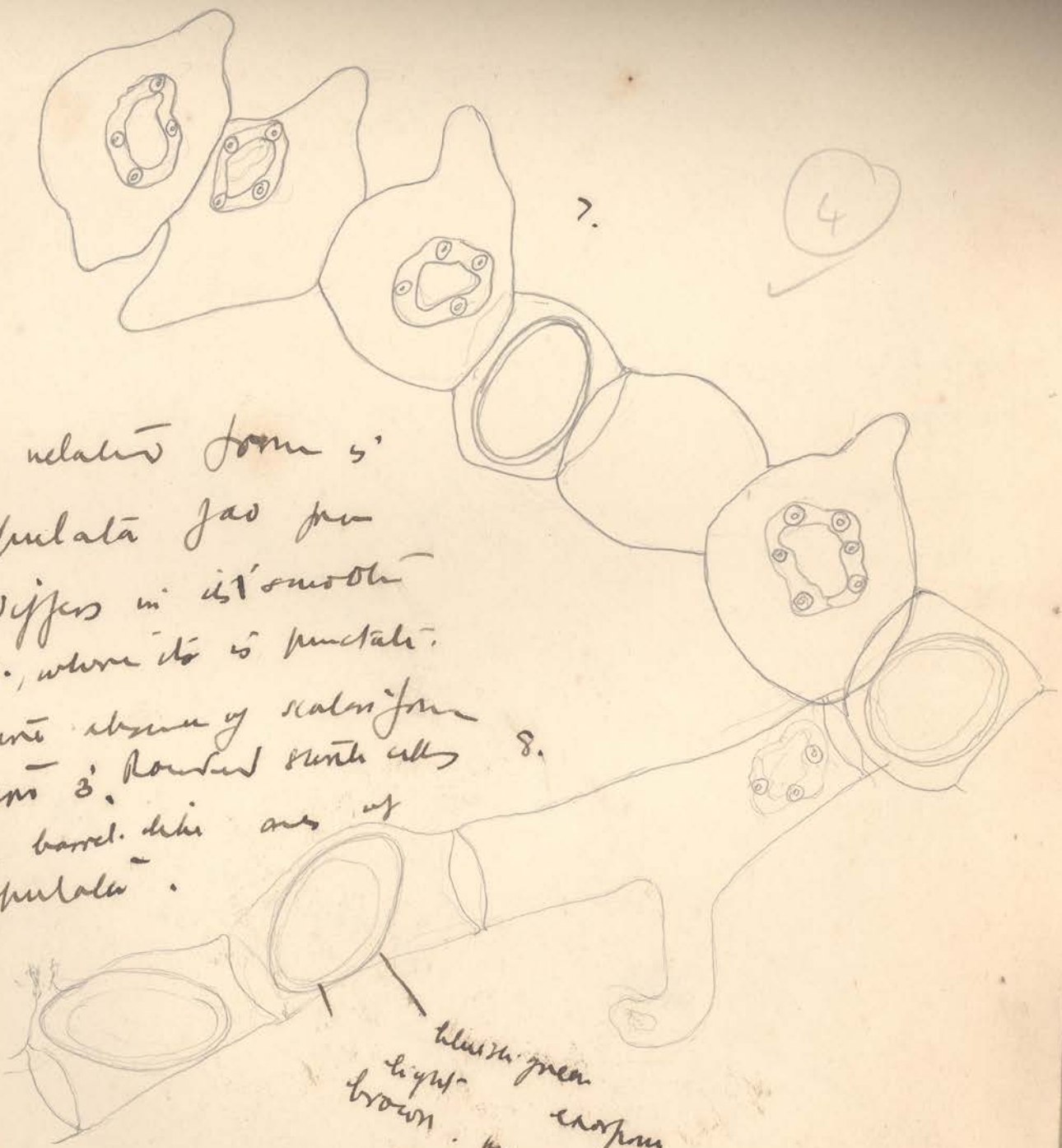
5.




mixed with Vacuolaria
Long zygospores
Sphagnum
(cont. in Europe)
Zygospores = 34–40 μ br
80–92 μ long
chlorospore. with hyaline
translucent
mesospore. with
Meso. wall
reticulation
Vegetative cells 34.38 μ br
4–6 times as long.
Spore brownish yellow
to yellow.

S. marginata aplanospore.

Sp-wall

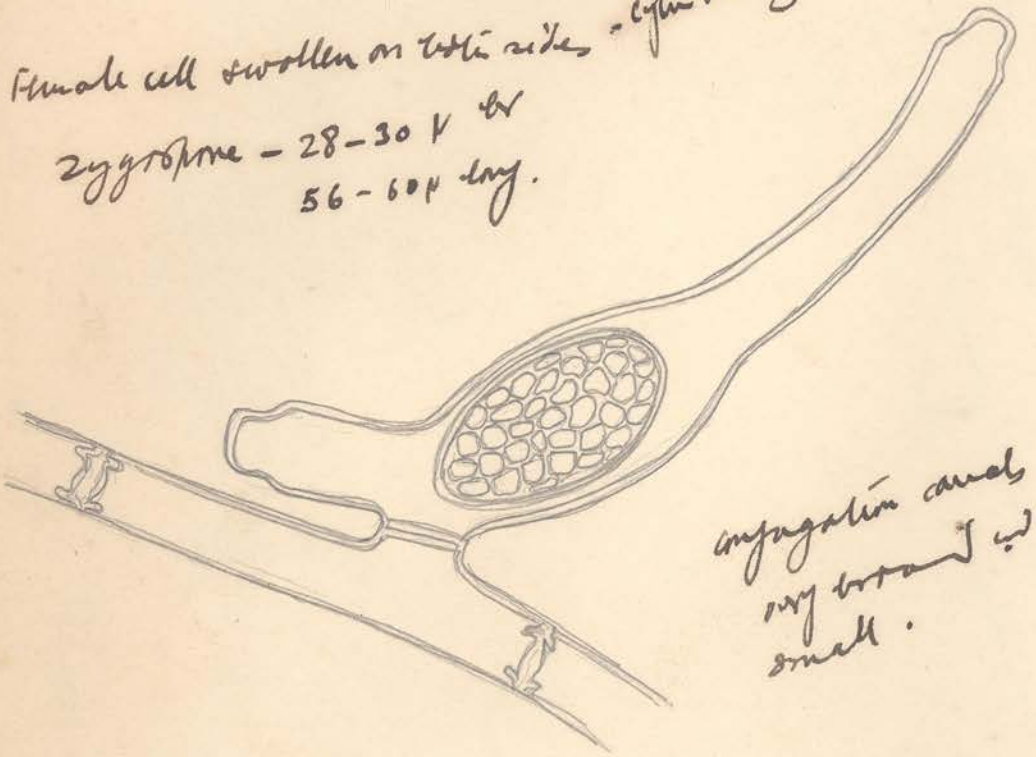


Nost. nearly related form s'
S. subspaericulata from
which it differs in its smooth
spore-wall, whose cells are punctate.
and the mature cells are
conjugating 8. Round cells 8.
which are barrel-like are of
S. subspaericulata.

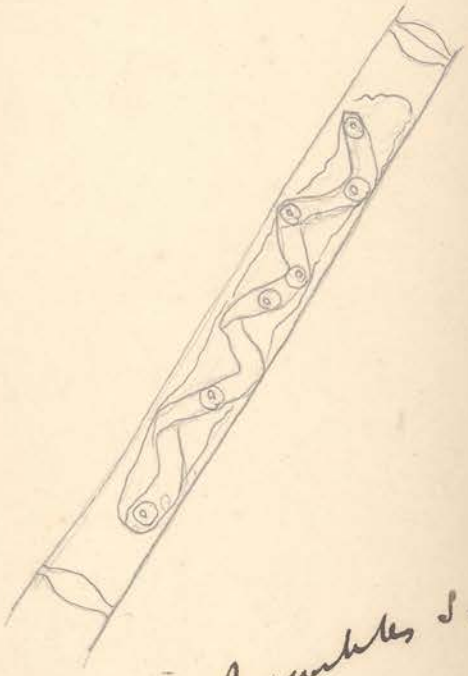
Vegetative cells 16–19 μ diam. and 6–9 times as long single deciduous. Septa.

Female cell swollen on both sides - cylindrically.

Zygospore – 28–30 μ diam
56–60 μ long.



conjugation canal very broad and small.



Kadi. Banda Road.

8th. Feb. 37

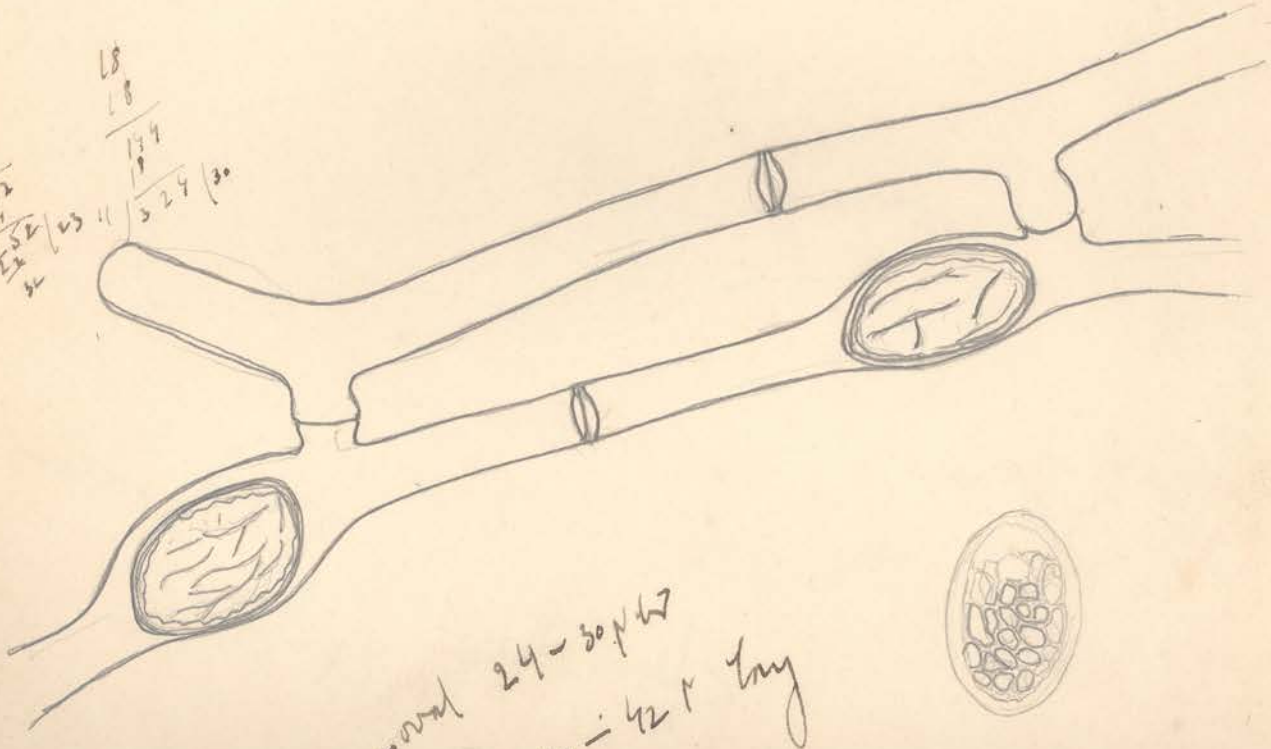
Tube

Appendix — Resembles S. cylindrica. Czech. nov. sp.

Differences: 1. longer & longer cells
2. Scalariform conjugation
2. Receptacle with reticulate walls & is smooth & brown in S. cylindrica

Sphagnum Skugi.

Hyaline cells
14 – 17 μ

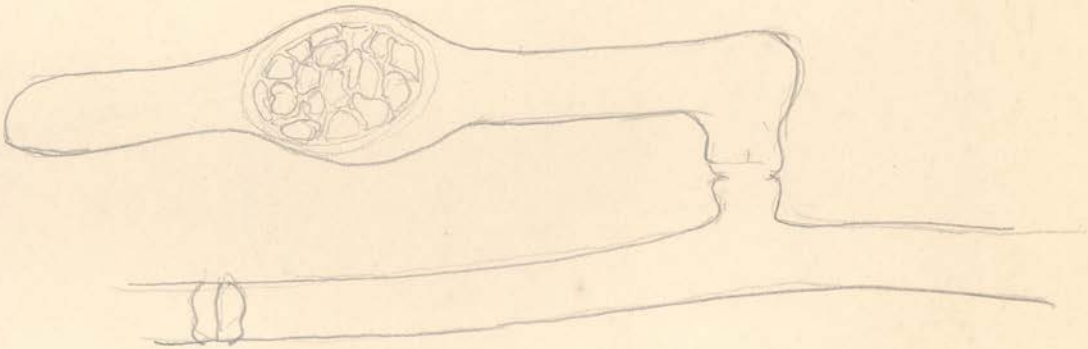


Leaf-cross-section. Fig. 7a.

Chlorophyllous cells 24 – 30 μ
40 – 42 μ long
Pores in reticulate membranes

26 – 34 μ

Sprzęgła Skuja.



Tube no. 7.

Spirogyra mannanae.

Locality – Nanorama Vadi. Dated. ~~Conda~~ 23rd. Feb. 1937
Basti. U.P.

Zygospores = oval to rounded in shape
typical form in female cells
which we wished to
another site.

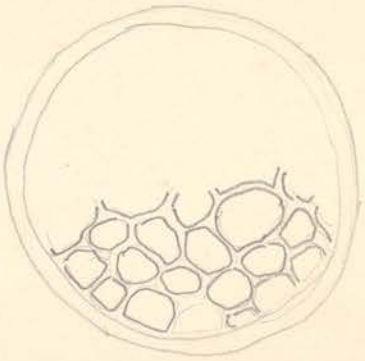
Vegt. cells = 80 – 100 μ dr. 65 × 82 μ in diameter

Zygospore wall with
polygonal reticulations

Resembles S. submarsicum. Trans.
differs in reticulation of spore-wall,
which is smooth in former.

Sphagnum mannanum.

Sphagnum.

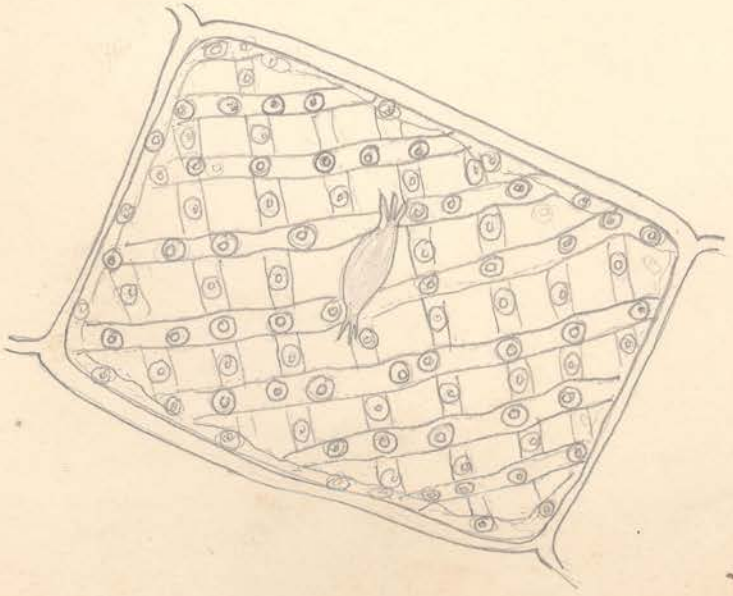


50

55 — 60 x 15 / 48 / 8 / 11 | 189 | 9.

70 / 15 / 56 / 7 / 11 | 126 | 11 / 14 / 11 / 50

90 — 98 x



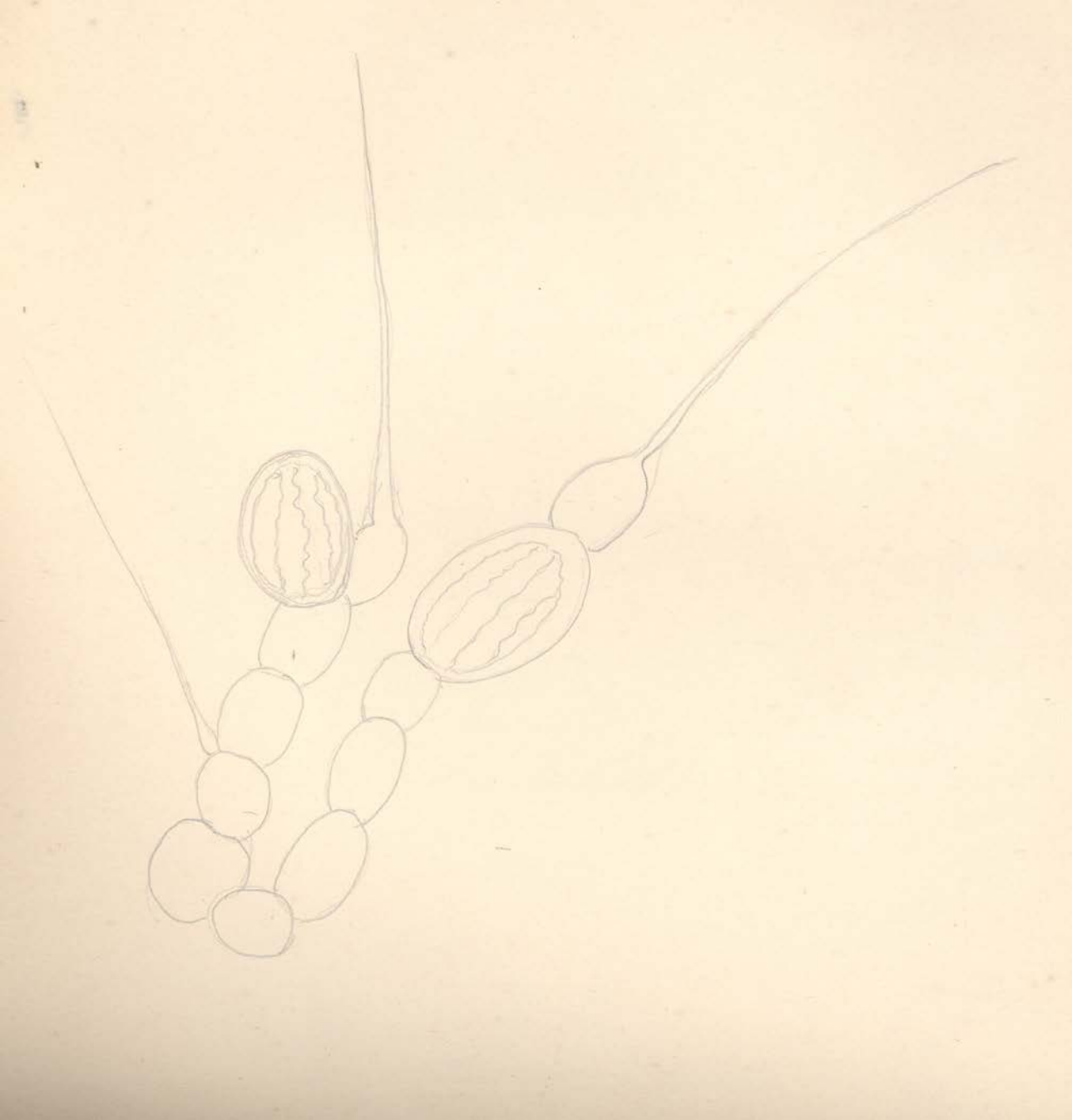
Vegetative cells = 90–100 μ long.

= 80–100 μ long.

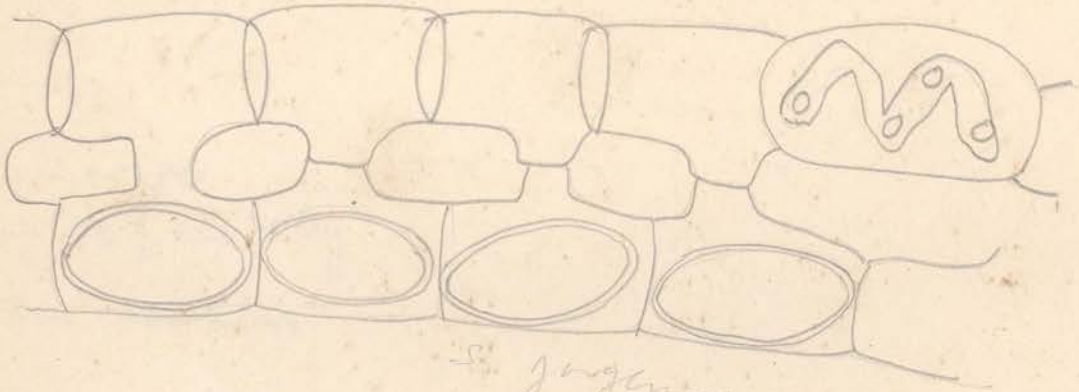
X

80 x 115 μ long.

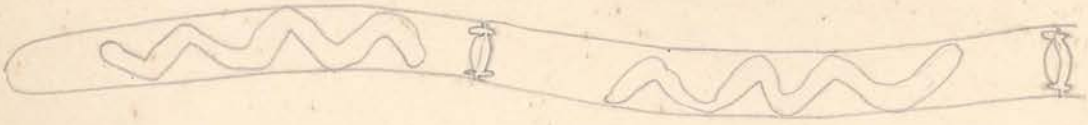
7–10 Chloroplasts



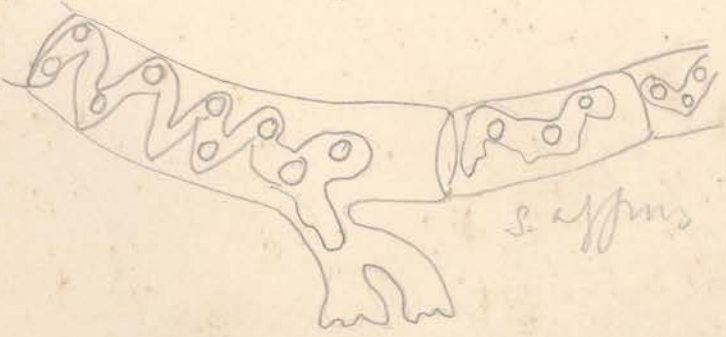
S. rivularis



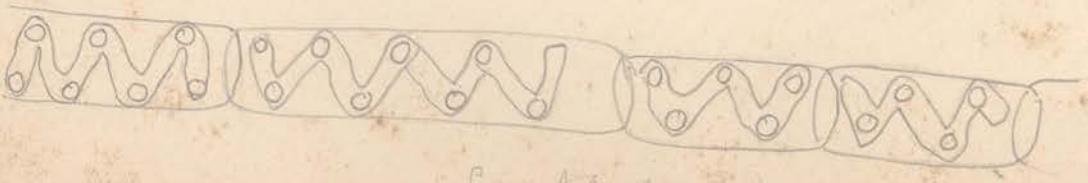
S. fragilis



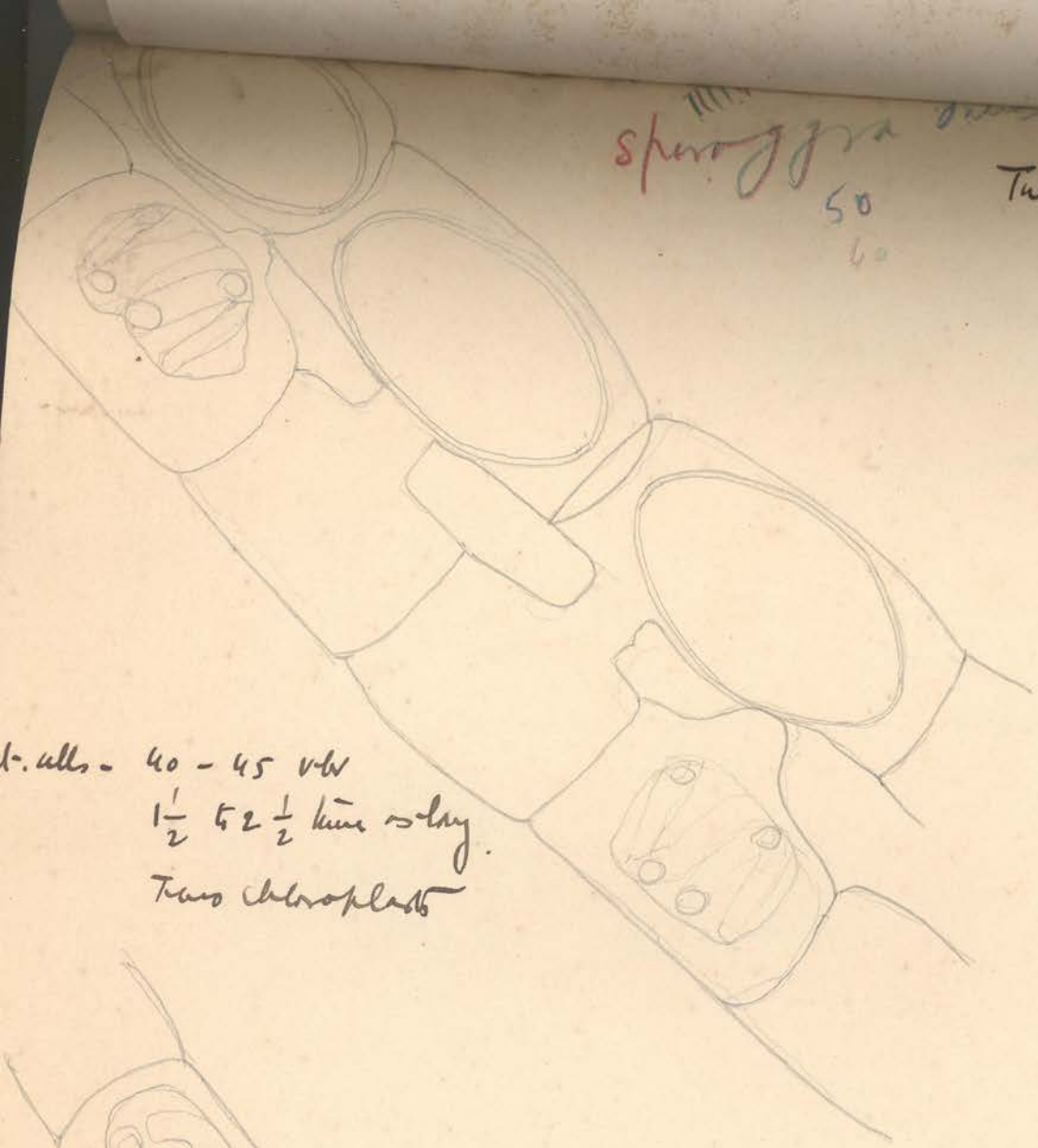
S. triandra



S. alba



S. fragilis



Tube no. XV

Table Salcib March 31.

Zygospores ovel

40 – 45 V long

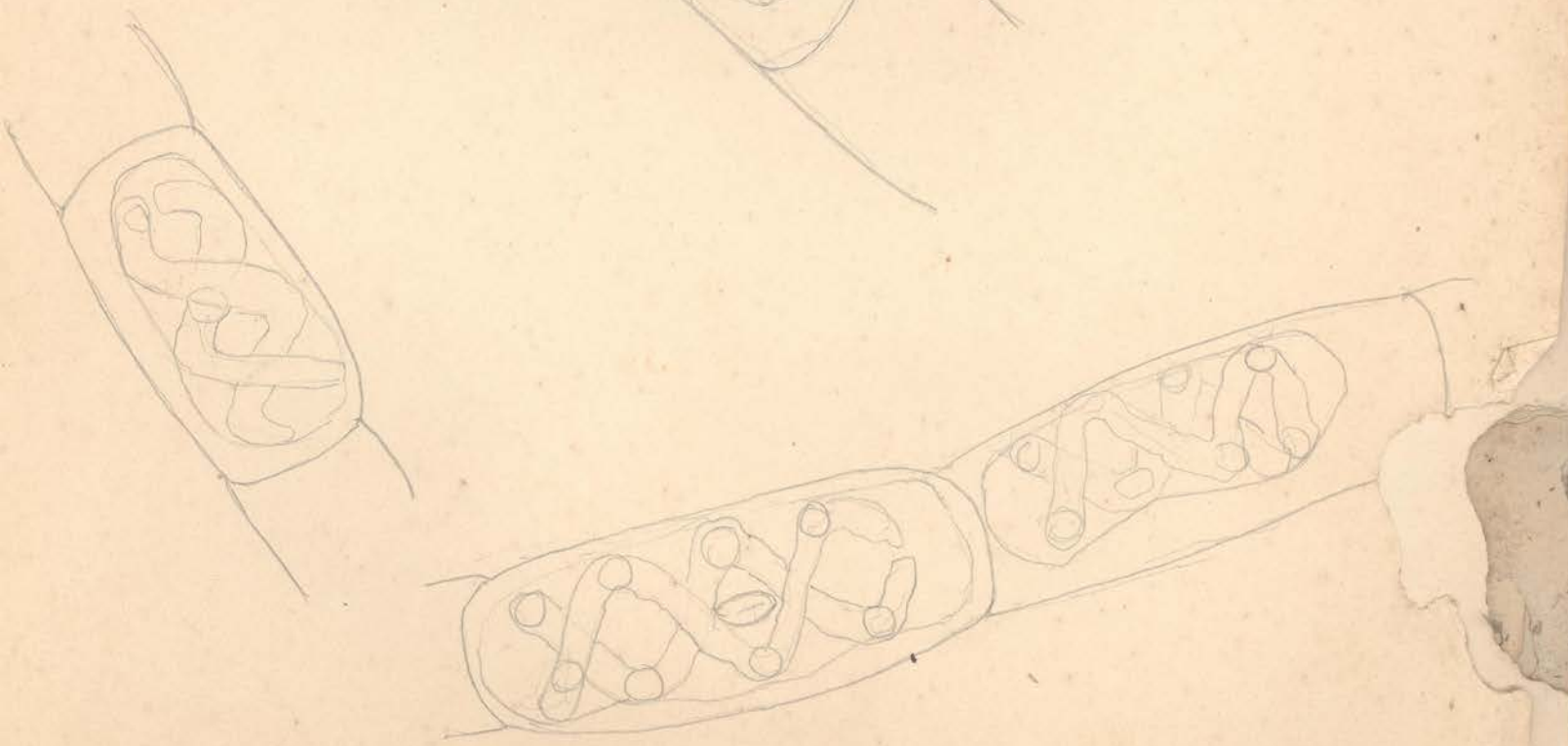
70 V – 75 V long

Vegetal cells swollen

Veg. cells – 40 – 45 V long

$1\frac{1}{2}$ to $2\frac{1}{2}$ times as long.

Two chloroplasts



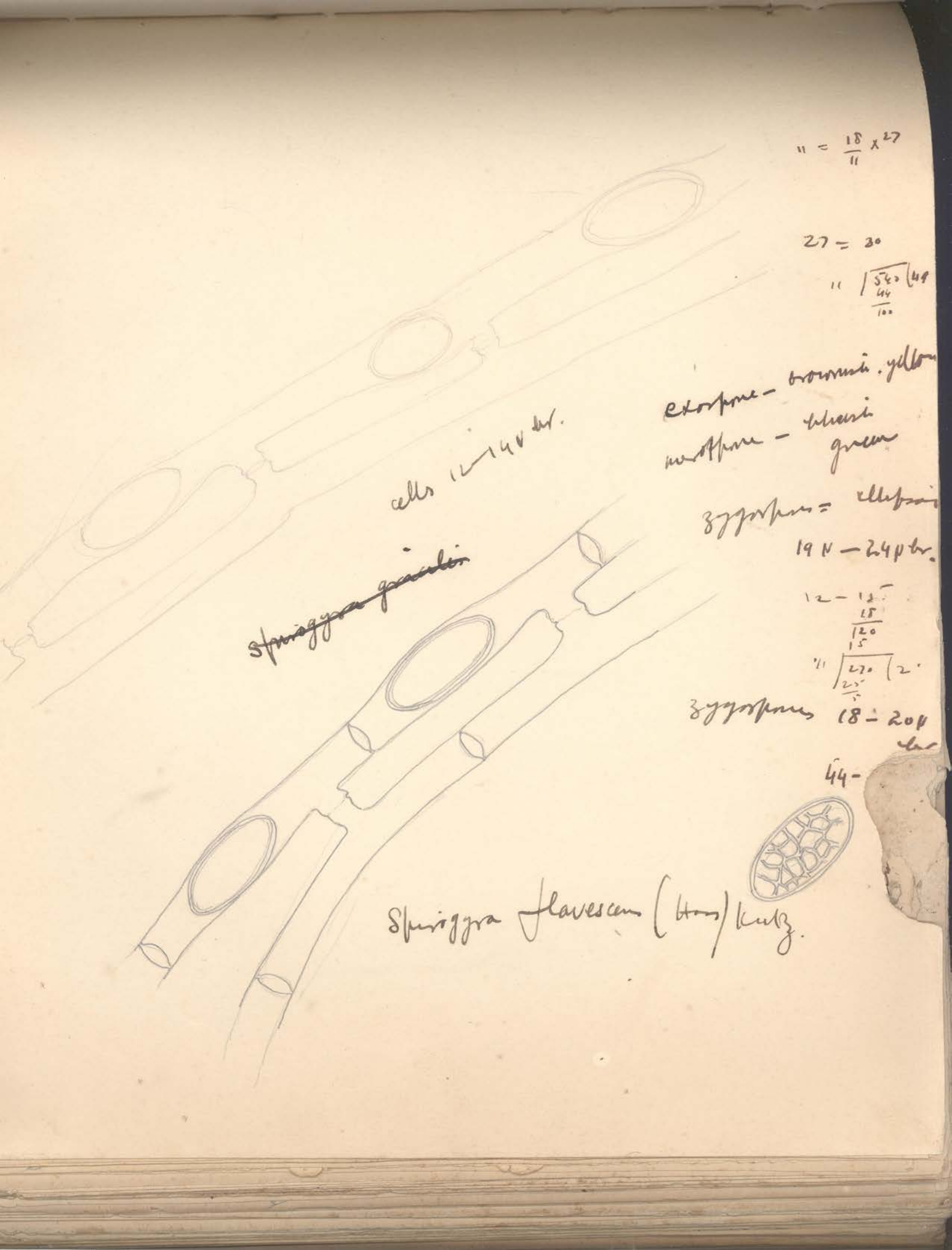
S. flavescens.

11 = $\frac{18}{11} \times 8$

8.

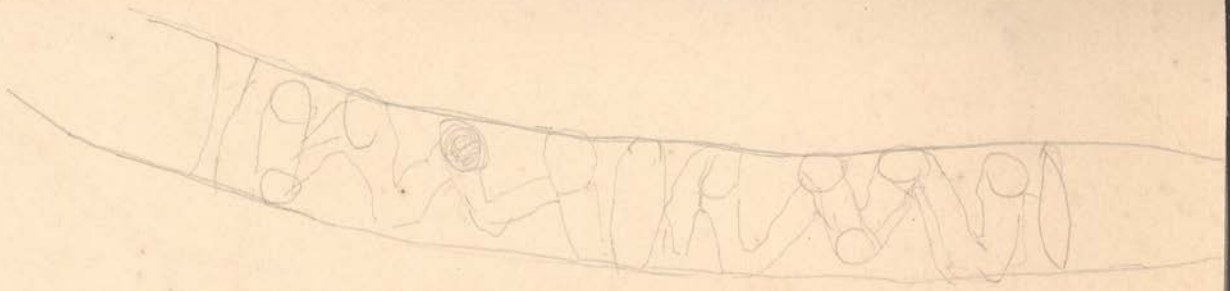
11 / 144 (13
11
34
33

Vegetativ
alle
filamenta
12–14 µ breed
med
Ove
sporer


11 = 18/11 x 27
27 = 30
11 | 540 | 49
44
100
ectoplasm - brownish yellow
endoplasm - bluish green
zygospore = elliptical
19 N — 24 μ br.
12 — 15
15
120
15
11 | 270 | 25
Zygospores 18 - 20 μ br.
44 -
cells 12 — 14 μ br.
Spirogyra flavescens (Hass) Kutz.

Spirogyra parvula Trans (Czurda nov. nom.)

Sexual differentiation



Cells = 20 μ br. – 24 μ br.
2 ½ 5 times as long
chloroplast one with 2 ½ 4½ spirals

Zygospore = 26 μ br.
Oval.
36 – 54 μ long.

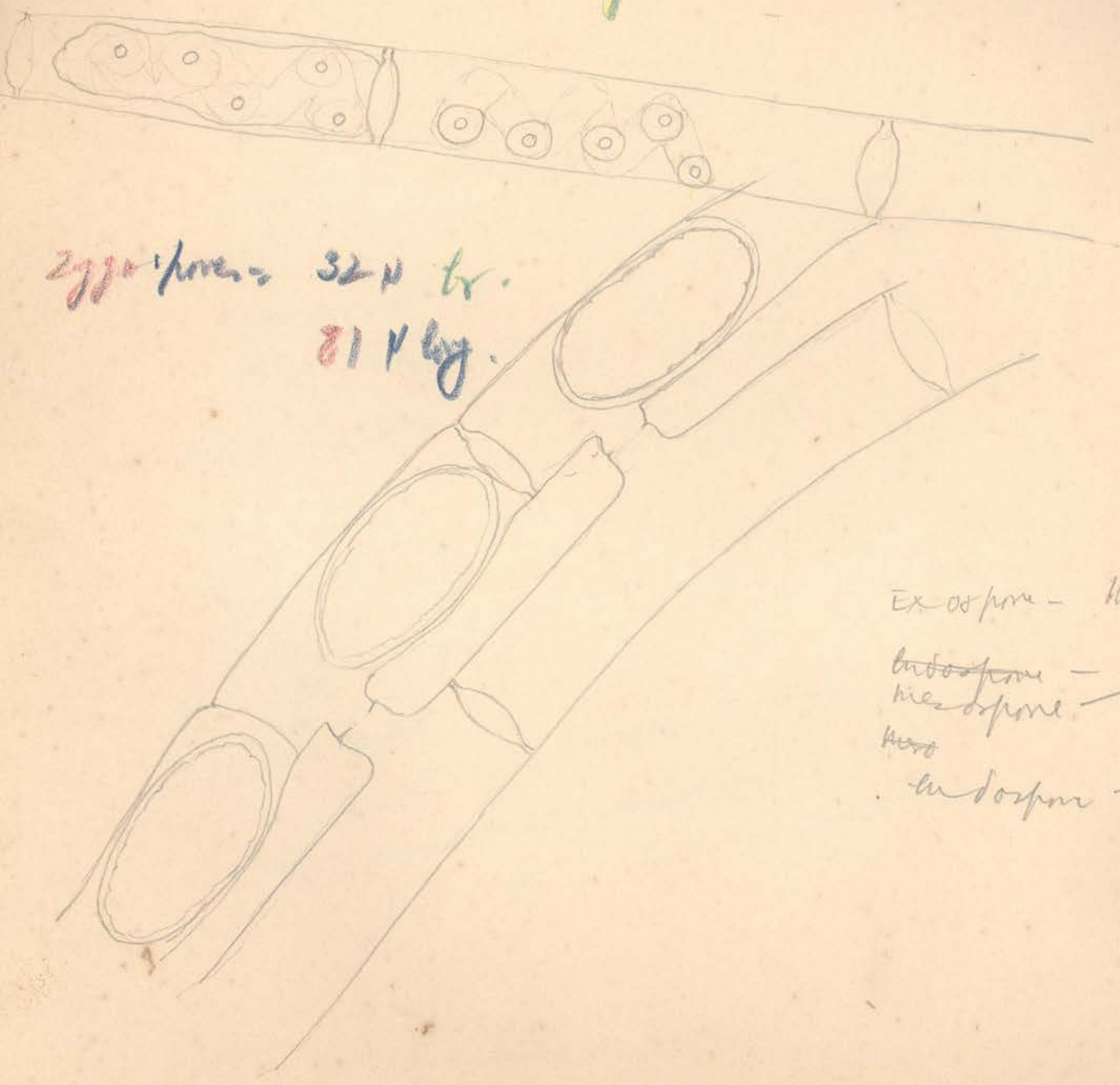
Zygospore-wall
exospore – brown. smooth
mesospore – blue green. smooth
Endospore. – light brown with depressions.

Spirogyra haladosa Czarda.

Tube no - 10
Dawyra
Abril 81

Cells = 25 μ br.
4 - 5 times as long

Zygospores 32 μ br.
81 μ lg.

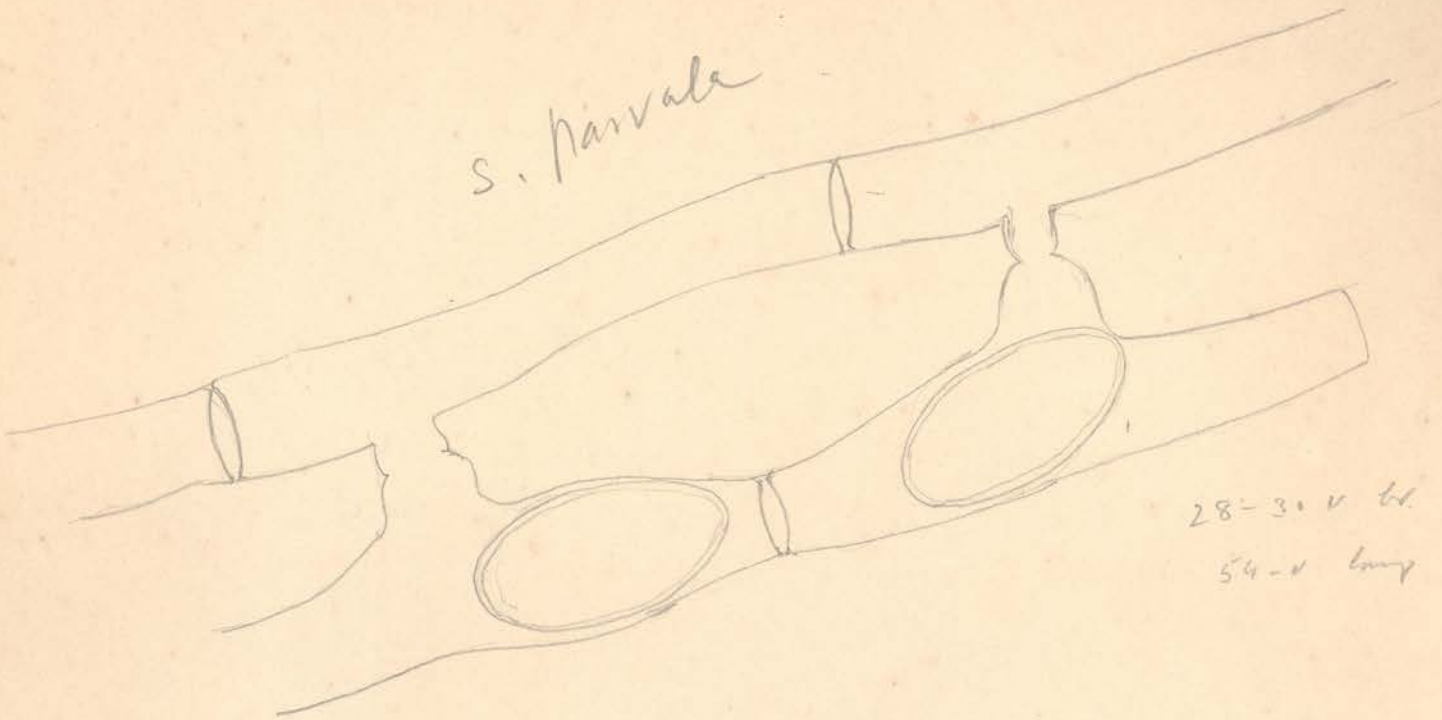


Exospore - thin, brown

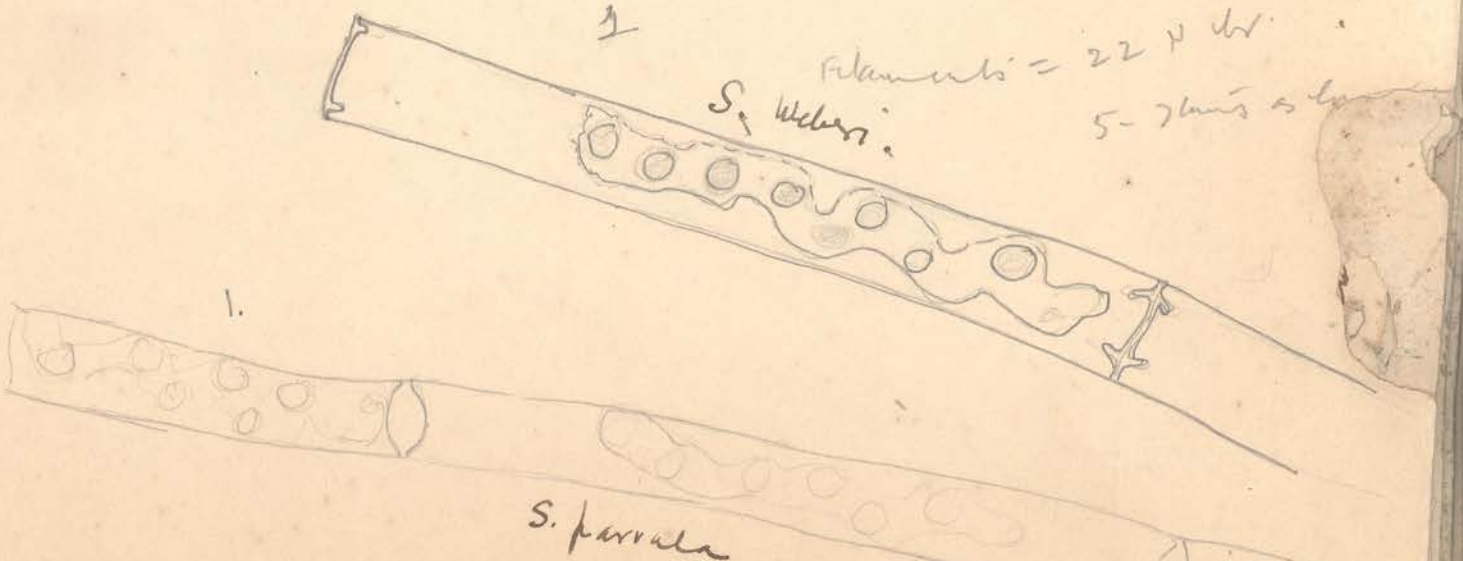
Endospore — Mesospore — bluish-gre

Endospore — tra

Table no 5.



28–30 V hr
54 V lamp



Filament = 22 V hr.
5 lamps as

Filament = 180 hr.

Tafel 105.

Spirogyra parvula.

kommt nächst mit S. gigantea Kütz. überein. Mass 31

und S. varians. in dicht Rasen Mass 31

Filamente weiter ausgebreitet 18 μ breit

Zellen schwellen.

Copulation - noch total unbekannt.

Seal. Copul. - zygospores 22-24 μ br. - 30 μ lg. — 44-46 μ lg. - 54 μ lg.

Zel. Copul. - " 24-26 μ br. — 45-50 μ lang

. female cells swollen.

zygospore = 25-27 μ br.

54 μ.

30 μ

3

4.

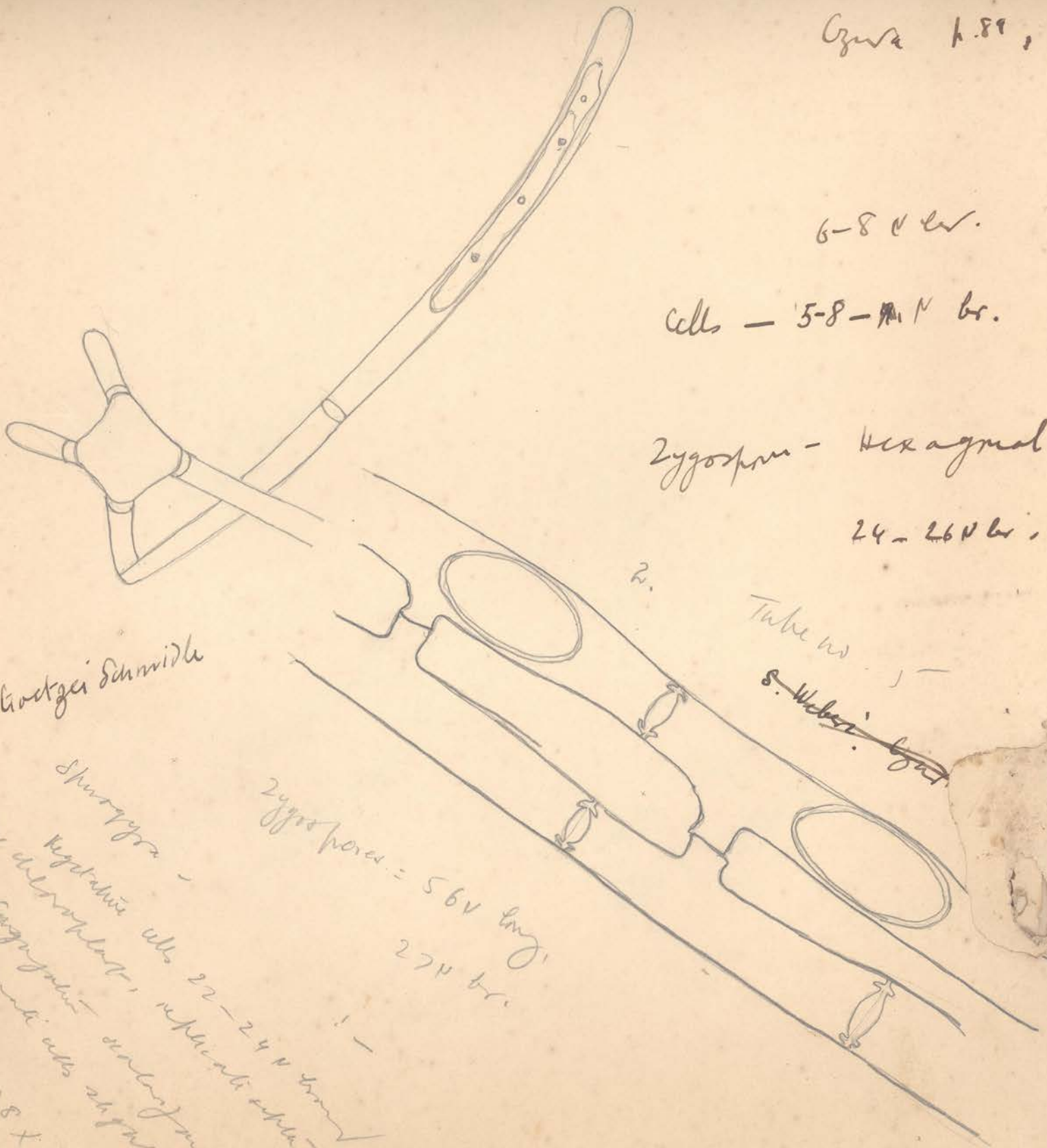
48 μ

26 μ

Nongeotia viridis (Kutz). No. V

Wittrock,

Cuba 1.89,



6–8 V br.

Cells — 5–8 — M V br.

Zygospore - Hexagonal

24–26 V br.

2.

Tube no. 1 —

S. Wahrl.

. Goetzei Schmidle

Sporangia -

Kegelrund Cells 22–24 V lang

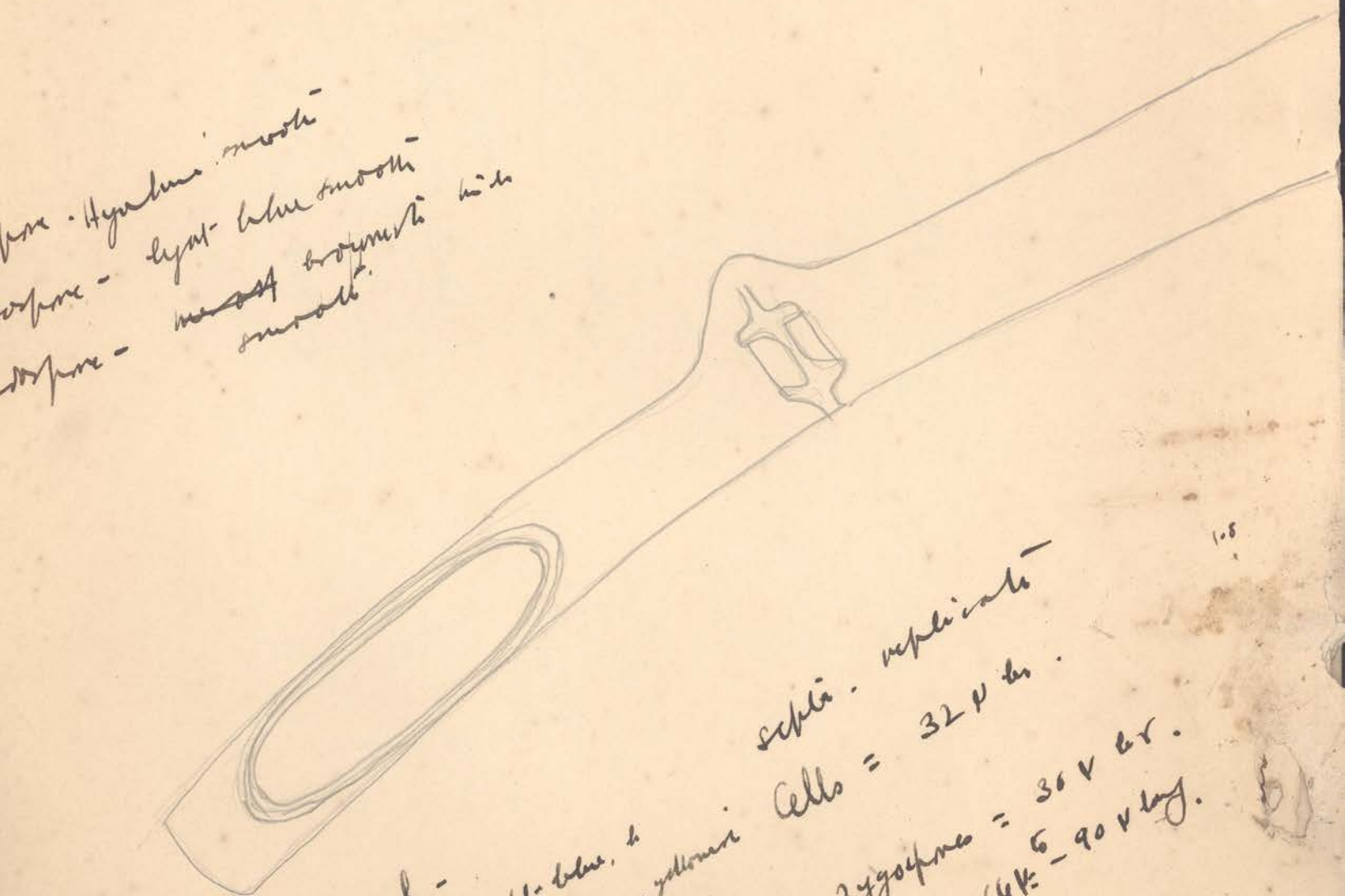
Zygospore = 56 V lang

27 V br.

!—

Spirogyra Hassalii (Jenn) - Petit

Tab cc. XXII (17).



...pore - Hyaline smooth
...spore - light-blue smooth
...spore - massed brownish-black smooth.

Zygospores = oval -
exospore light-blue. smooth
endospore - brown. yellowish

Cells = 32 μ br.

Zygospores = 36 μ br.
64 - 90 μ long.

Tube no. XIII

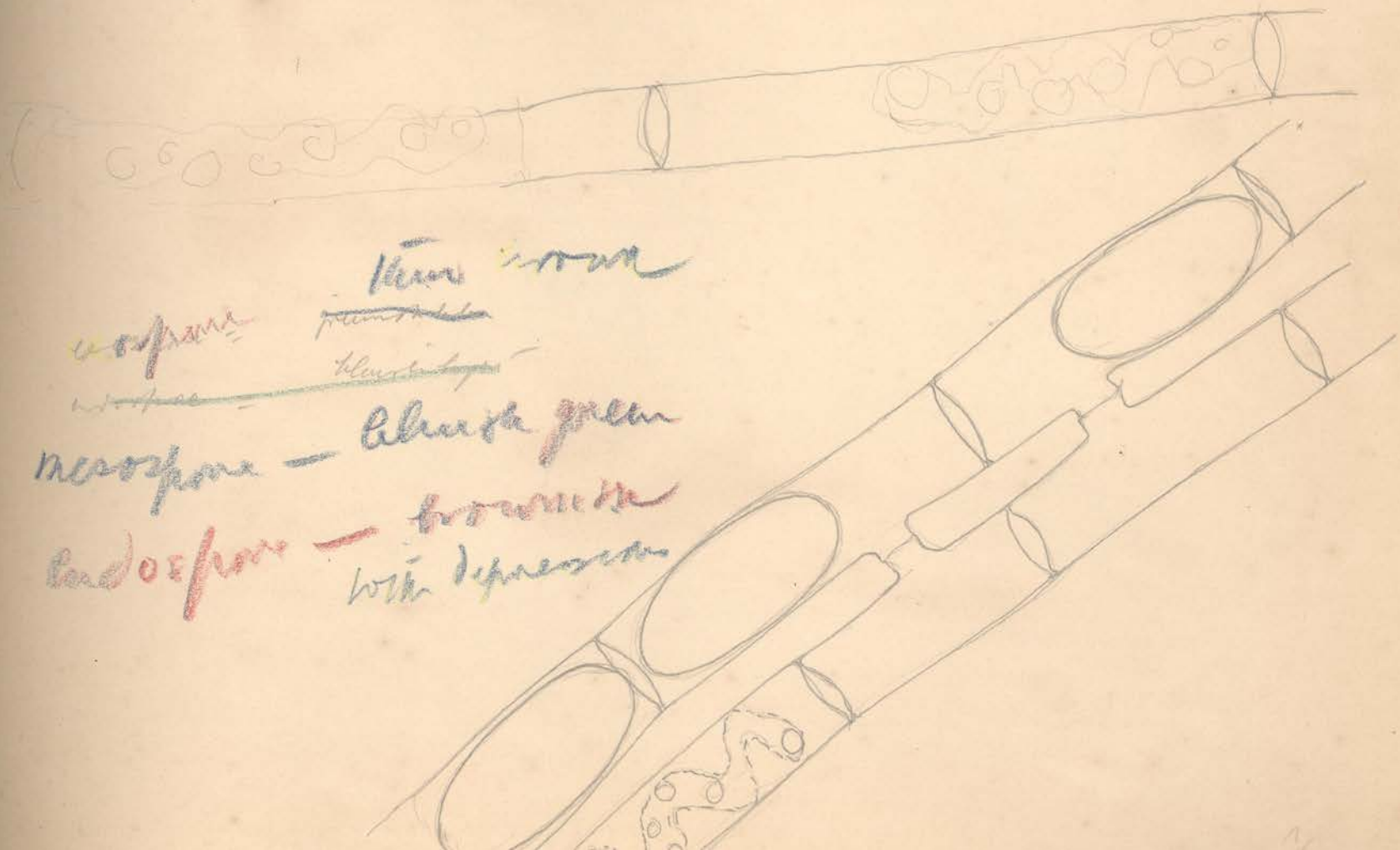
Sporangia palmodesa
Cyanea.

Loc. Boxdal Sport 31

5 - 8 times as long

Vegt. cells = 20 - 25 μ br.

zygosporen = 25 μ br — 32 μ br.
oval 45 μ long — 80 μ long



meiospore — Clear pale green

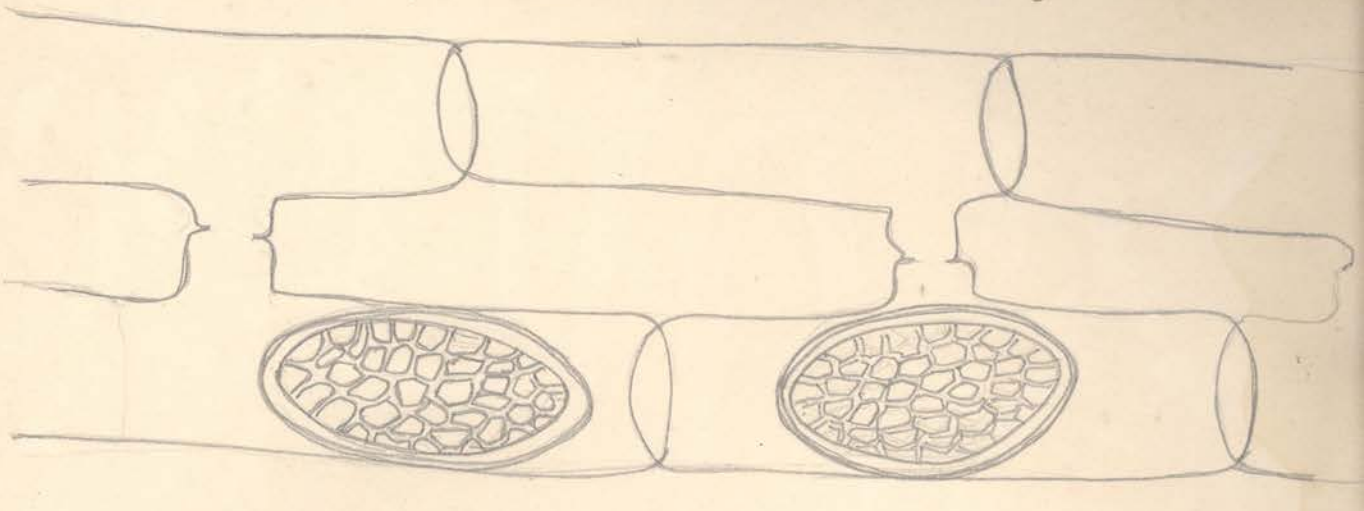
mesospore — brownish

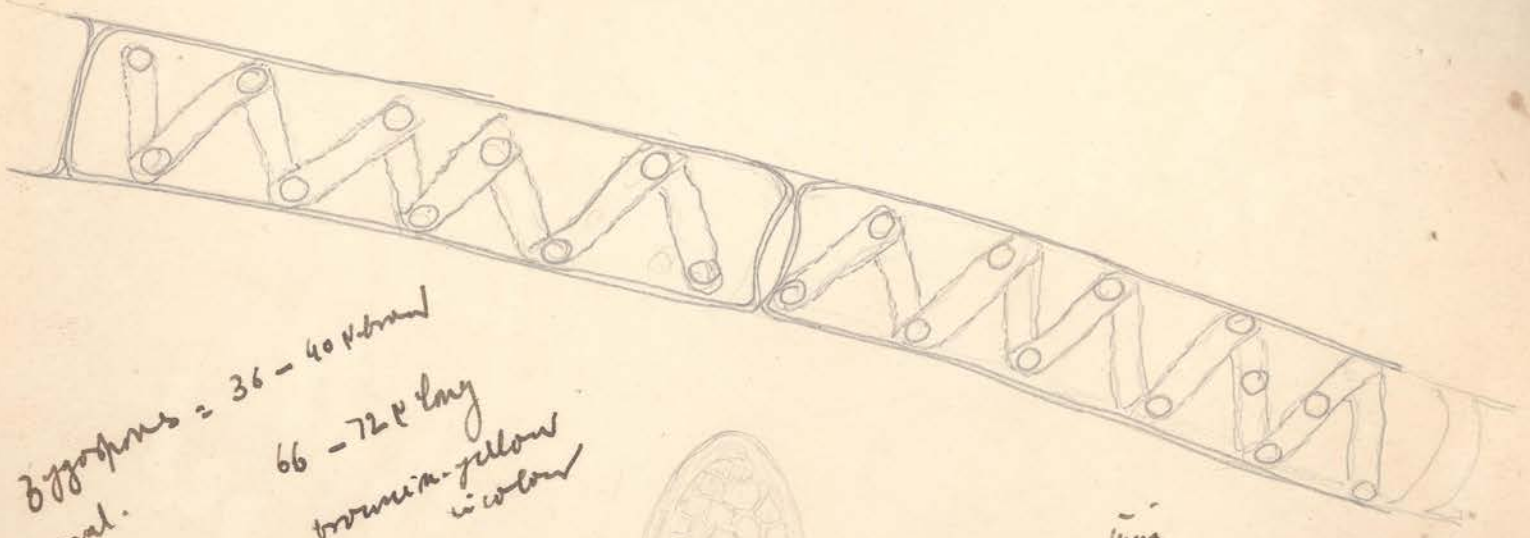
endospore — brownish
with depressions

Spirogyra daedalea. Lagerheim.

Hab. – Found free-floating in a pale-yellow mass mixed with Mougeotia arcuata sp. nov. in a freshwater lake near Bakhori Tehsil Tanda, Distt. Fyzabad U.P. in the first week of December 1936.

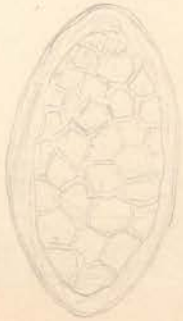
Difference from type is in the absence of the horizontal cross-bar in the cross-walls.



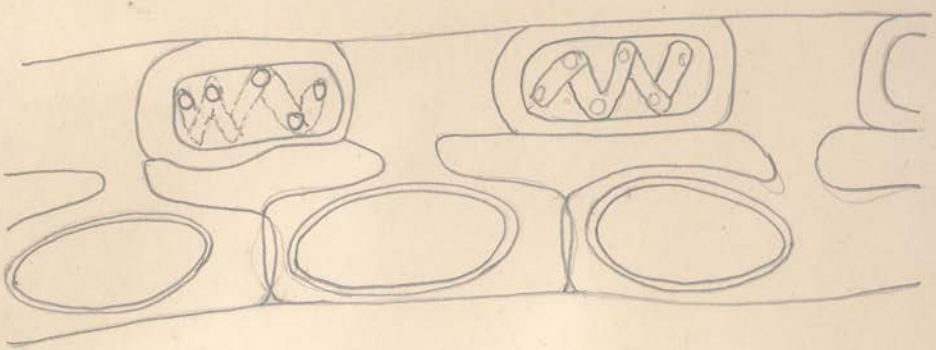


Zygospores = 36 – 40 μ broad
oval.
66 – 72 μ long
brownish-yellow
in colour

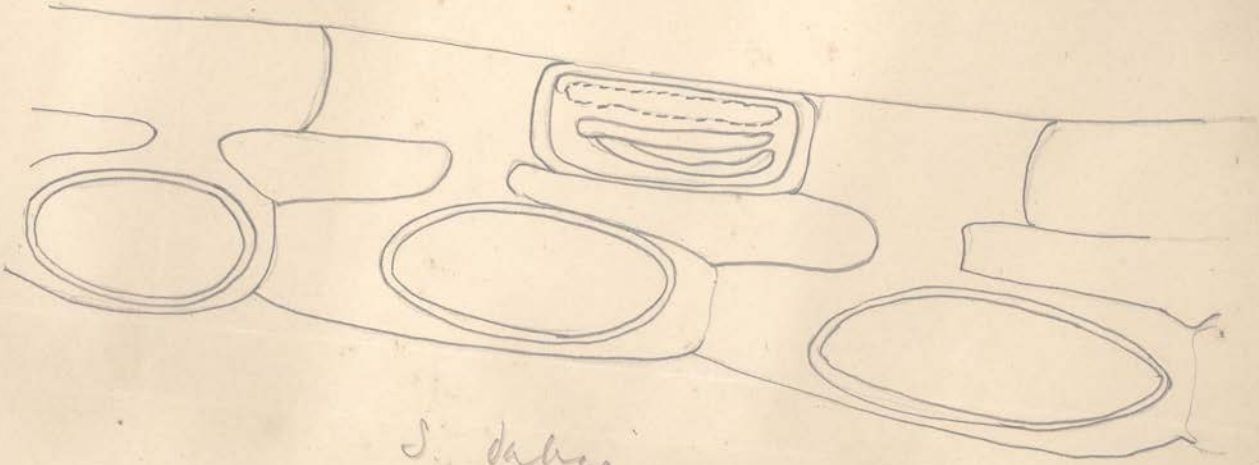
Cells =
34 – 36 μ broad
8 – 10 times as long.



– exospore thin
light-blue in colour
mesospore thick-
brownish. wavy
endosporium as spore-wall

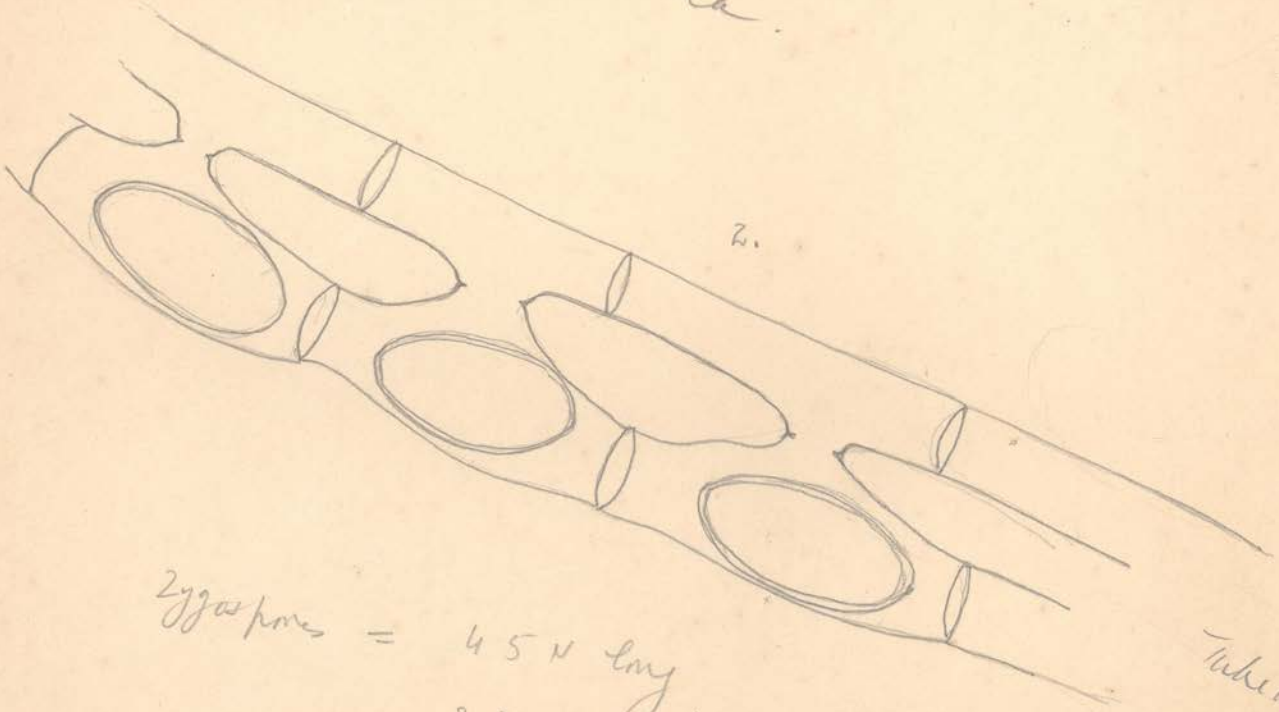


S. Agnus.



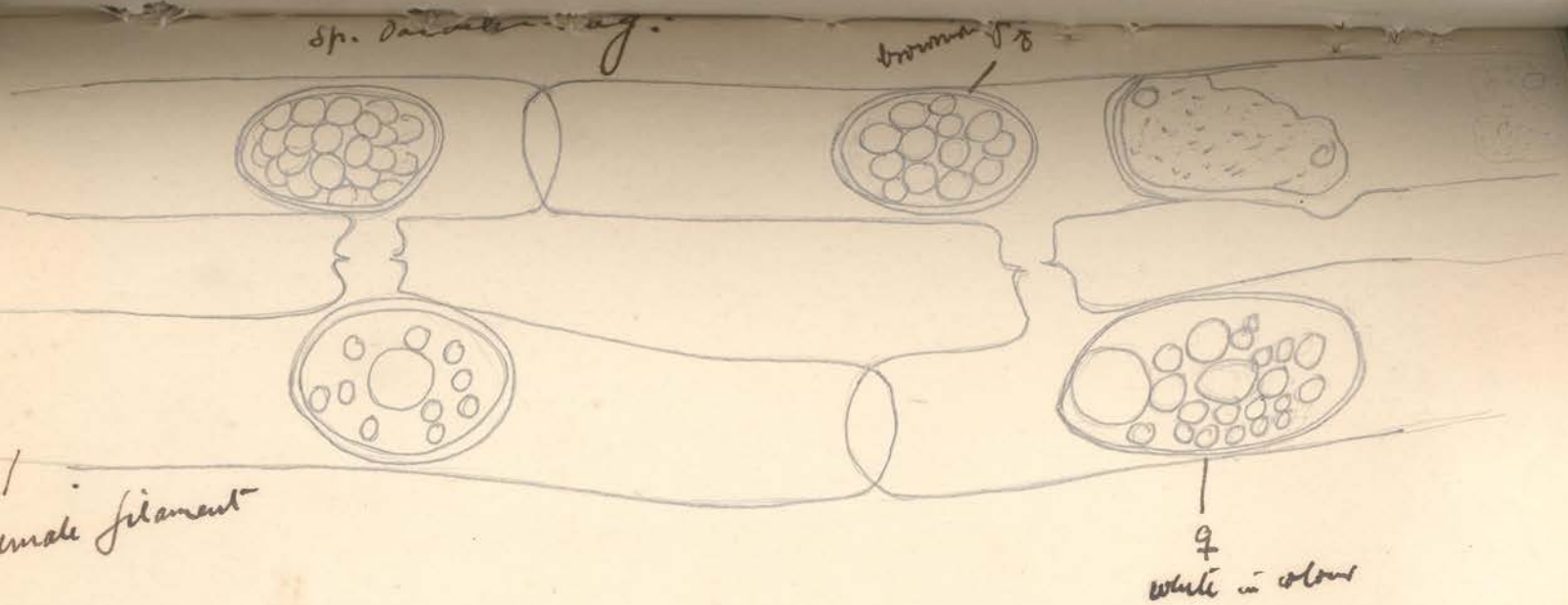
S. Salvia

S. parvula.

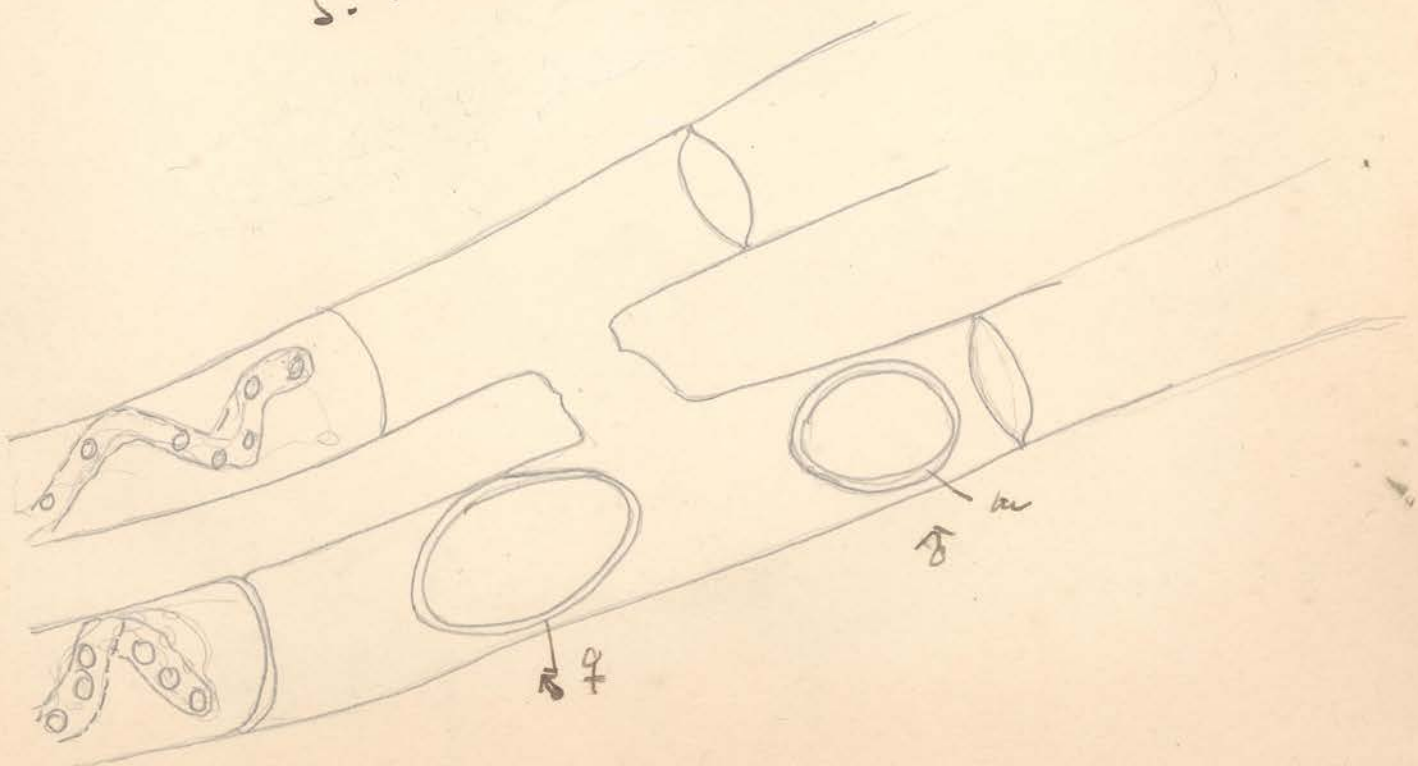


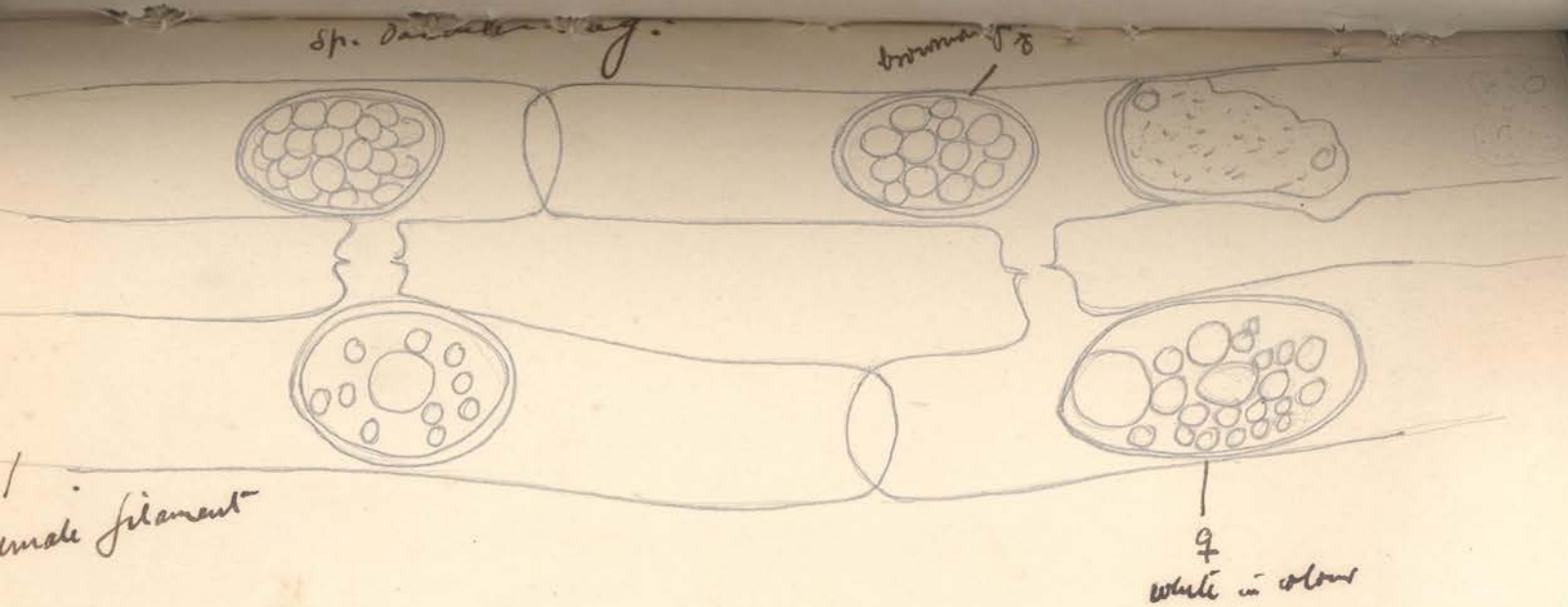
Zygospores = 45 N long
22 N broad.
-29

Tubercles

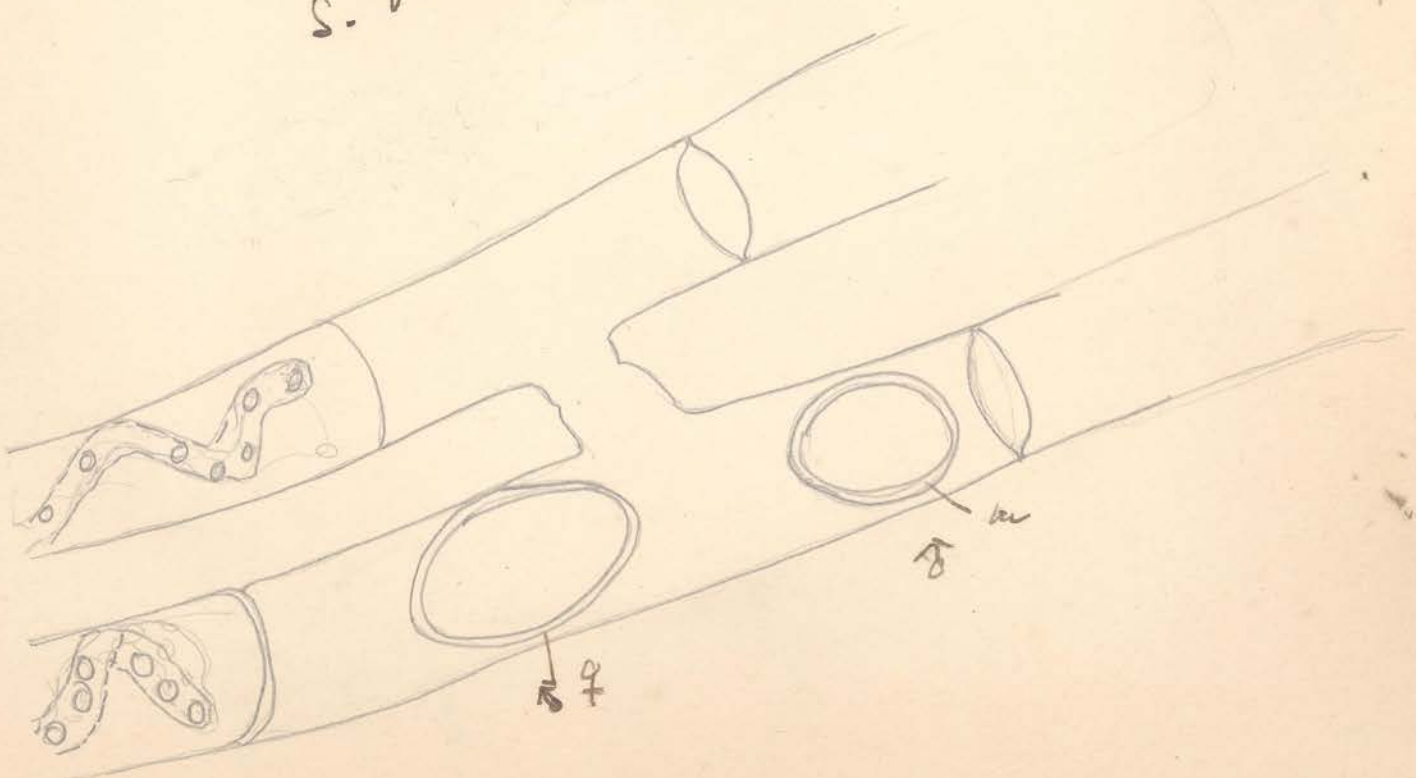


S. [illegible] Lag.





S. [illegible] Lag.

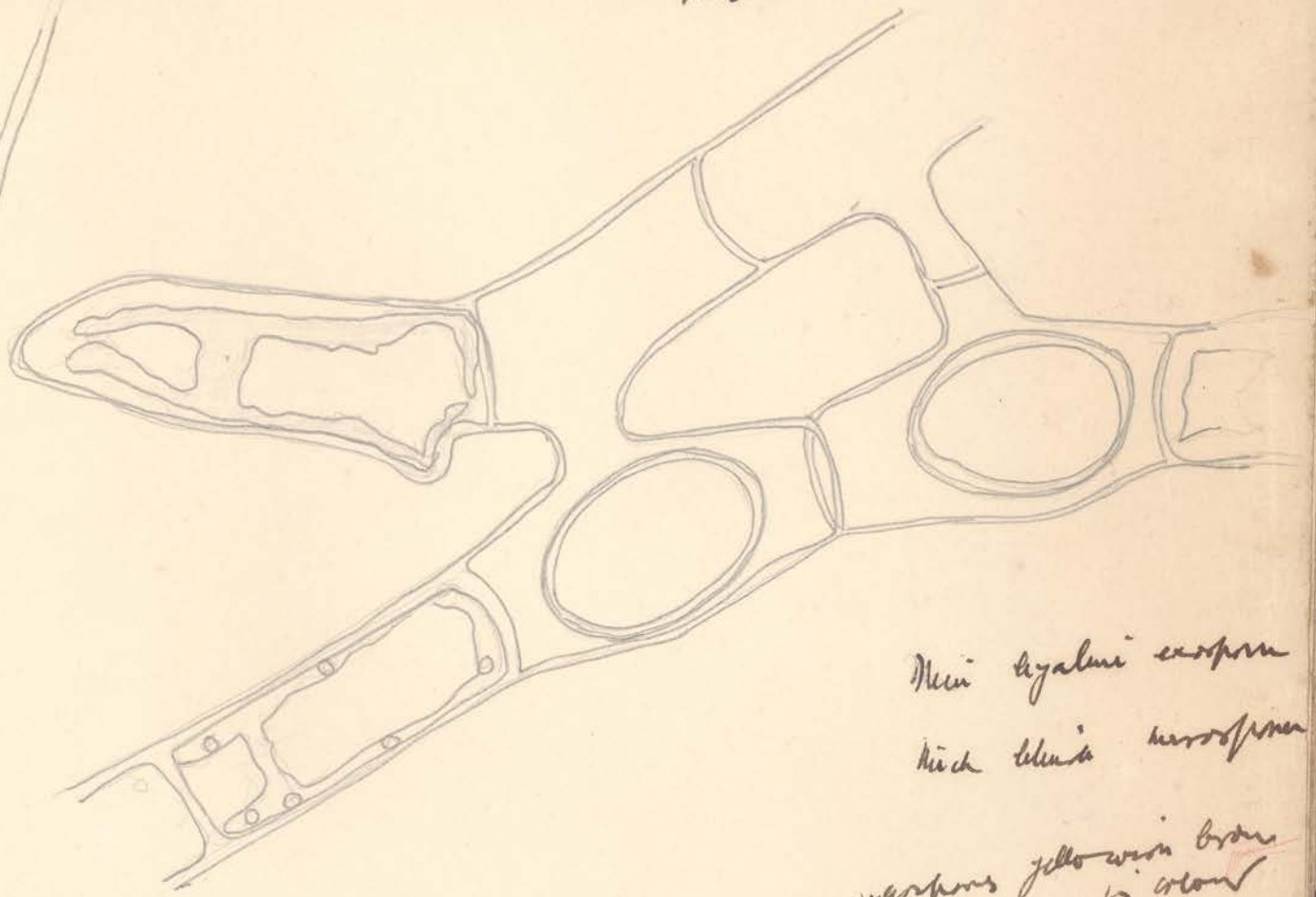


Zygospores:- 52μ – 56μ long
36μ – 38μ broad.
oval.

cells = 26μ – 28μ broad

Semi-terrestrial
form found growing in
mud in water not more than 1 ft. deep.

Spirogyra rhizopodes.
Shaw.



Tube w. 5.

Mem. hyaline except
thick blue meridional
zygospore yellow-brown
in colour

Two closely
Two closely lying each with chloroplast
cells within very thick walls

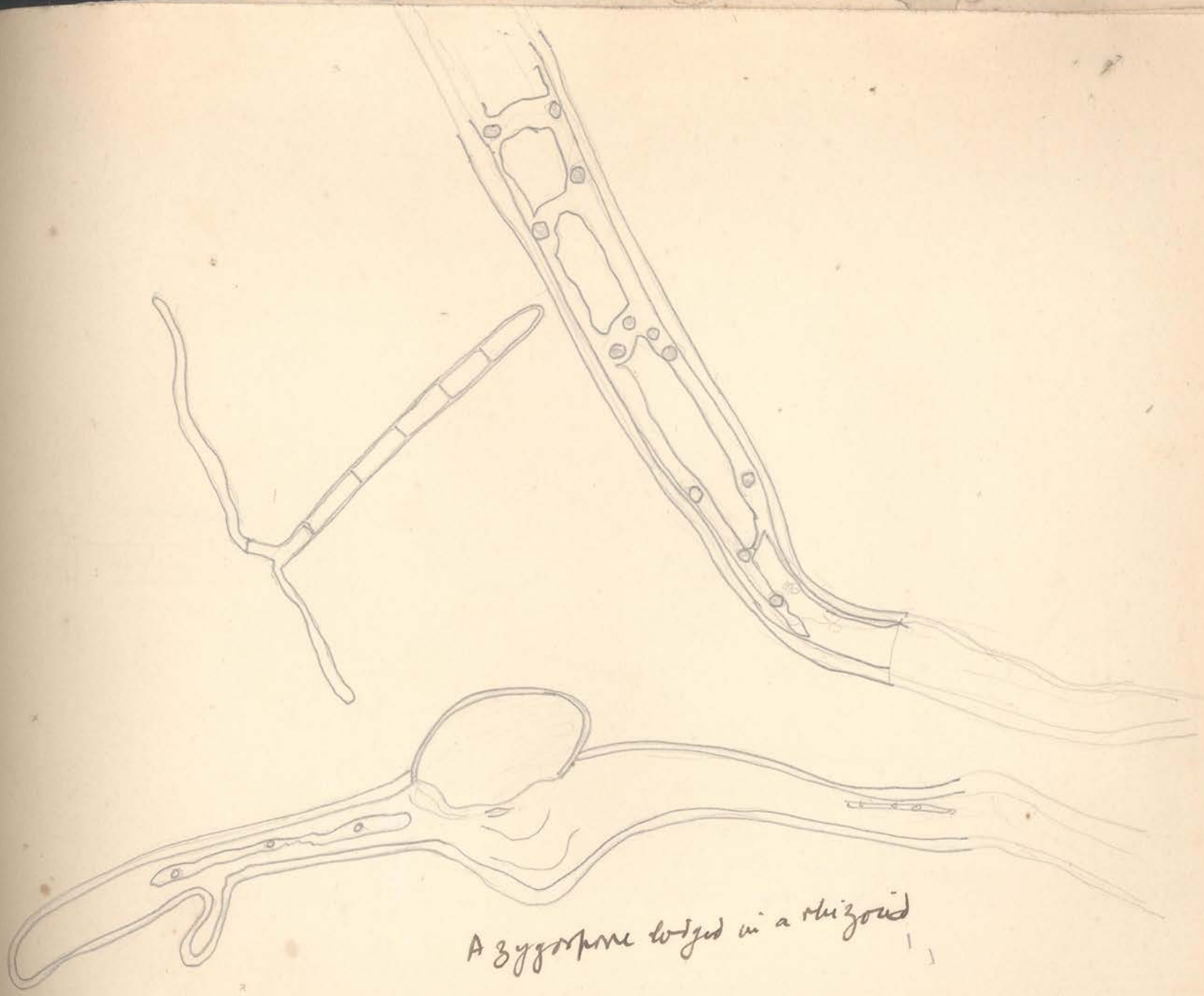
An enormous species of Rangotia

Rangotia tenuis (Cleve) with

Rangotia lepus.

cells = 16–18 μ broad

cells = 16–18 μ broad



A zygospore borne in a rhizoid

Veget. cells 28 μ – 45 μ br.
2 – 3 times as long
Zygote chloroplast ?

Sphaerozyga condensata (Vauch).

Zygospore oval
32 – 34 μ br.
60 – 70 μ long

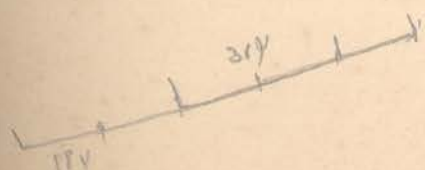
Table no. 14.

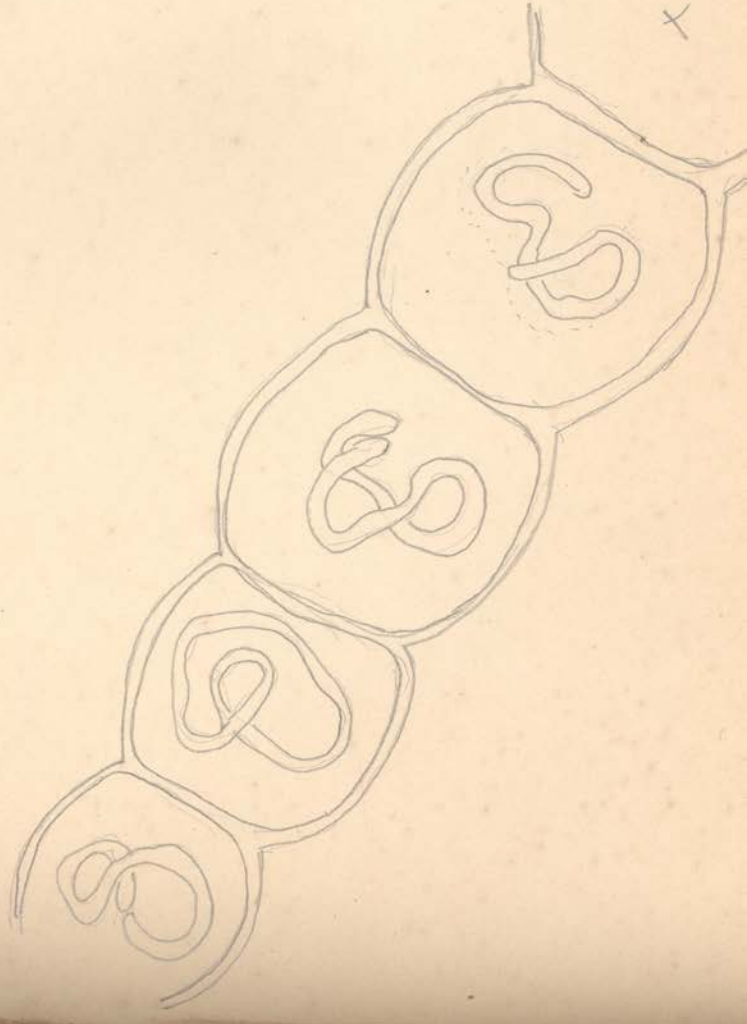
Specimen examined

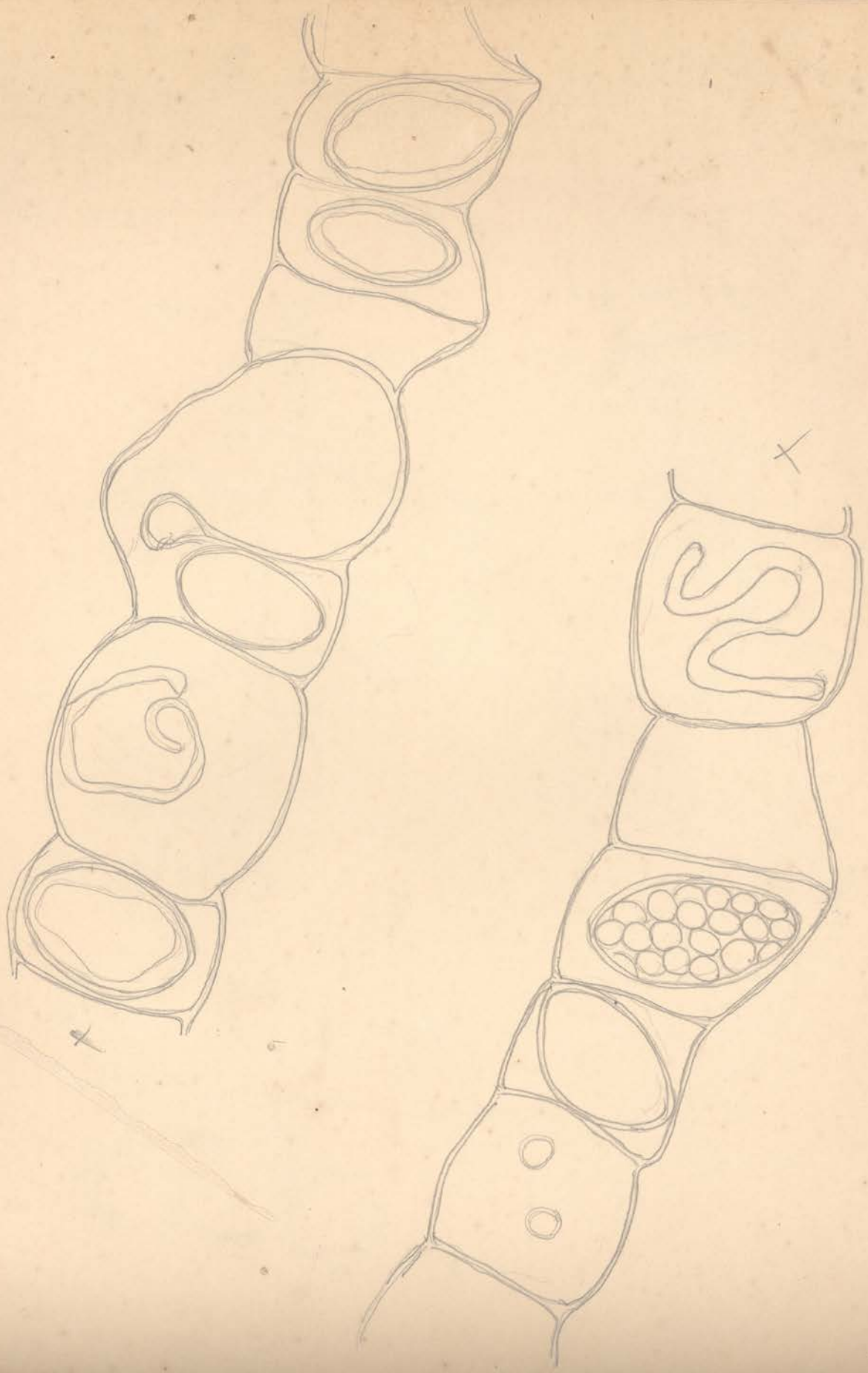
Table of Species

20. Sph. Lagerheimii – 186
Sph. condensata – 178
Sph. Woodsii – 171 Exo – W Australia

From S. Woodsii Kutz it differs in the larger size, the scalariform conjugation, & the cells containing zygospores being well rounded

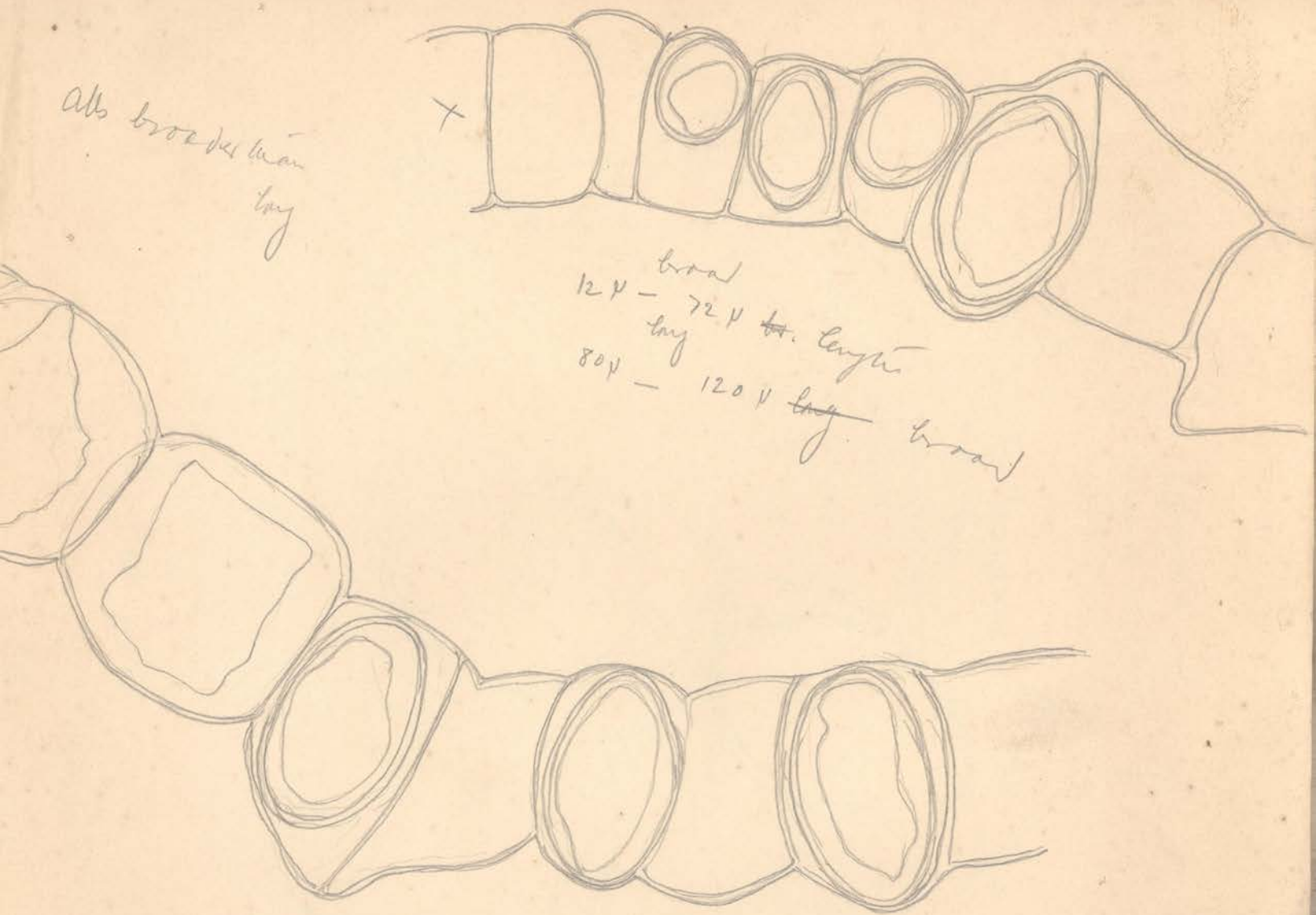






117 36/4/149

Alls broader than long



broad
12 μ — 72 μ th. Length
long
80 μ — 120 μ ~~long~~ broad

long
broad

Cells — 54 μ — 90 μ — sometimes heart-shaped elliptical
broad 36 μ 54 μ diam

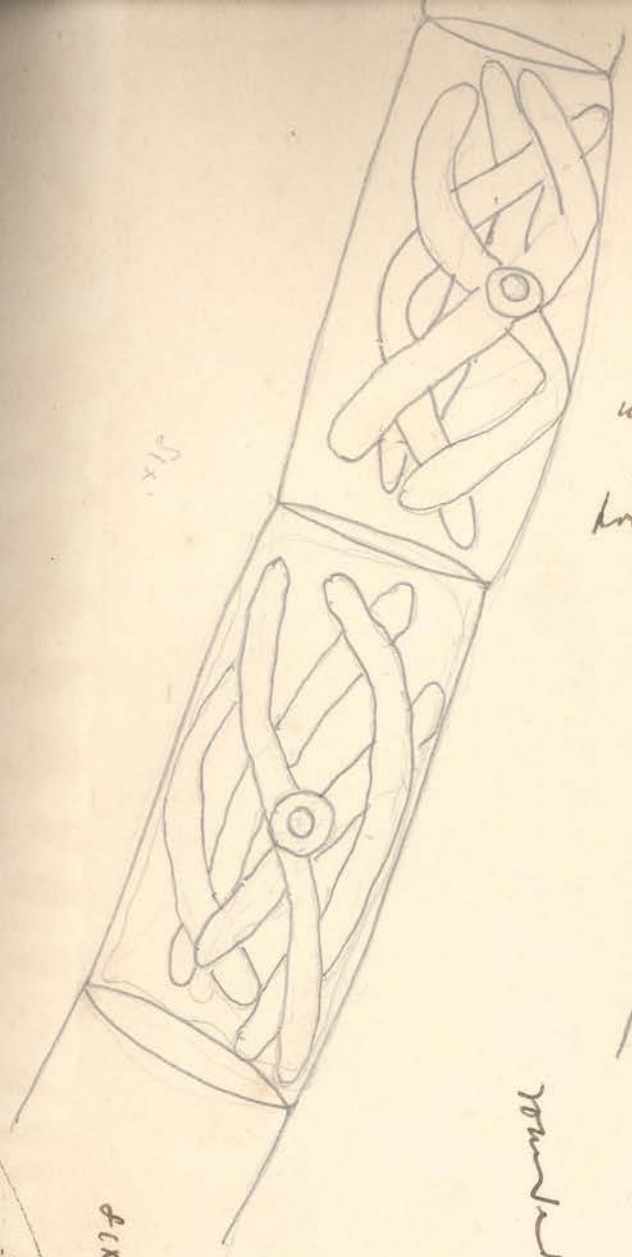
54° μ long — 138 μ long.
broad 138 μ

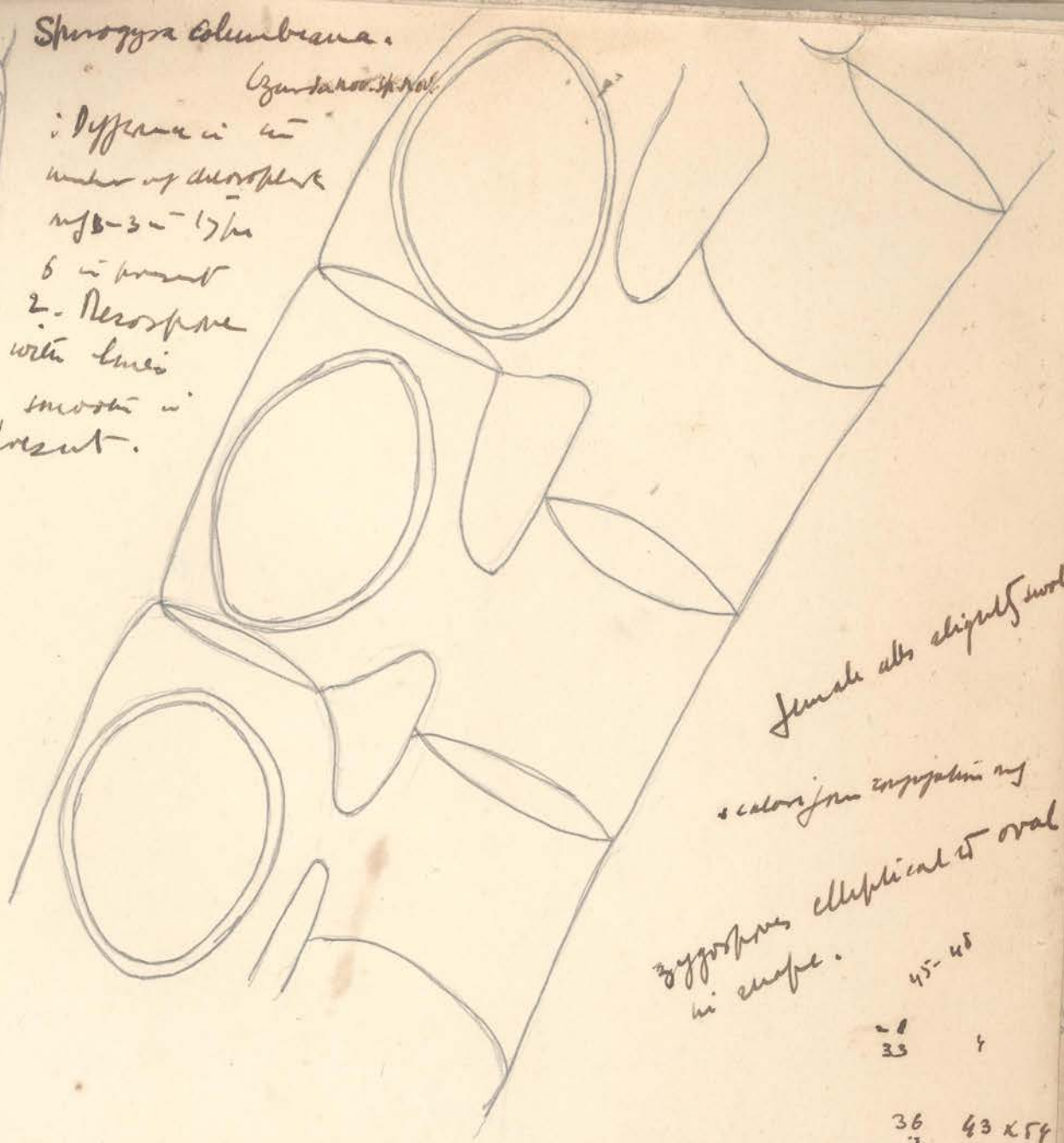
Zygospores = 54° μ br. 72° μ long. — Oval:
36° μ diam. — round

Spirogyra Columbiana.

Czantaro. Sp. Col.

: Oogonia in
under op chlorophyll
reife 3 = 17 lang
6 in breed
2. Nerospore
with knee
towards in
bezet.





Tube wA.

Columbia from Rehoboth. 15 Nov. 37.

Fruits ellipsoidal (Trans) Oogonia
mit 1-8 = Sporen
in 1 Oogonium
2 Oogonia with
Oogonia in

Female cells elliptical to oval

Zygospore elliptical to oval
in shape.

45-48

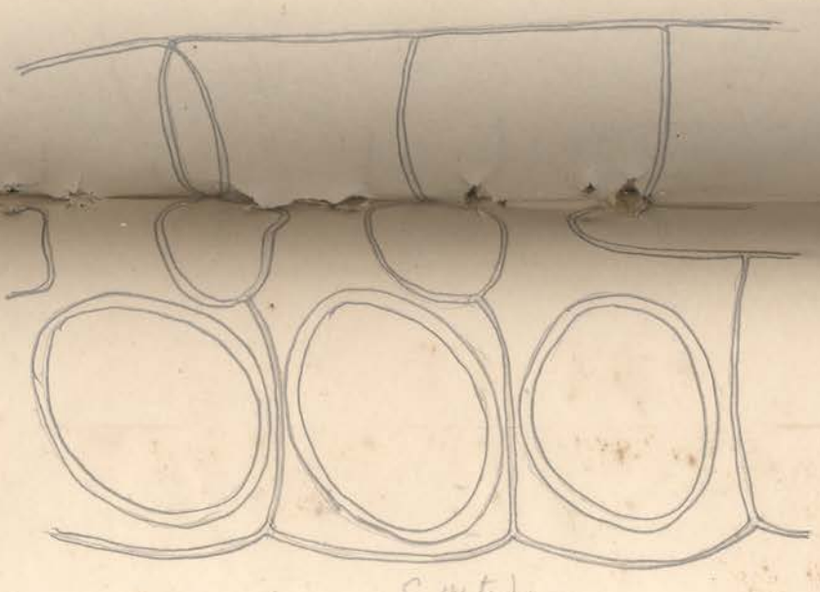
36 43 x 54

33-35

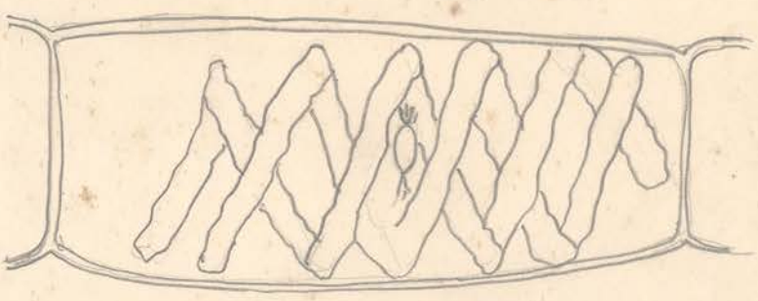
Vegt. cells = 44 x 54 N broad

2 to 2½ times as long

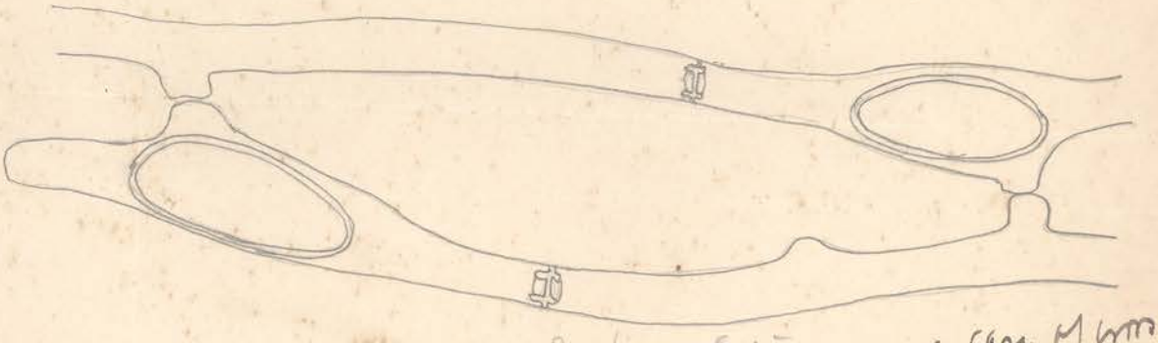
Zygospore = 54 – 58 N broad
×
72 – 80 N long



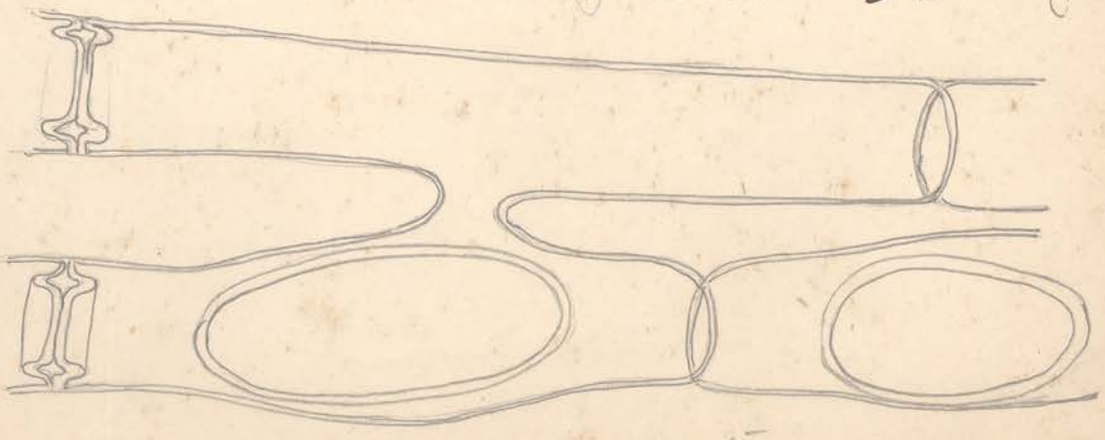
S. nitida –



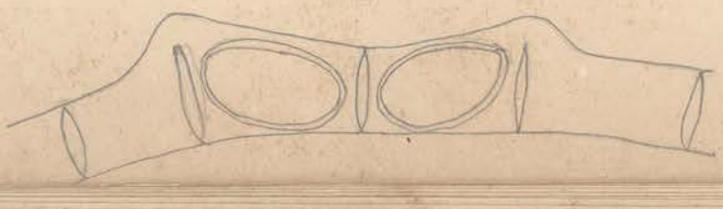
S. nitida

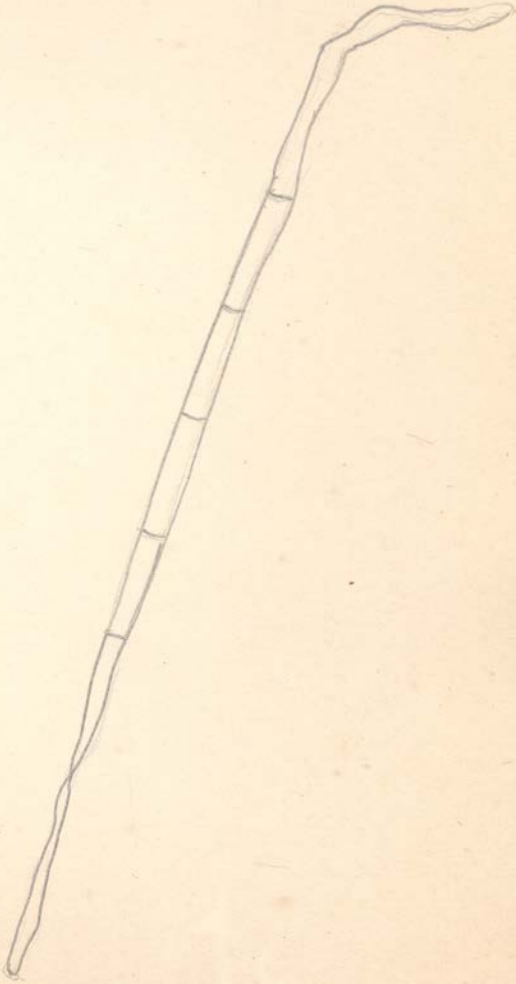


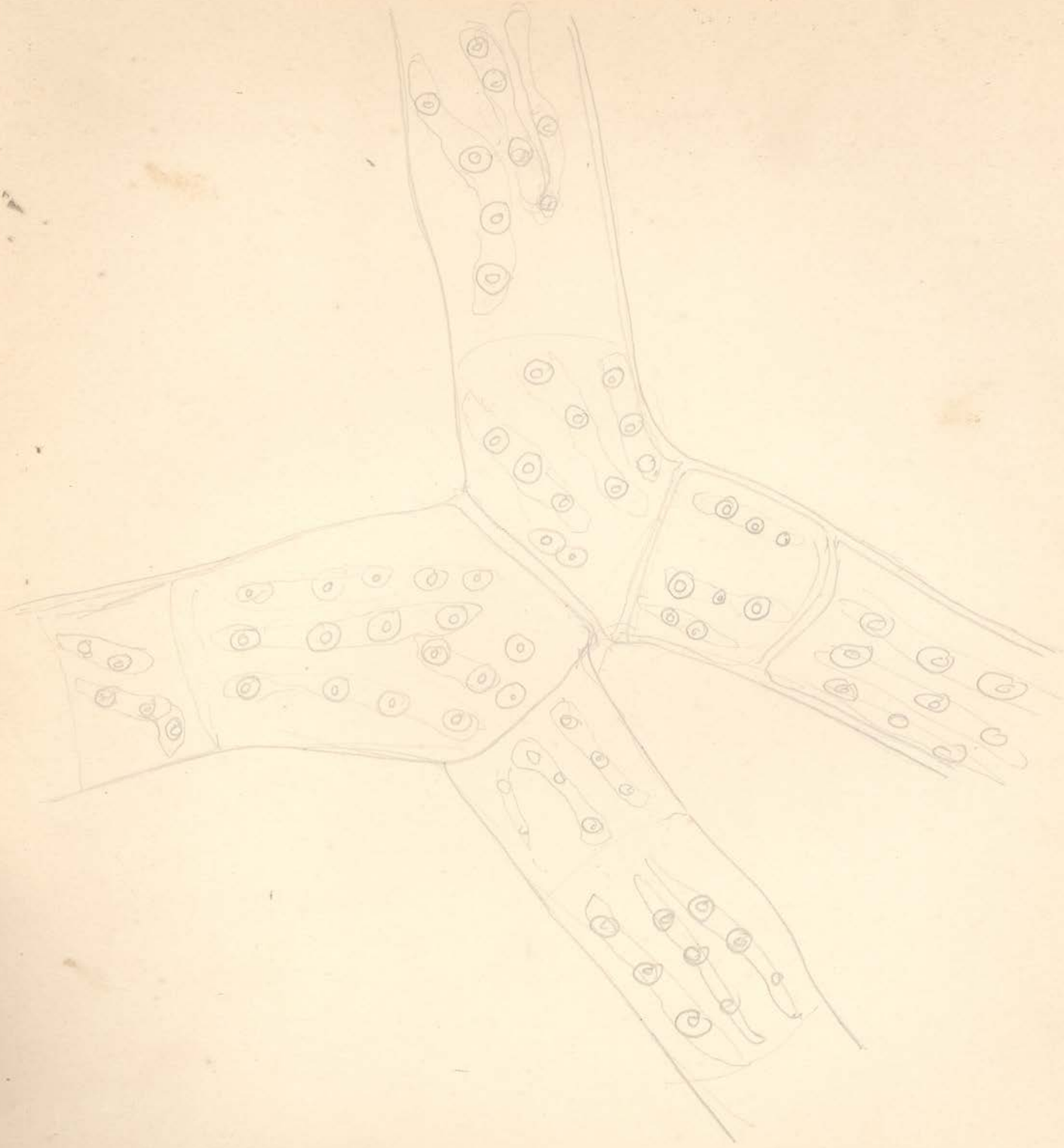
S. fuscolata – a cam. ang.



S. quadrata







{Spirogyra spreeiana: Kützing. In un-
dam nearthrosis emorsis, dentis rectiusculis
Loc. – Collected from a pond in Pilsbury Grass farm in the

Fr. gathered on 6th Feb. 37

Cells = 12–16 μ br. one chloroplast
septa replicate.

Zygospore = 24 μ br.
48 μ long.

arcolations on
surface.

100% swollen.

S. torulata (Trans) Gauda =

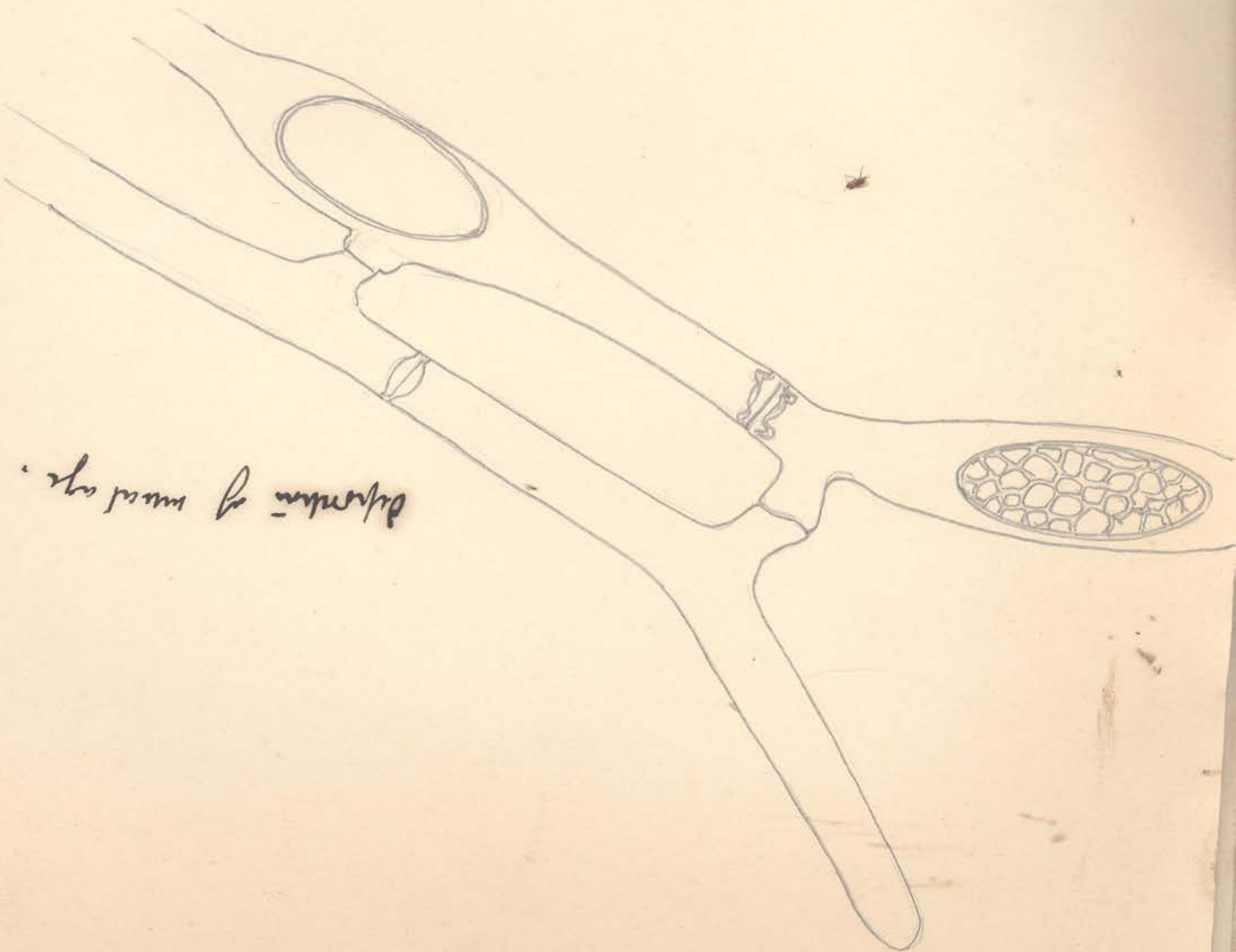
S. inflata (Vauch) Rabh.

lateral conjugation.

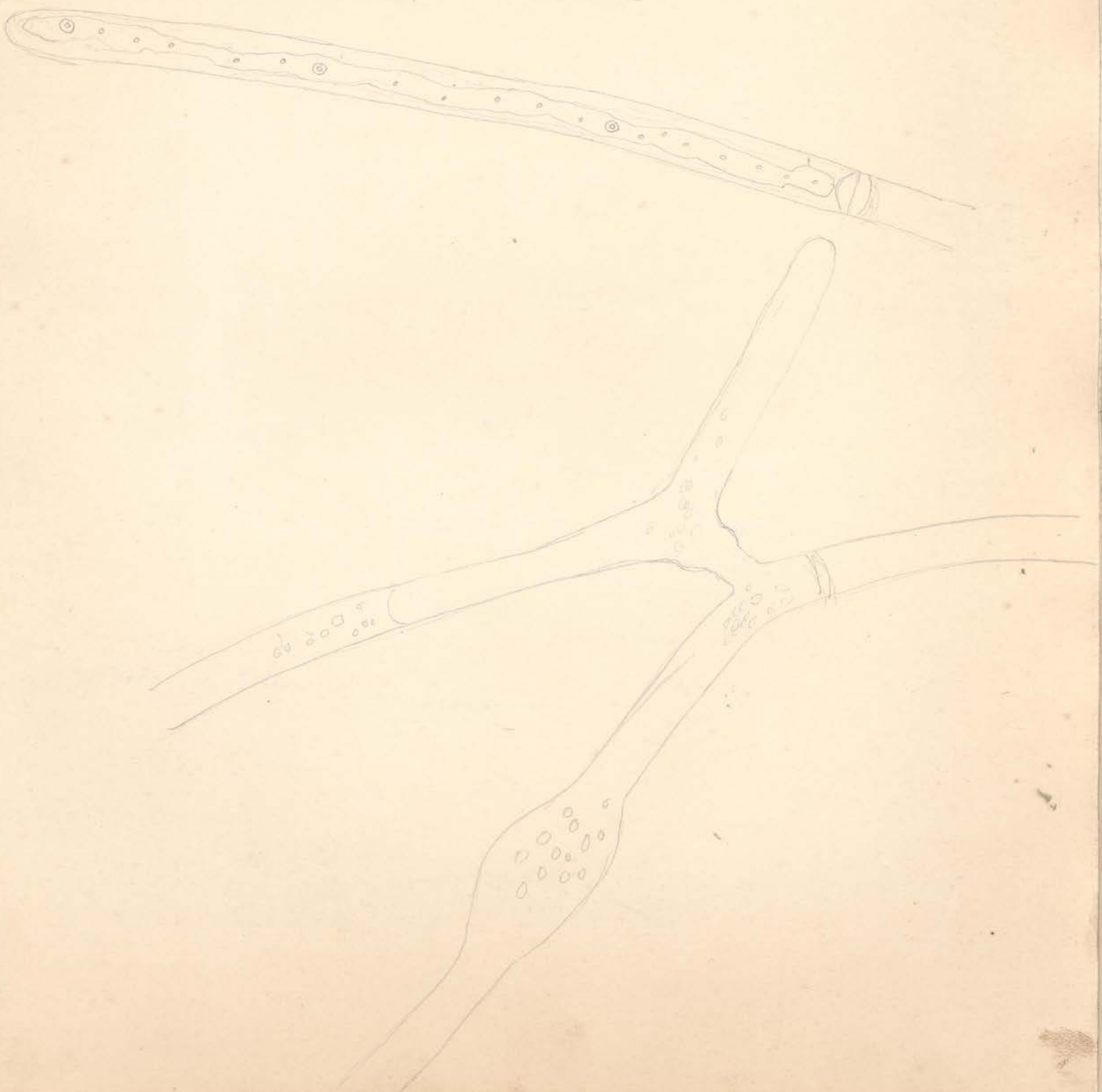
Conj. conjugatum in
S. torulata.
(Original
specimen)

same difference from S. Naegeli Kutz.
Differs from S. fovcolata (Trans) Czurda
only in smaller size & zygospores.

S. fovcolata (Trans) Czurda.

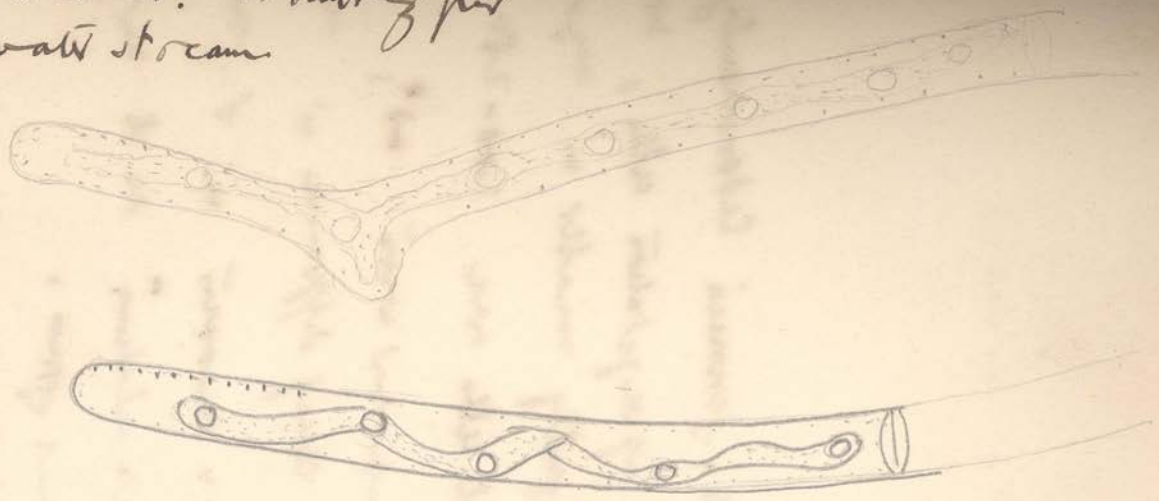


S. liana. Trans.
Var. reticulata
Jav. ISV.



Spirogyra liana : Var - rechanalis :
Var nov.

Tamba Road. V. Ramirez pur
Freshwater stream



Spirals at 1 right-hand end.
a reversing change at
reversing in 2
Oblonga.

Spore

Zygospore - yellowish in colour.

8 x 2.

s. fennica Cederevertz in
vegetativ cells, more
nearly square in size.
cells are 200-280 %
more wide (80% of
their diameter in length
in vegetative cells than
in S. fennica.

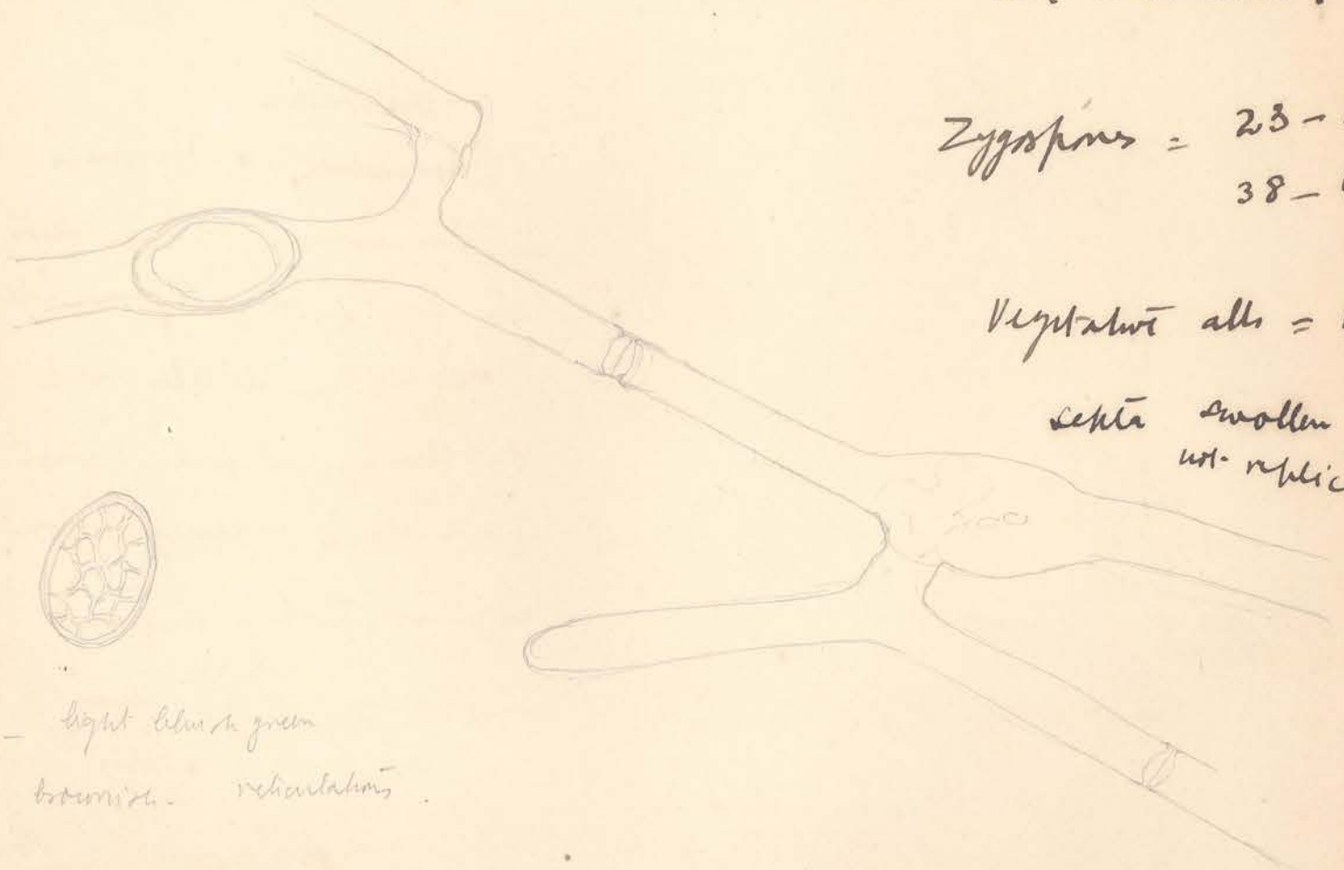
from S. flavescens (Hass
in size of its cells, very
from cannabis.

$\delta = \frac{17}{43} \times \frac{50}{1} = \frac{850}{43}$

Spirogyra liana. Transe. 1934. op. cit.
1 / 162 Var. reticulata

200 — 280% wide. Borge. Beiträge zur algenflora von Schweden.

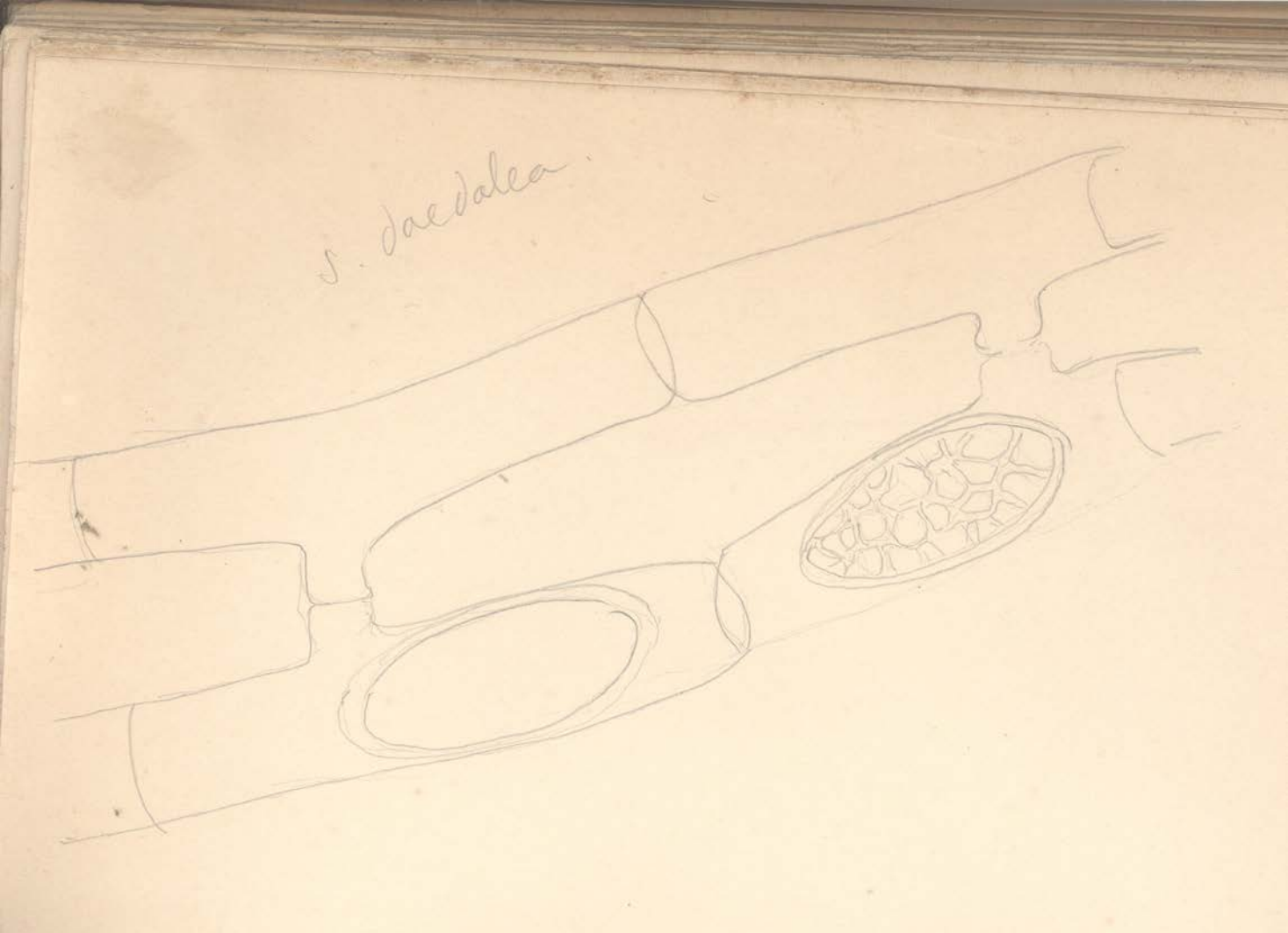
24 / 19 / 192 / 24 / 432

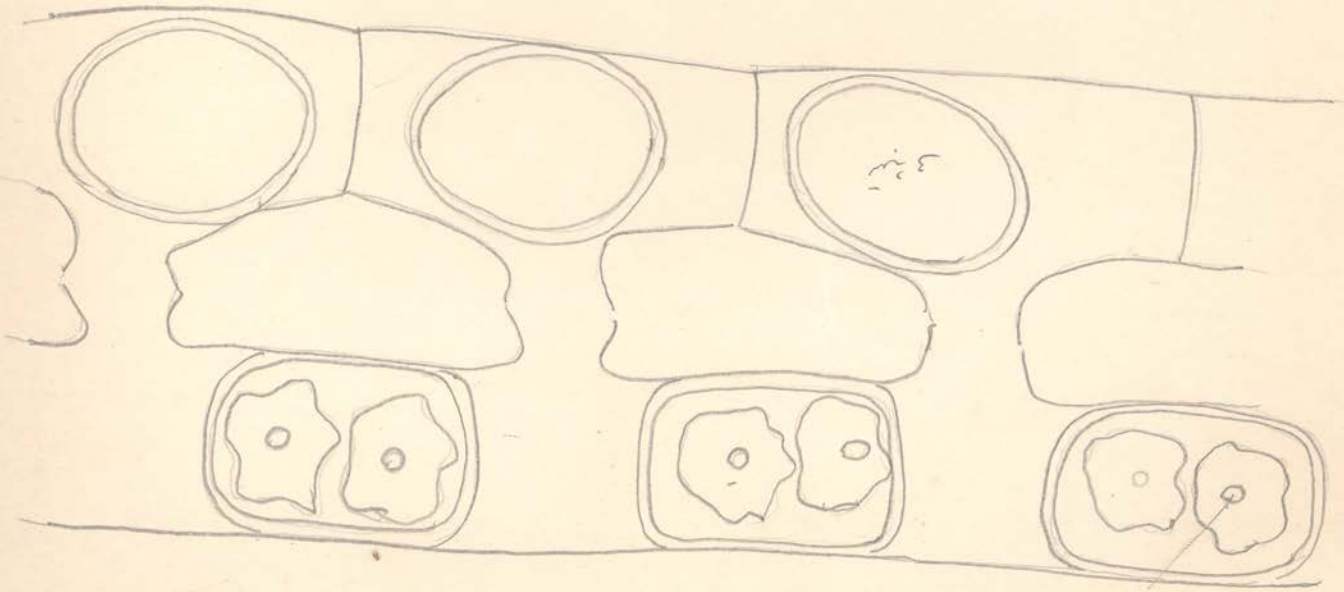


Zygospores = 23 – 26 μ broad
38 – 40 μ long

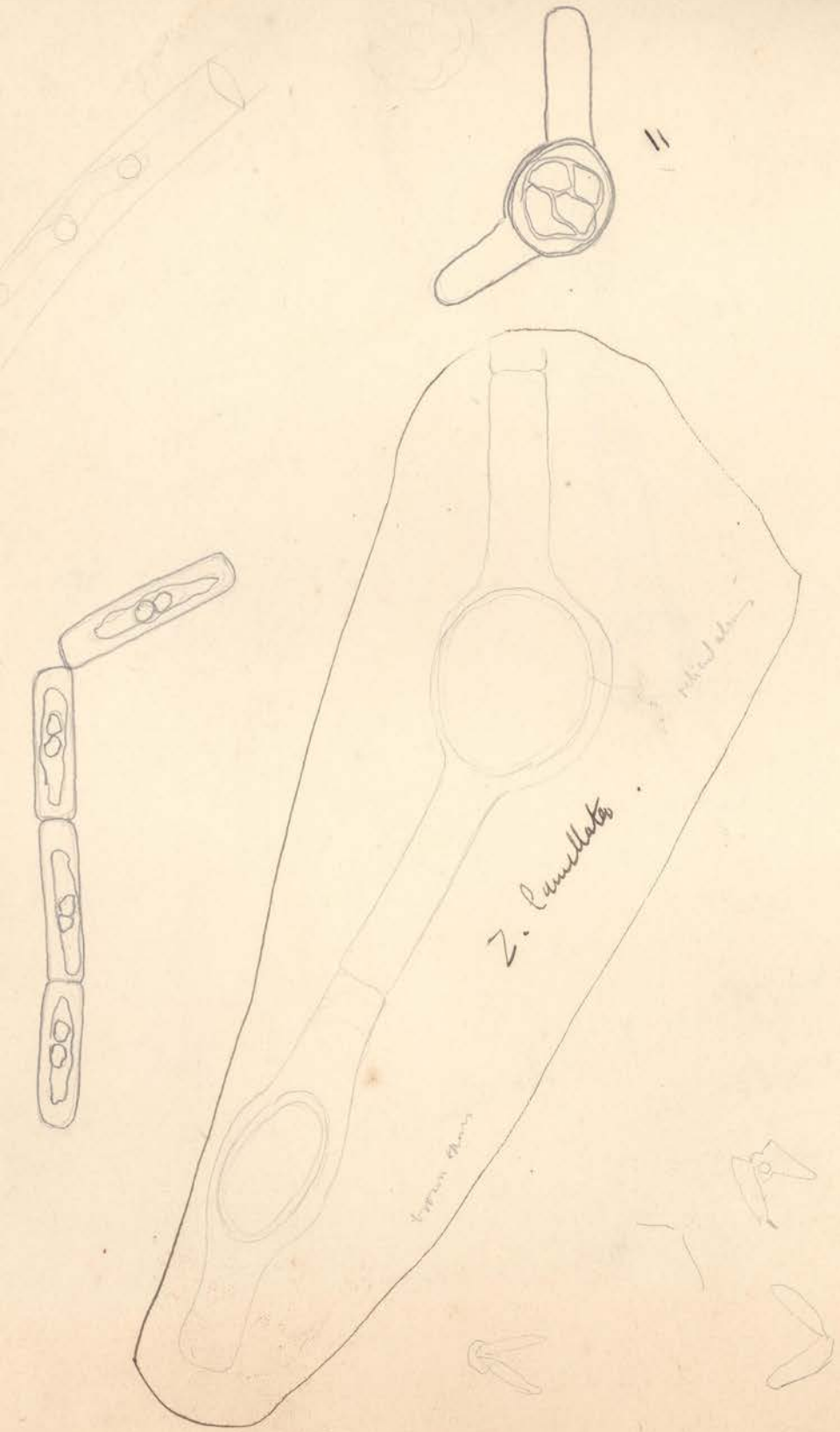
Vegetative cells = 14 – 16 μ broad.
cells swollen but not reticulate.

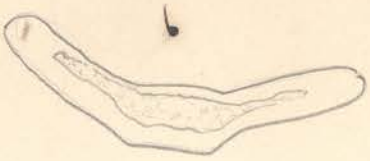
exospore – light blue to green
mesospore – brownish. reticulations.


S. daedalea

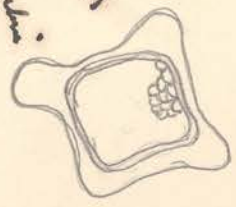


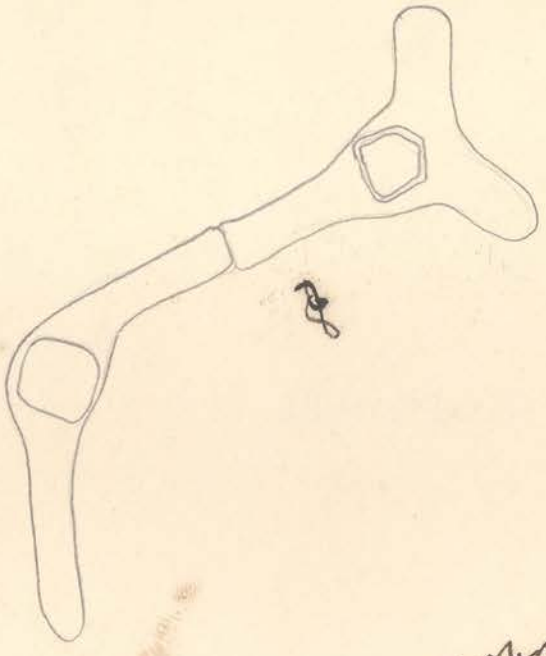
Zygnemopsis minutum.





Three-horned zygospores also seen.





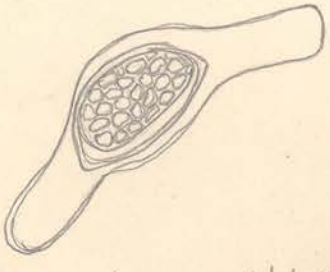
2 zygospores square

Very rare

22 – 24 N broad

excluding mucilaginous coat.

Including coat 30 N broad.

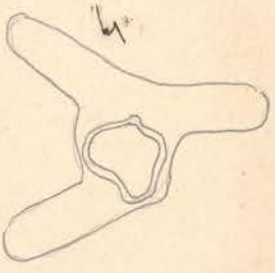


Acicular-sickle-shaped Ankistrodesmus very common. Measured this a Dongeria

18 – 20 μ broad

18 – 36 N long

excluding mucilaginous sheath



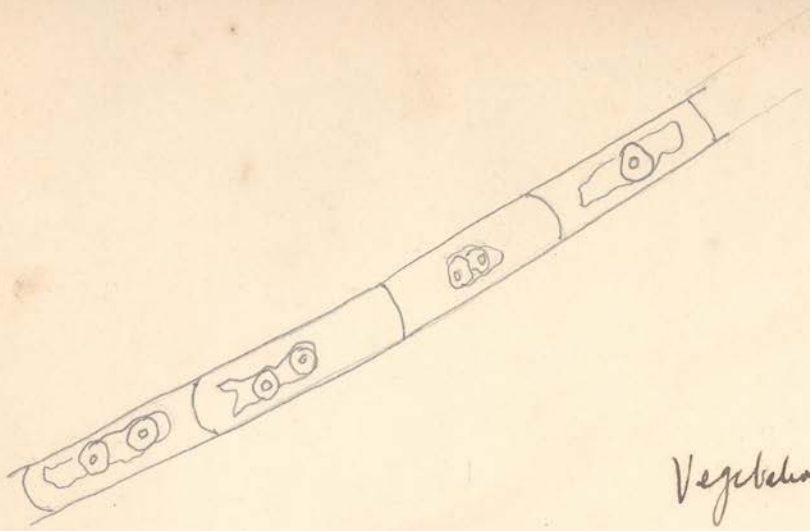
Closed cells 2. oval cells.

Ankistrodesmus 4.

Dictyosphaerium 37.

Coelastrum 6.

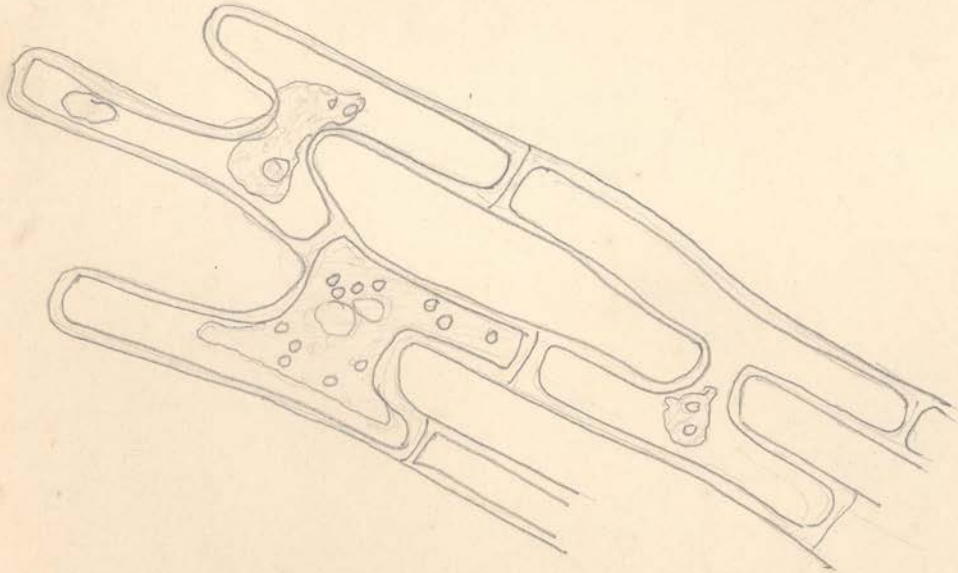
2. globosum ch. nov



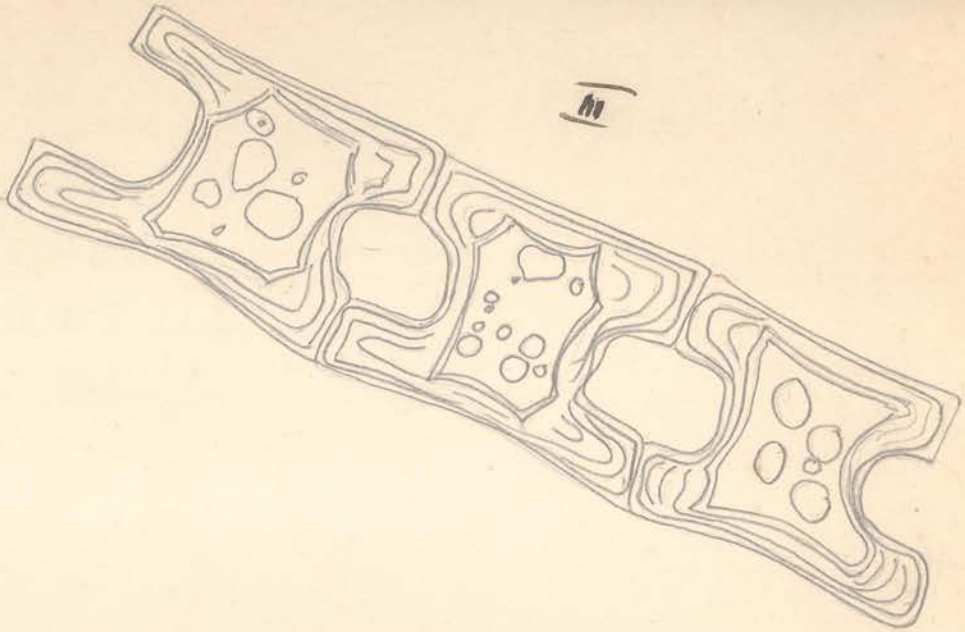
Vegetativ cells = 12 – 14 µ broad

36 – 72 µ long.

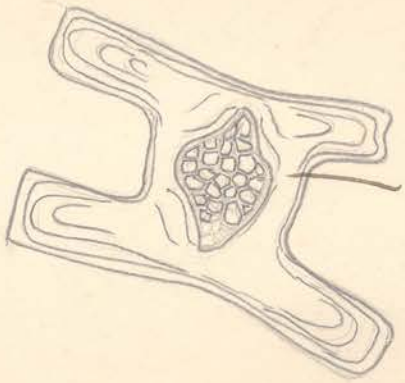
Chlorophasts not seen in



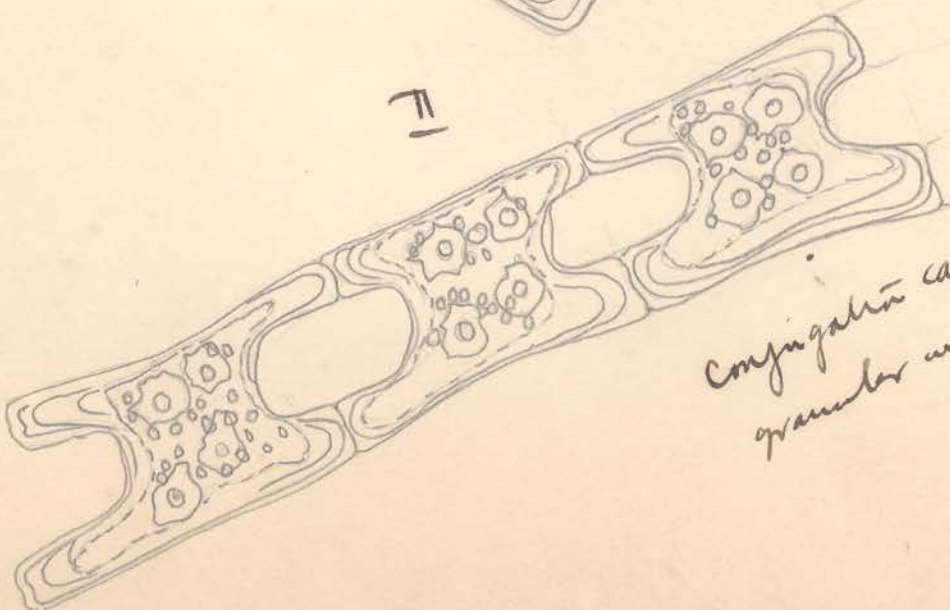
Zygnemopsis lamellata.



III



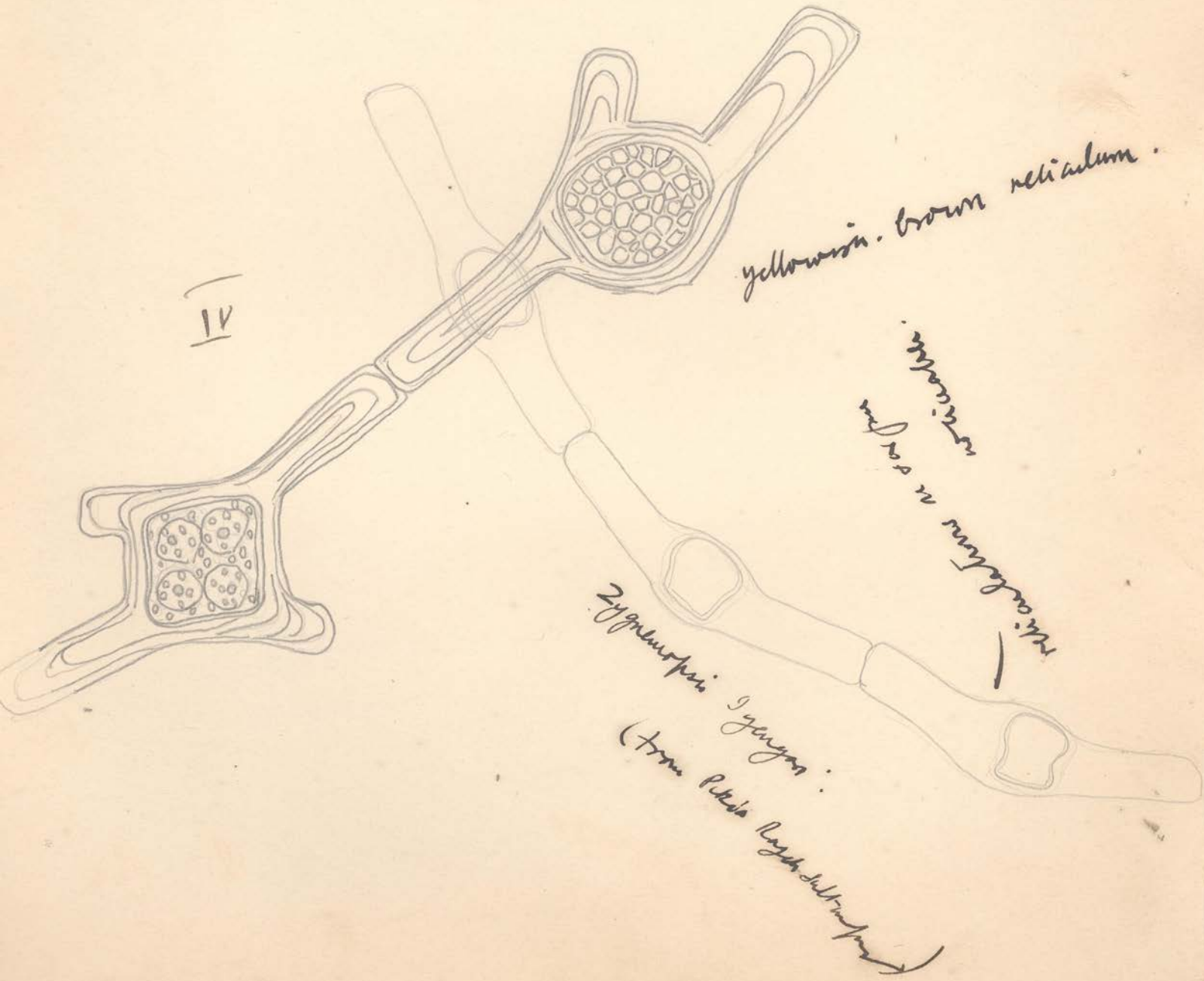
Spirilla chromat.



II

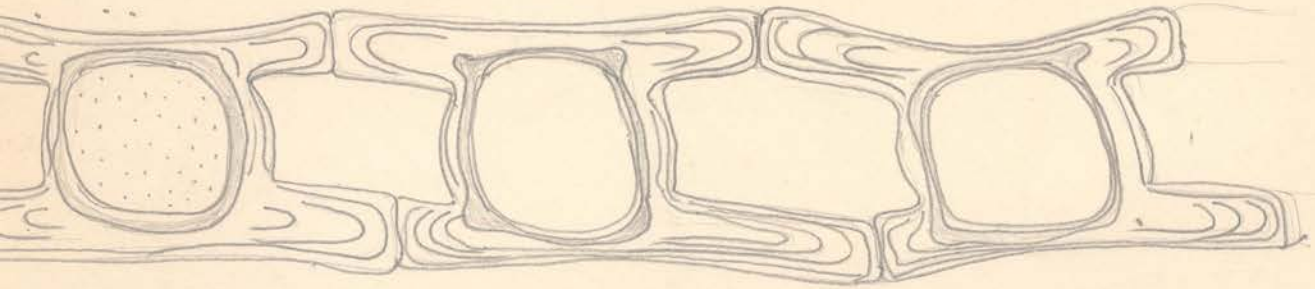
Conjugation canals very wide
granules rather visible.

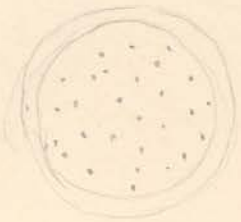
Zygospores – quadrangular to globose
great variety in shape
When quadrangular, two angles are in
same cross plane of obtuse with convex sides
In some cases sparkle shaped.



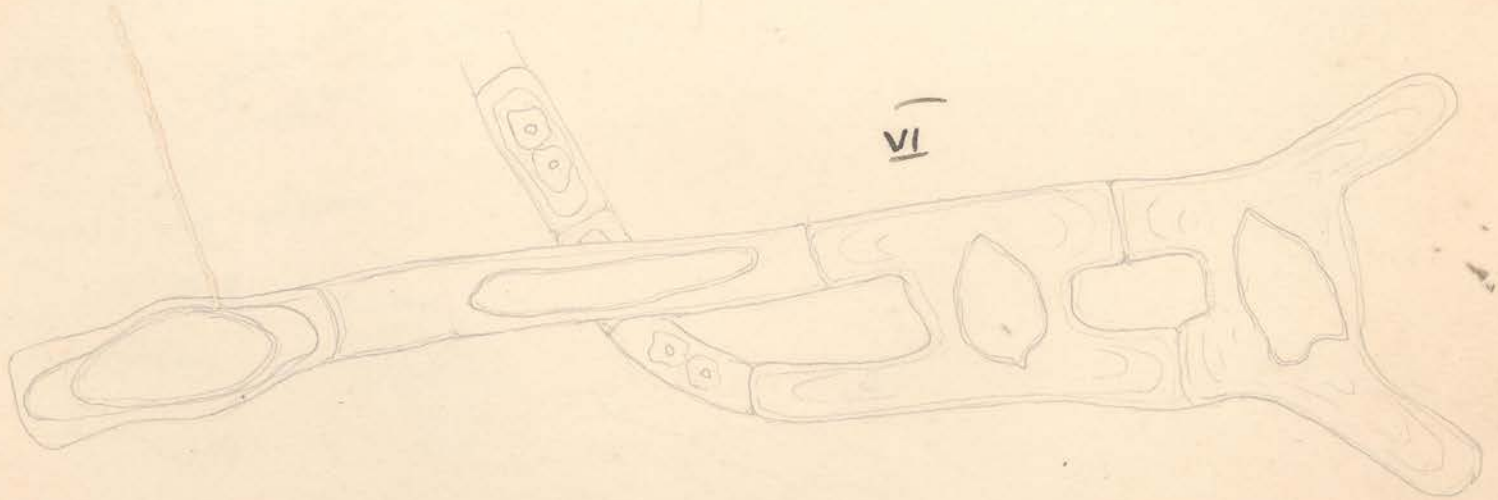
Dark greenish-blue spores . Zygnemopsis [illegible]

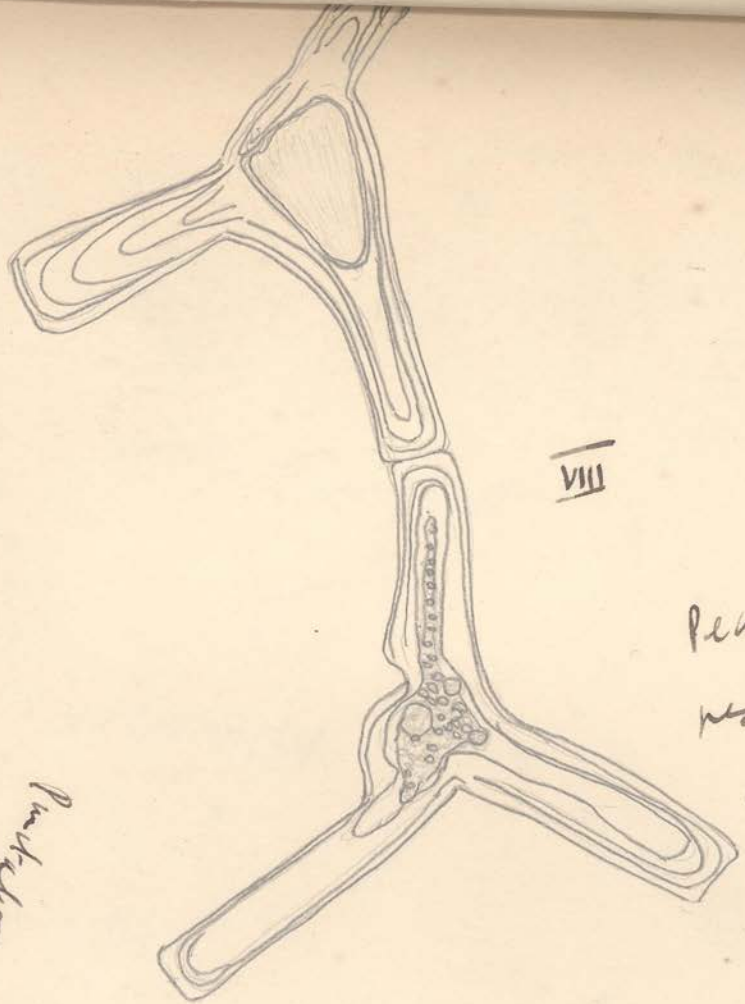
V





VI

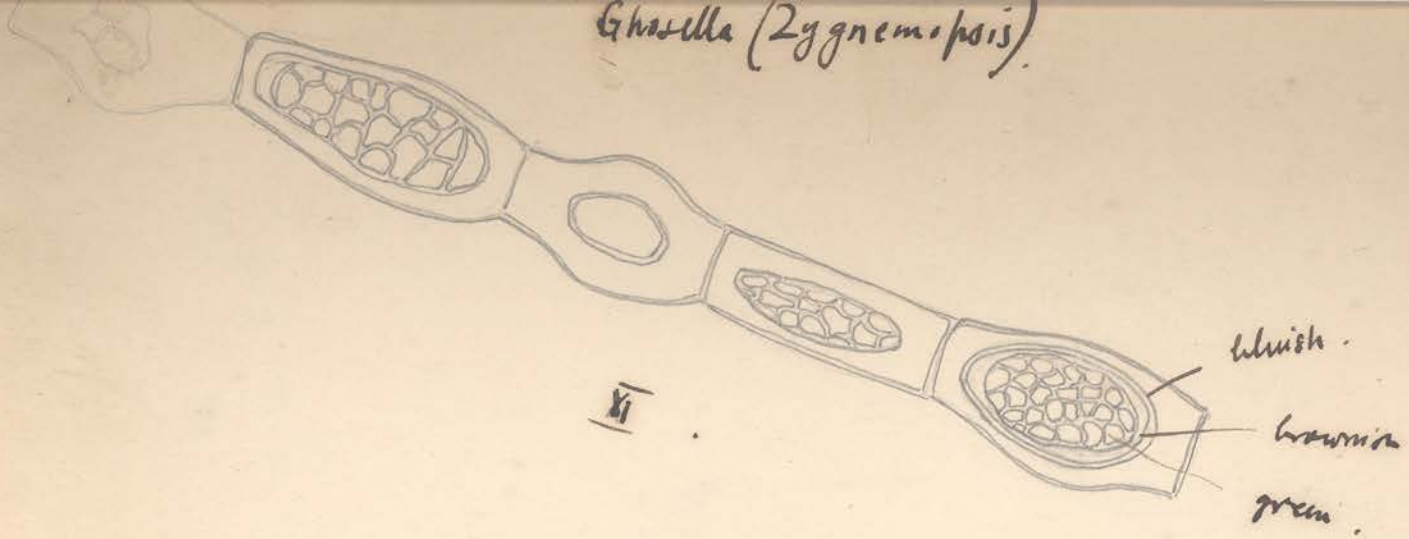




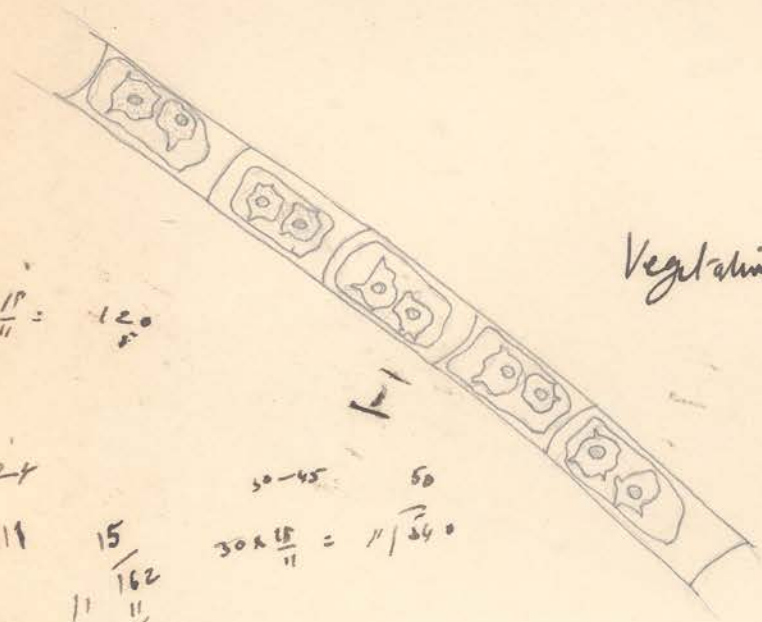
VIII

Pearlia triangular zygoptera
resulting from the fusion
of the ends of filaments
with the other of —
filament

Ghosella (Zygnemopsis)



VI



VII

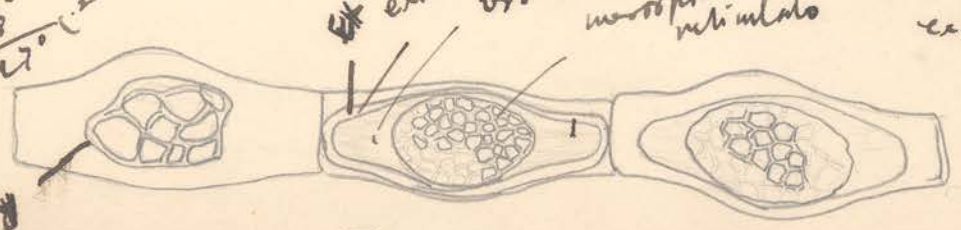
Vegetativ celle = 15 — 18 µ br.

32 — 42 µ long.

Aplanospore =

24 — 36 µ br
indeuvi af
cellens wall

18 — 24 µ br
endeuvi af

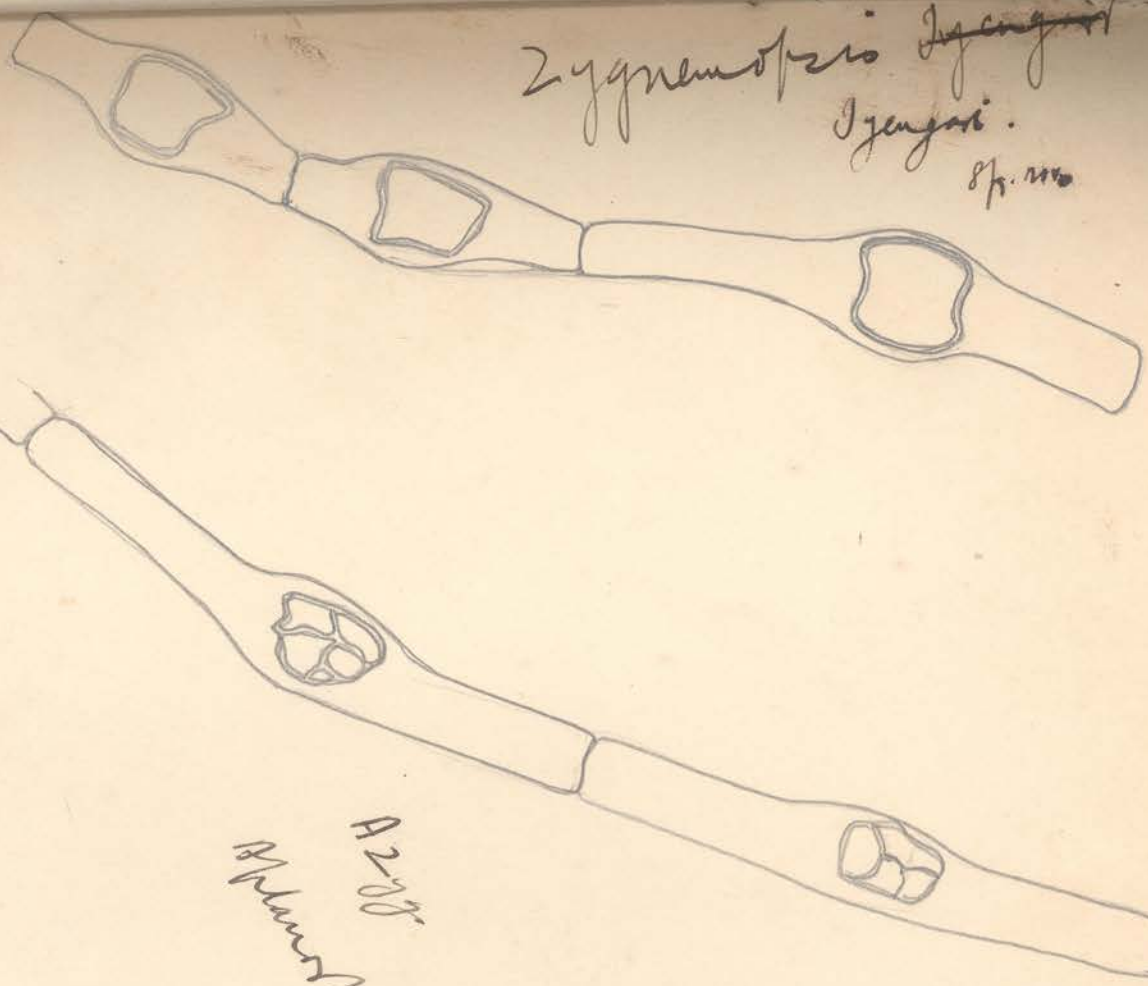


IX X

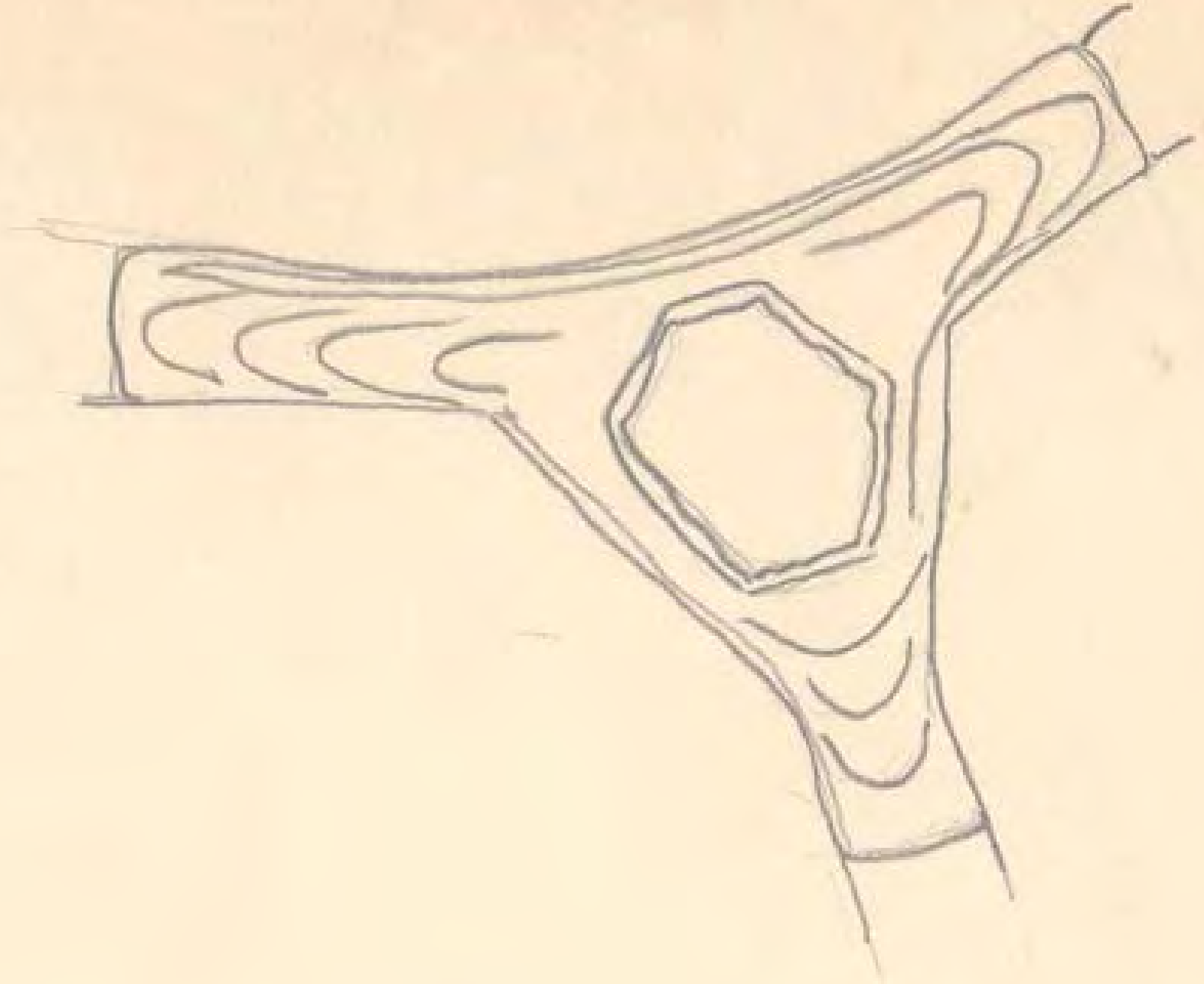
40 — 74 µ long

Zygnemopsis Gomphosphaeria Ghosella

Zygnemopsis Iyengari.

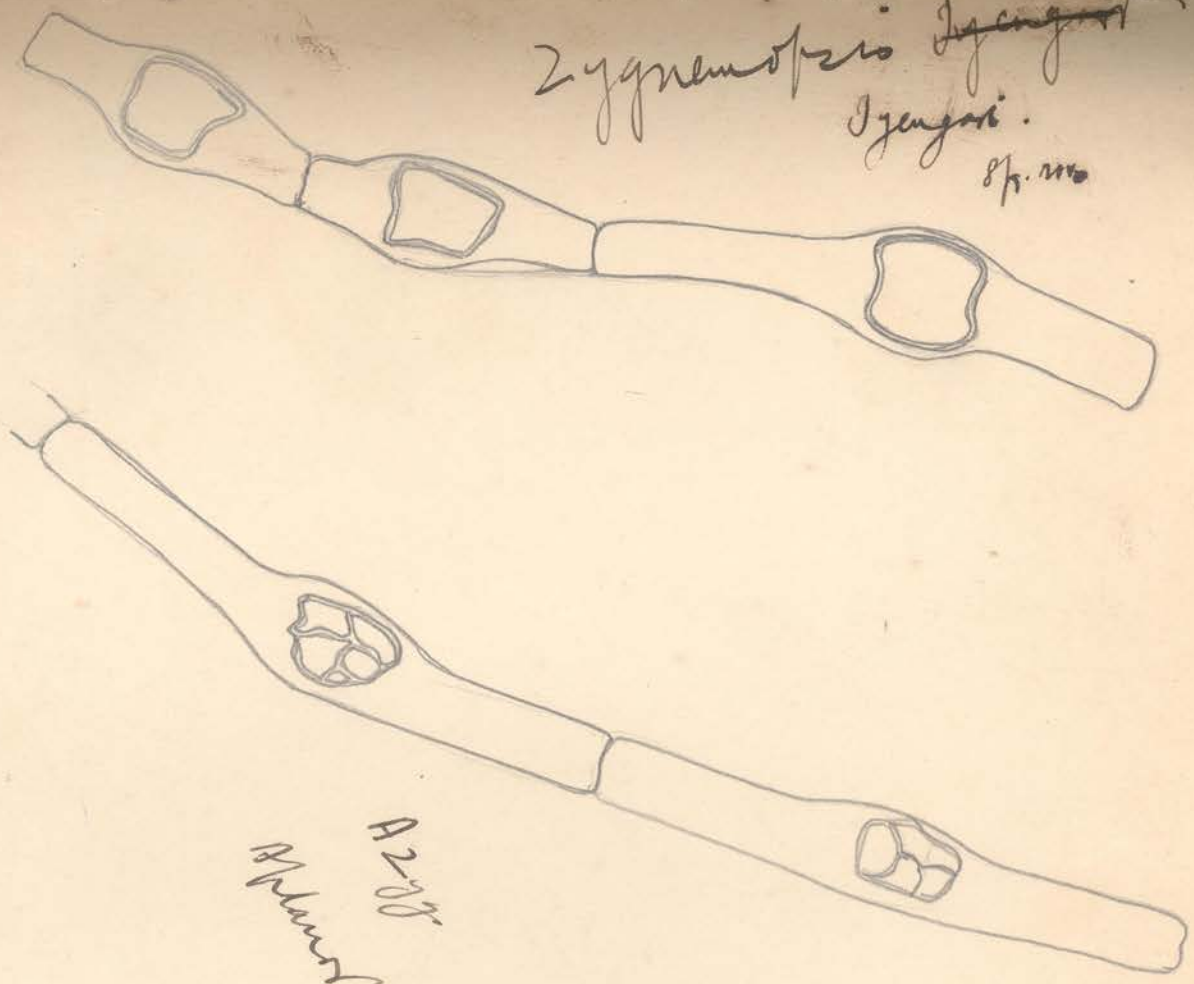


Azygo
Mesocarpus — 18 — 23 μ thick.
Long cells — 15 —



Zygnemopsis Iyengari

Iyengari.



A237

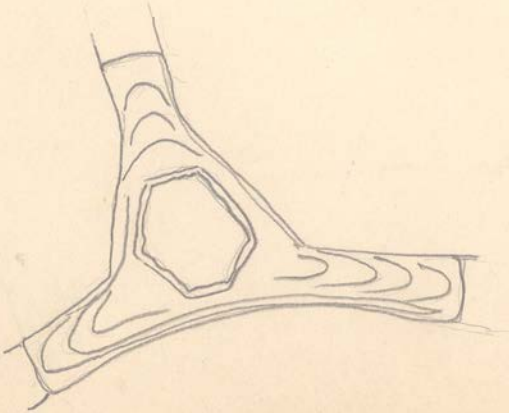
Allahabad — 18–23 μ thick.

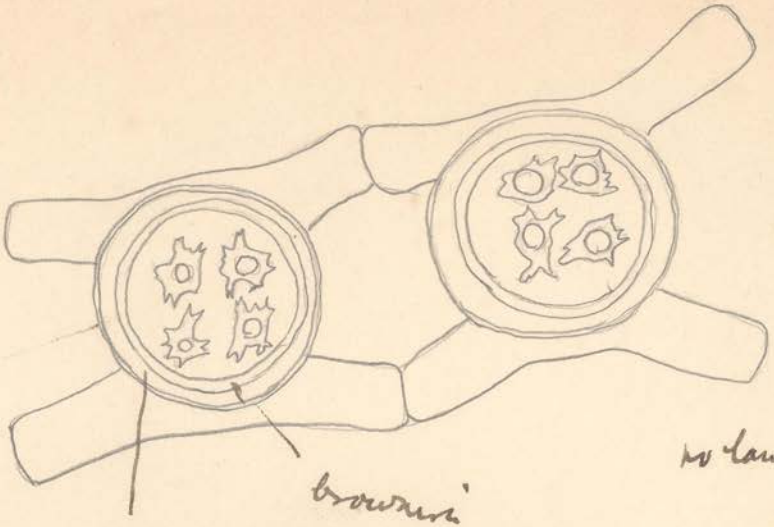
— 18

Cells 3–5 times as long as broad

6–8 μ broad

12–16 times as long





XI

eyespot.

light-blue
green wedge
& brownish
ring

yellowish
brown
matter

brownish
margin.

to lamellation
cell.

the remaining space
space is also colourless

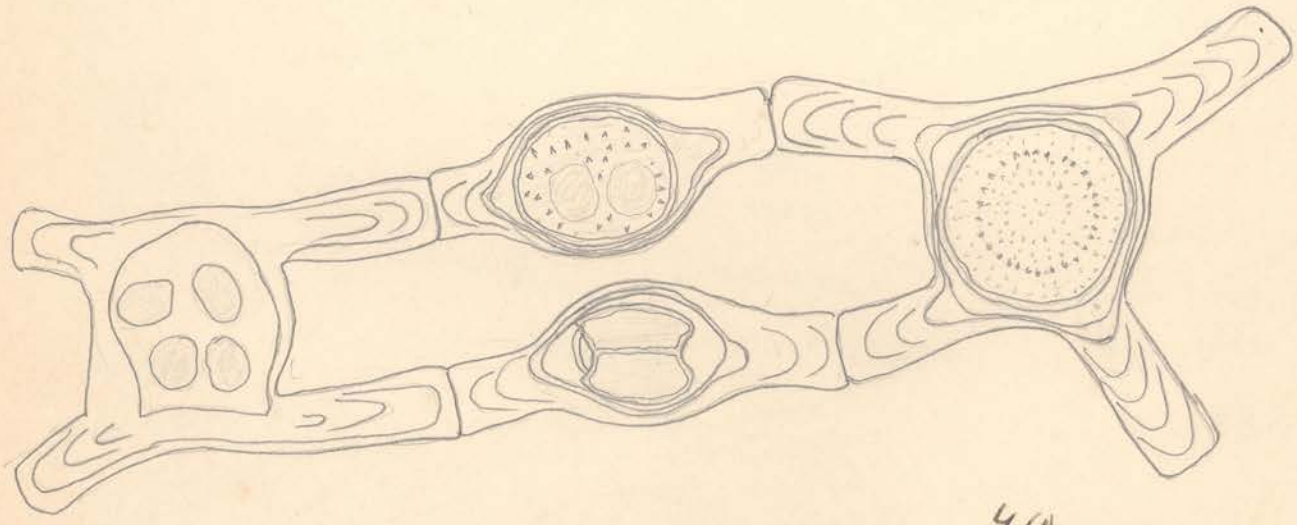
eyespot is colourless

18
25

11 | 4.
540
44
100

28-30
18
224
25
11 | 504 (46
44
64

IX X



46N - 50N - br.

Ektosome oglin
kidney-shaped
Atlas-Querschnitt

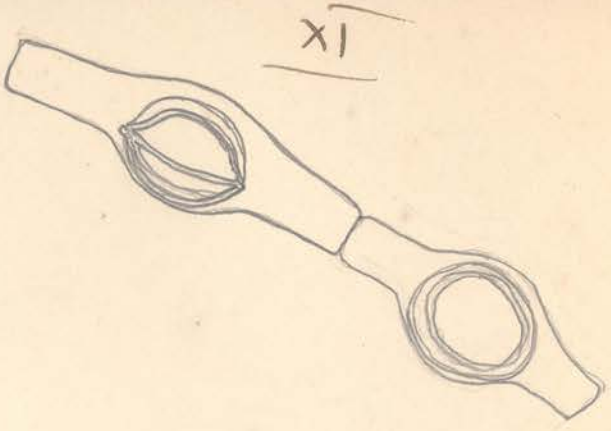
3 2N -
br.

54N long

Durchtrittsstelle
des Nervus hypo-
glossus

20-33
18
11 | 360
33
30 (33

Aplanospores.


XI


XII

Cysts. thick-walled
in early stages


XIII

Zygospores terminal
or on lateral
branches.


XIV

Spores. transparent yellow
in colour.

Aplanospores = 24 - 28 μ in diameter

Walls very thin
conspicuously
striated reticulations also seen

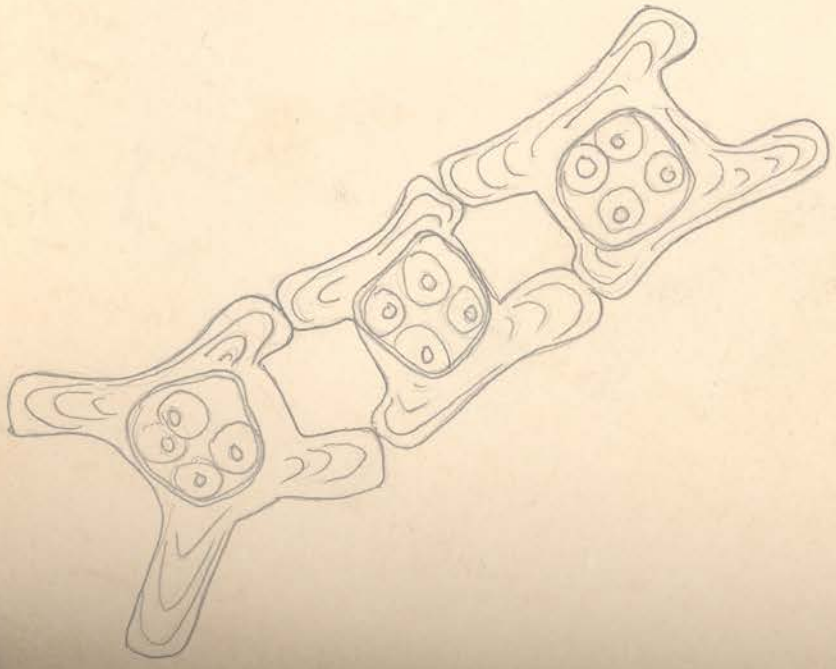
Zygnemopsis globosum

Zygnemopsis globosum.

Tunda Gud

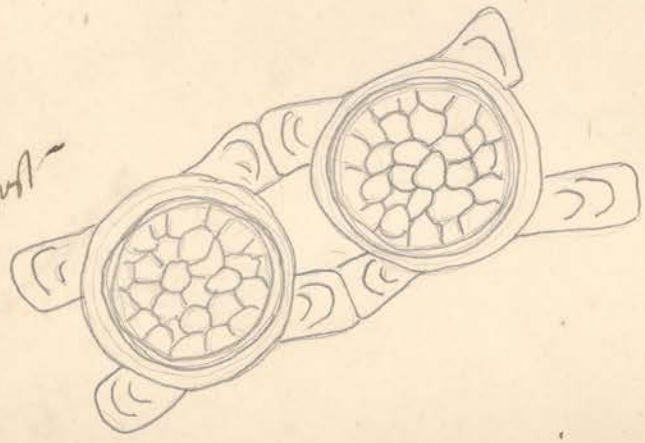
25 Th. Nov 37

Zygospore 36–40 μ diam.



Pandorina m. in surface of 2. media. (not-ma... also in ... Pitt... Immersed ... Some zygospores ... also parthenogenetic ...

2. globosum



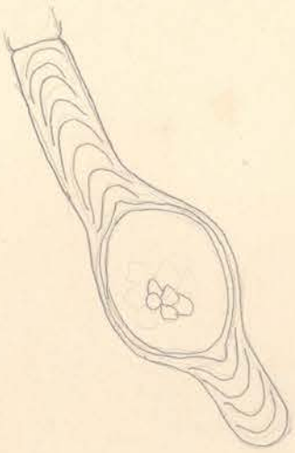
Reticulatum
4-6 N apart

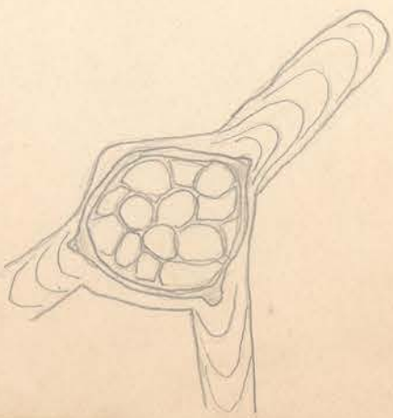
Two coats of adhesive
Thin ectospore – dark brown in colour
Thick endospore – dark brown, smooth
ectospore
endospore
Space between ectospore & perispore light brown in colour, reticulations

2 zygospores = 44-50 μ in diameter

Typically globose in shape. Many occasionally show oval & irregular forms

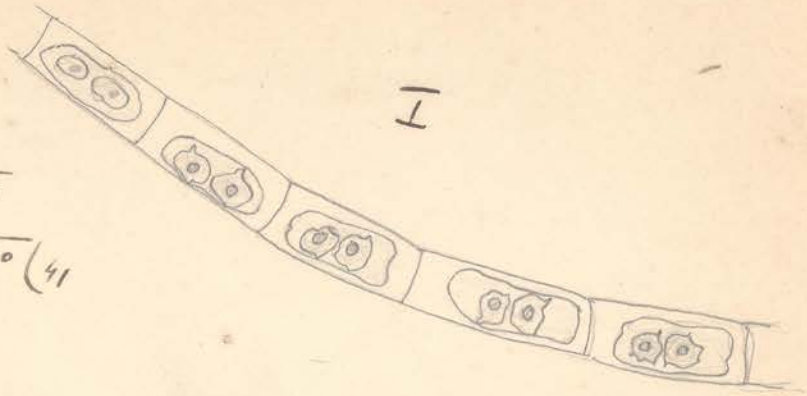
Z. globosum. sp. nov.



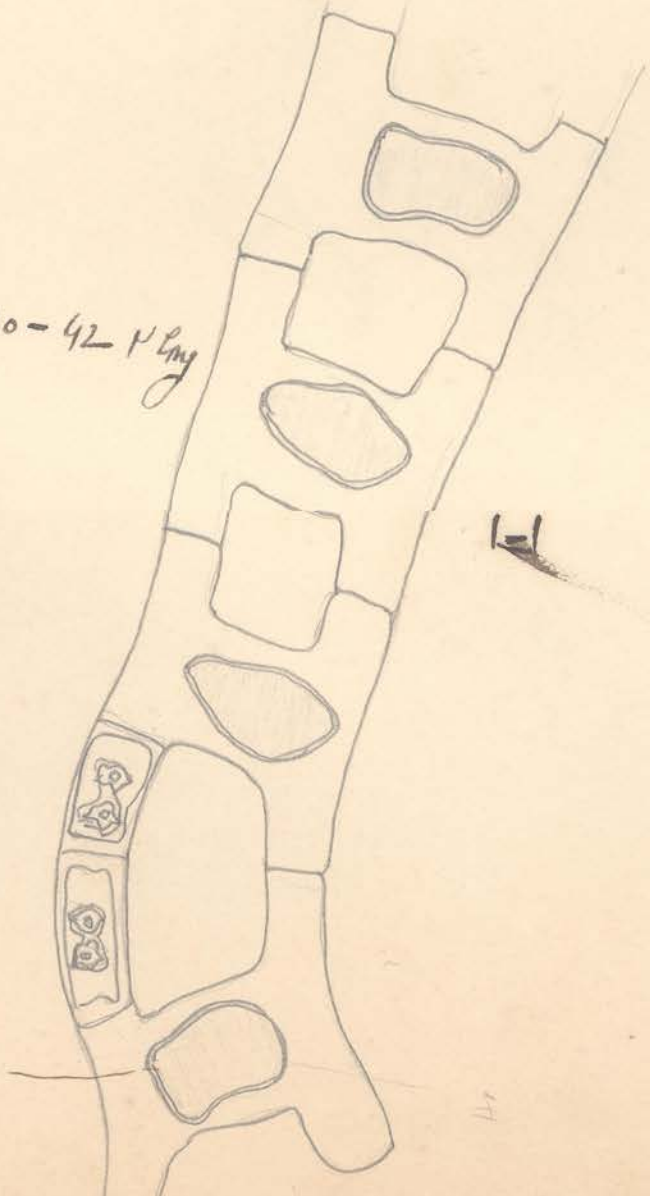


sp. nov.

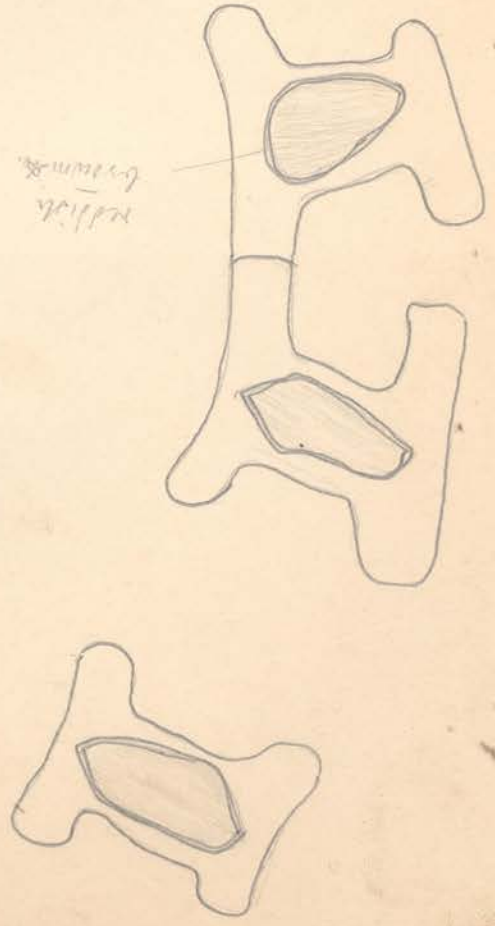
Zygnema splendens.
Rabenhorst



I



I



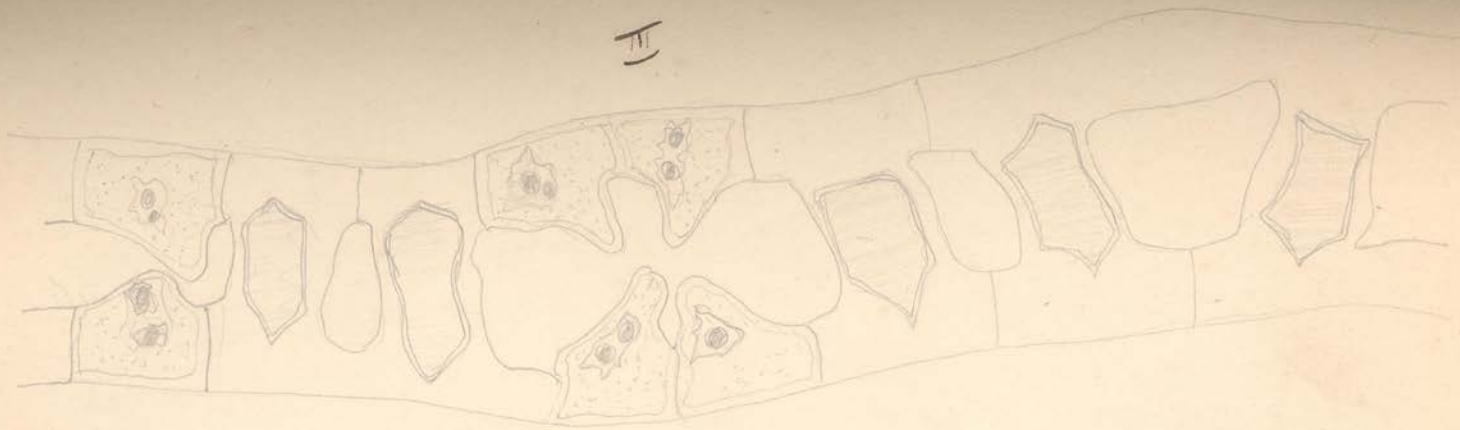
VI

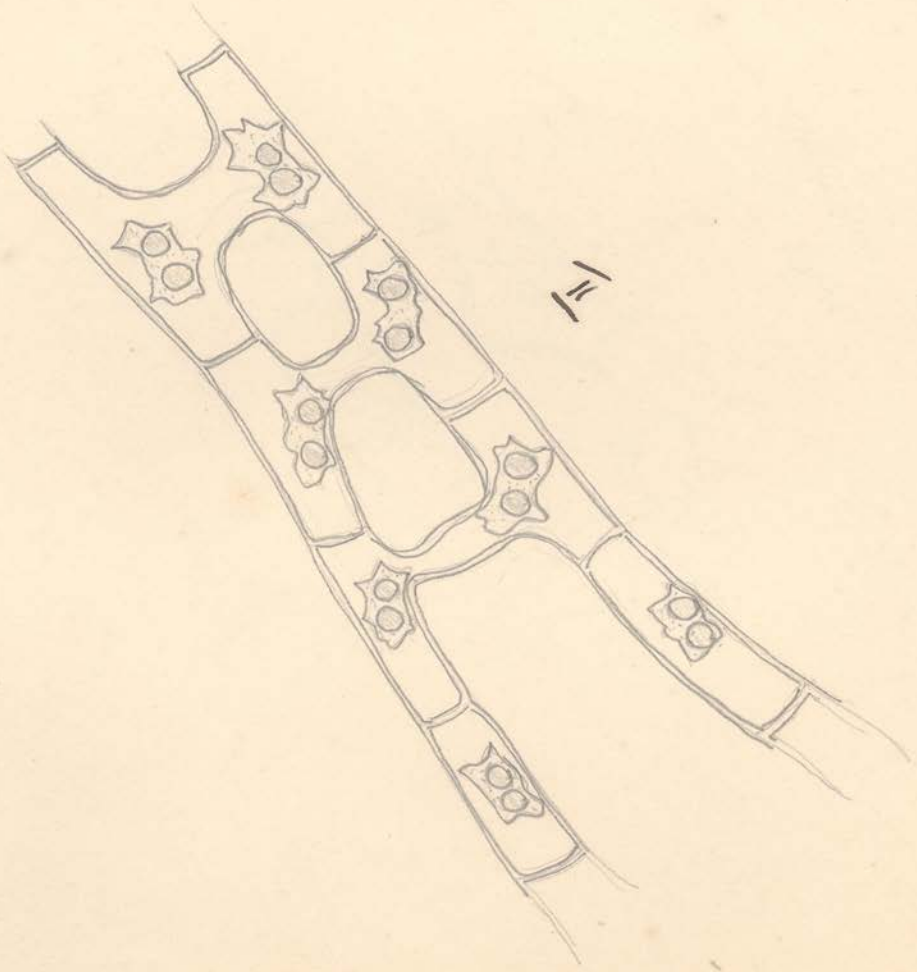
Zygospore: 30 – 42 μ long

Zygnema gracile.
n. sp.

Zygnema splendens.
Sp. nov.

II

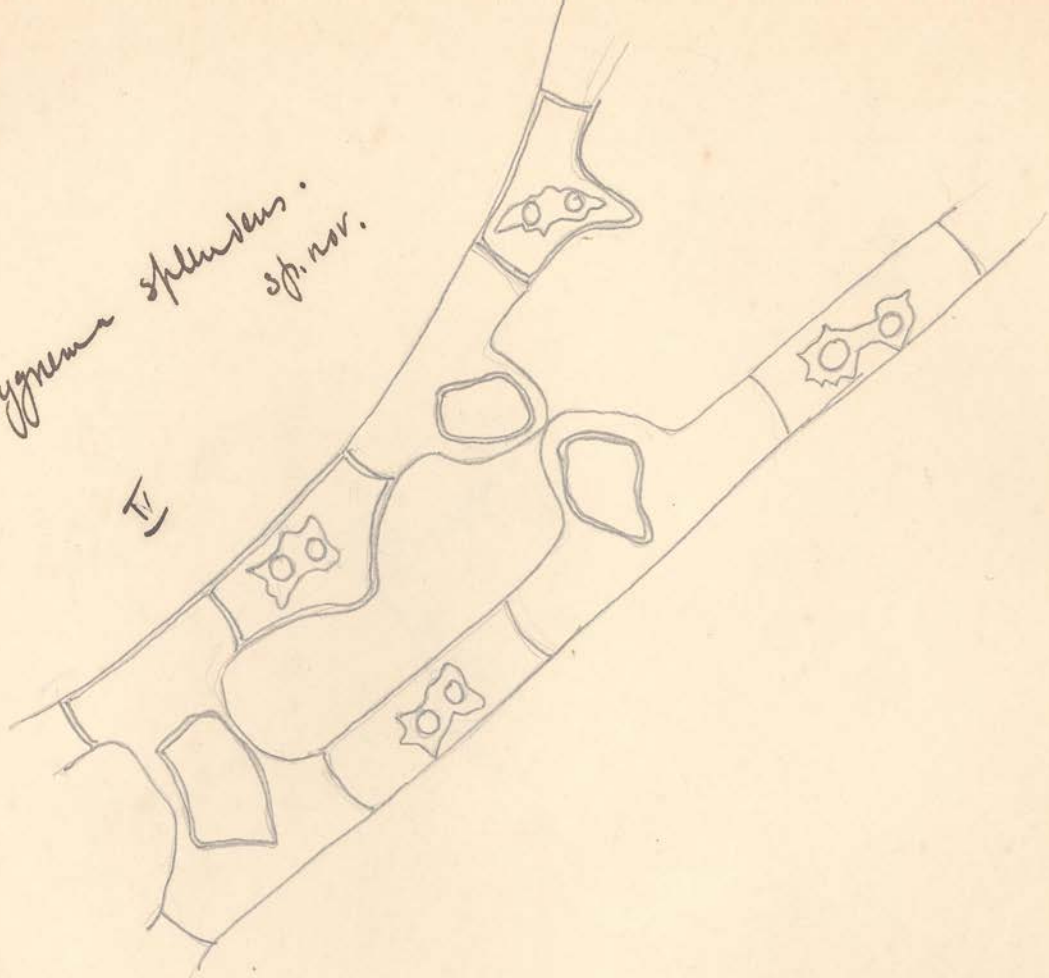




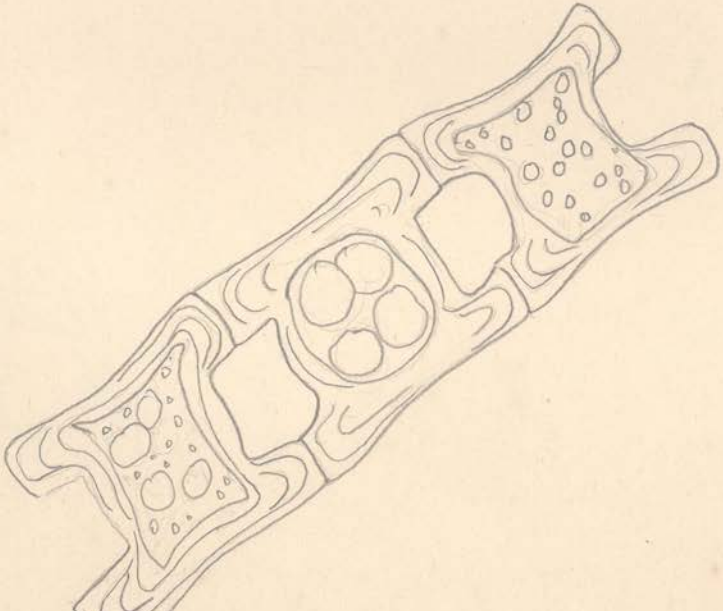
I=1

Zygnema splendens.
sp. nov.

IV



2. globosum sp. nov.



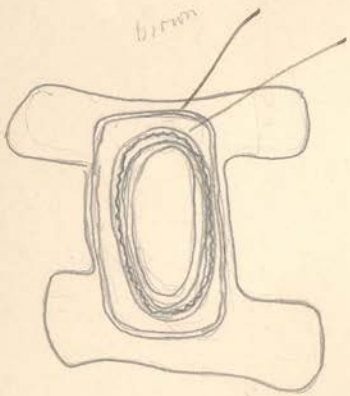
Rope shows
yellowish in
colour.

Two layers in wall.

Ripe Spores of Zygnemopsis

exospore light blue
brownish yellow
mucilage

mesospore - brown



Spore wall with much
reticulation on exospore

16 - 19

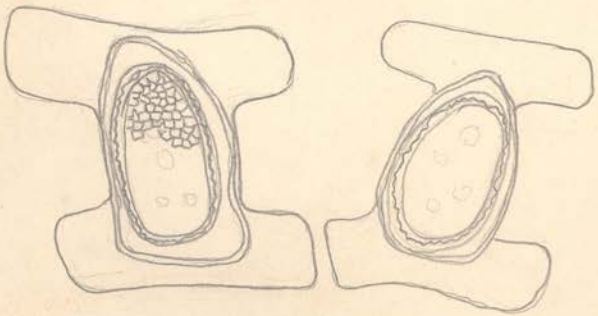
18
19
162
8
34 2 (31
8

18
15
108
18
258 (26
22
68

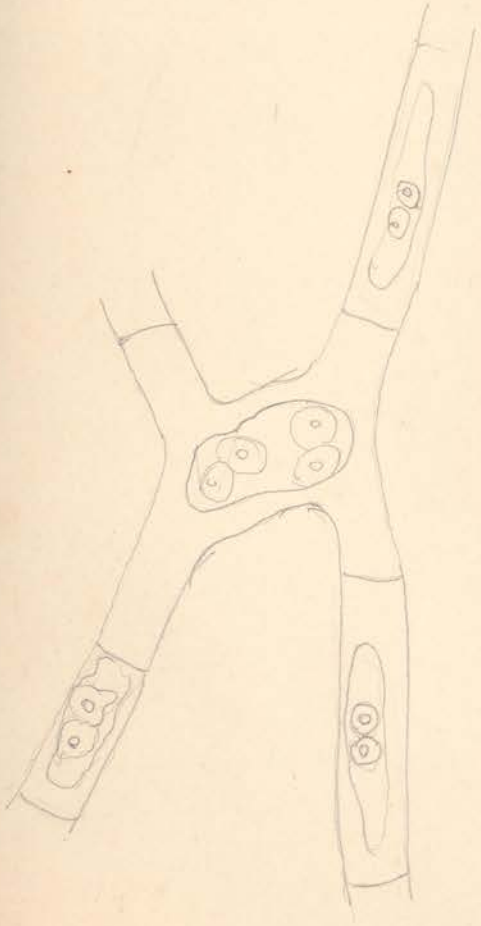
$\frac{15}{11} \times 19$

Zygnemopsis = 26 – 30 μ br.

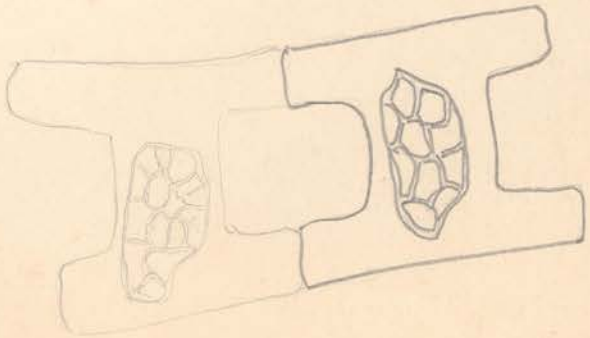
40 – 50 μ long



Zygnema splendens.
& f. nov.

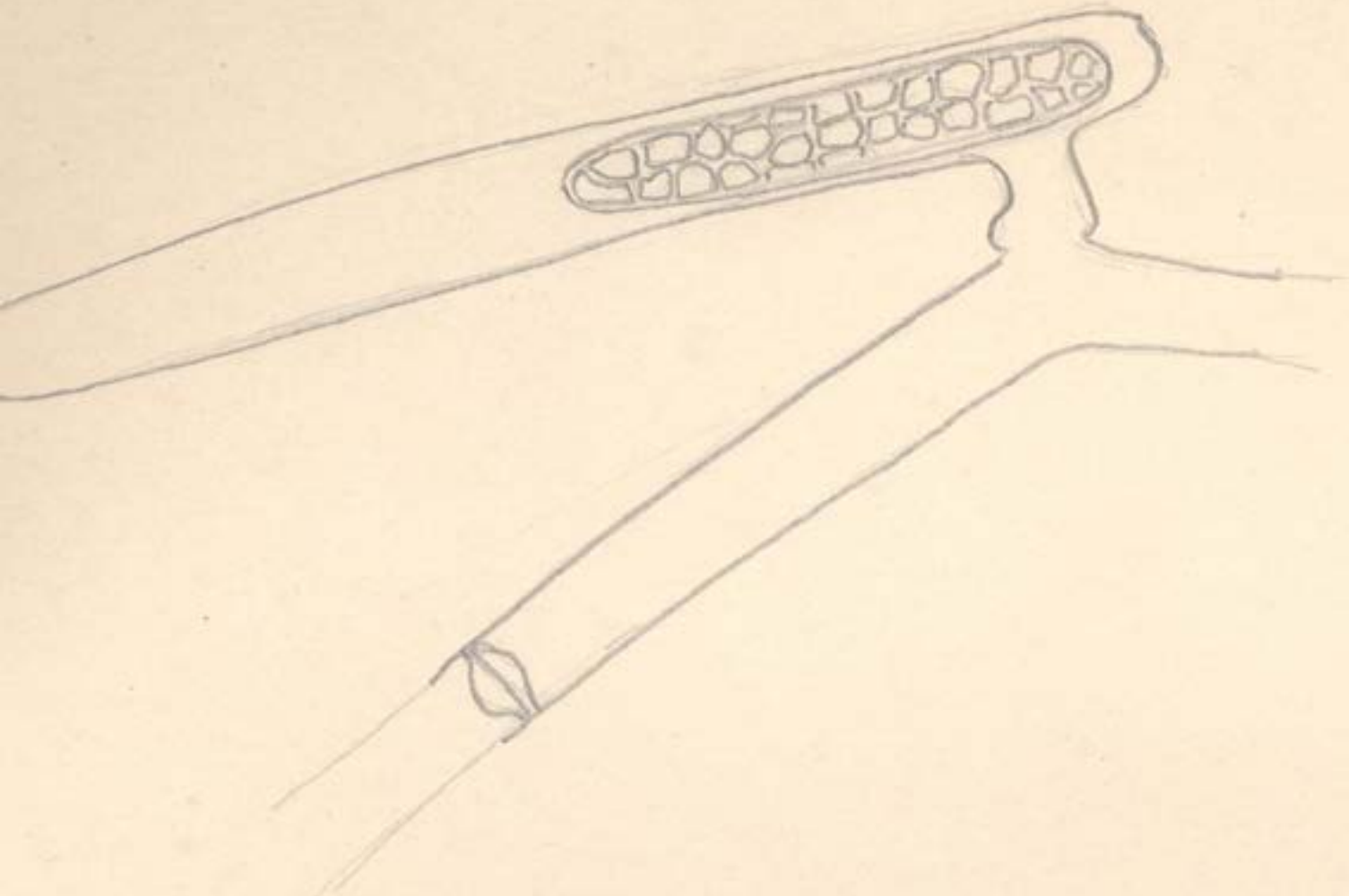


VII

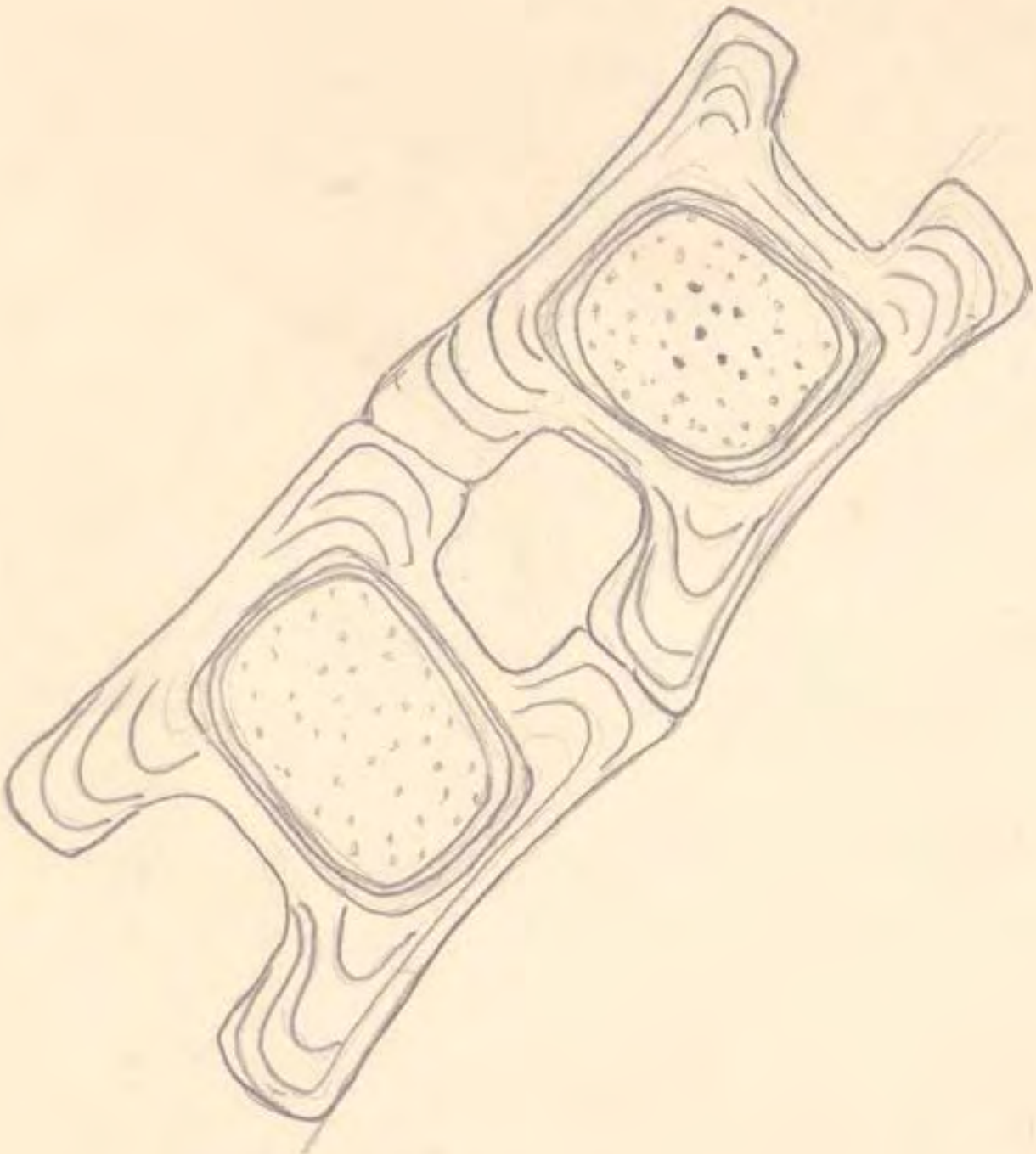


reticulation
in an outer
of zygospore

S. tiara. (Trans.

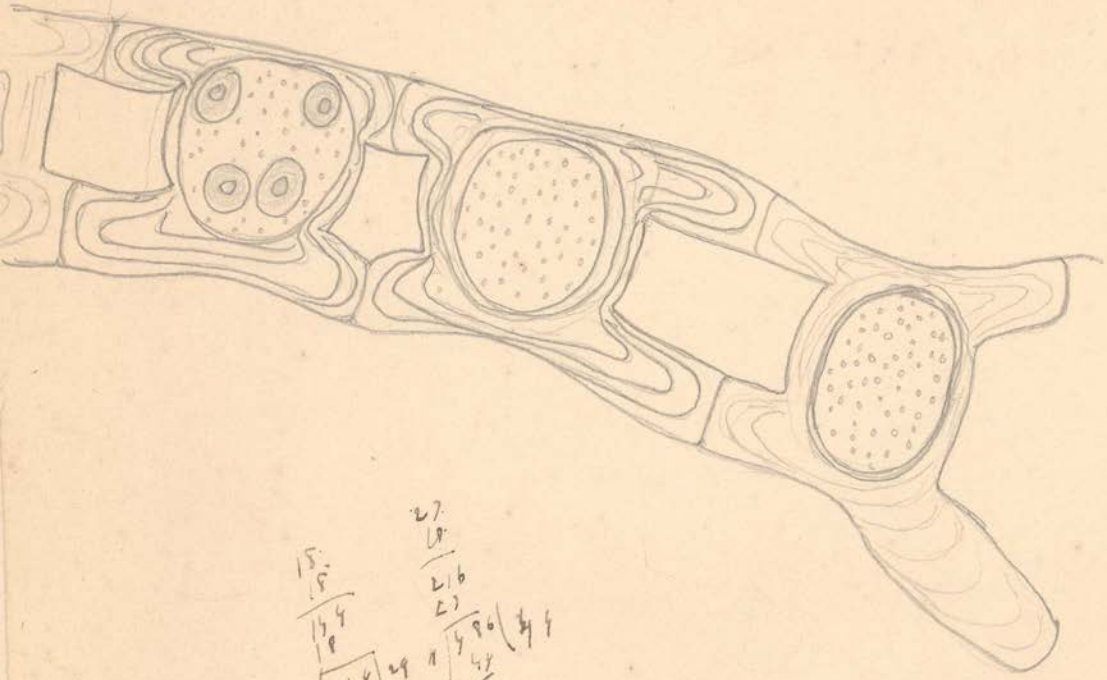


2. Sudica



2. nidica

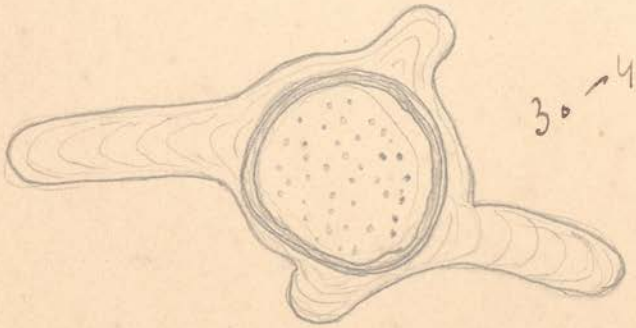
Glossella



exosporium - light

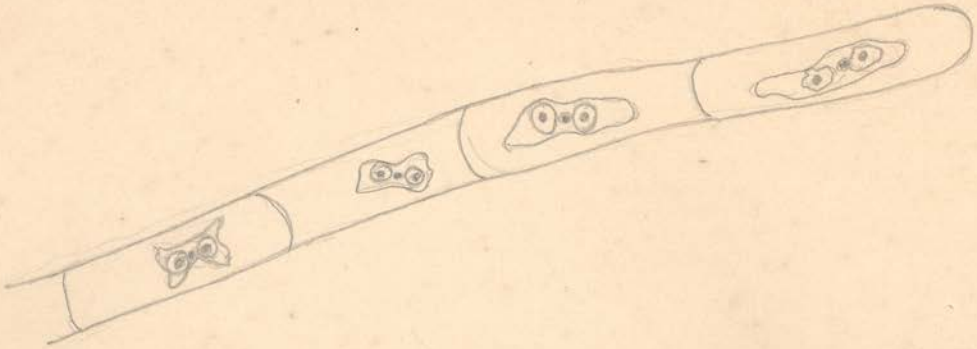
mesosporium - brown

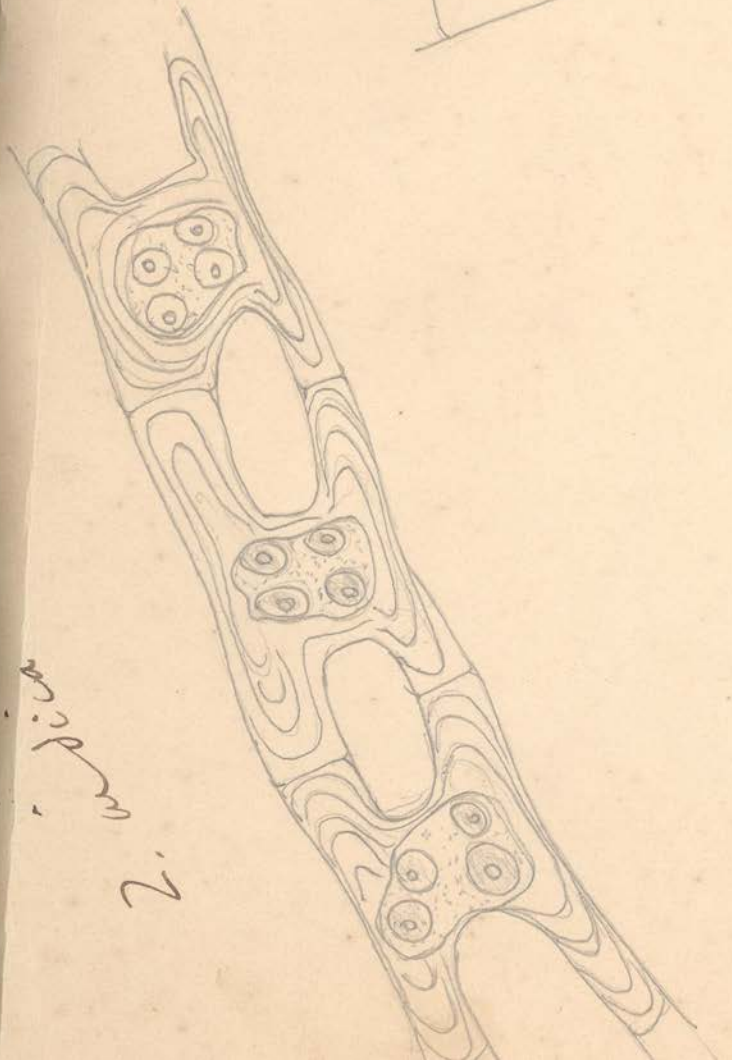
endosporium -

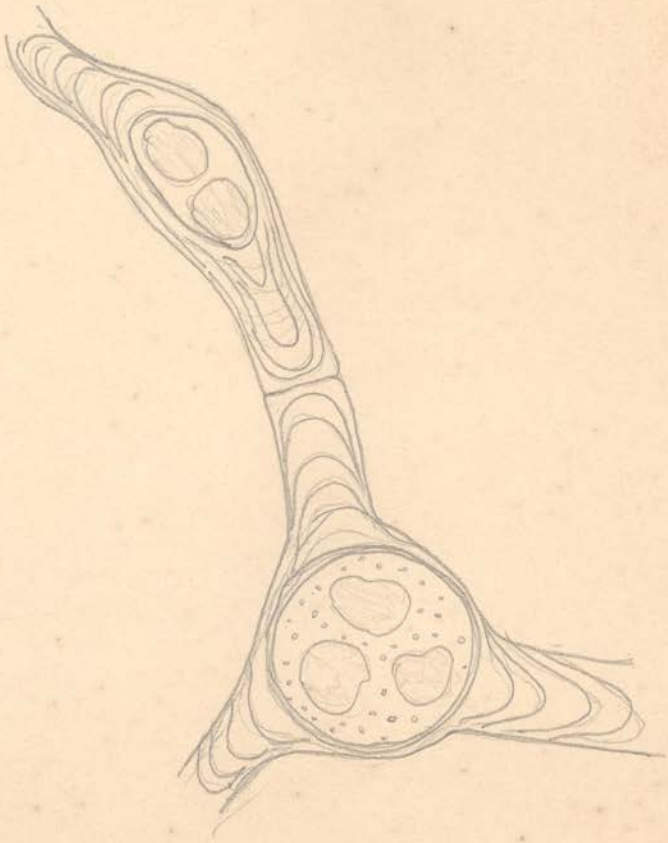


30-44 μ br.

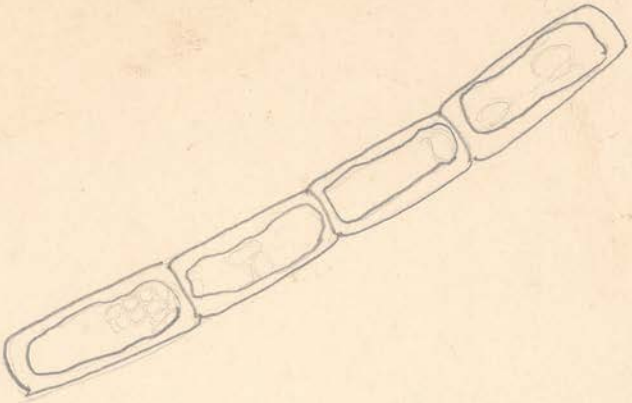
Ghozella indica . Kanth

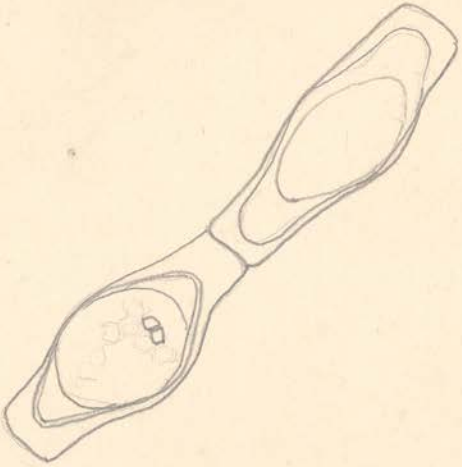


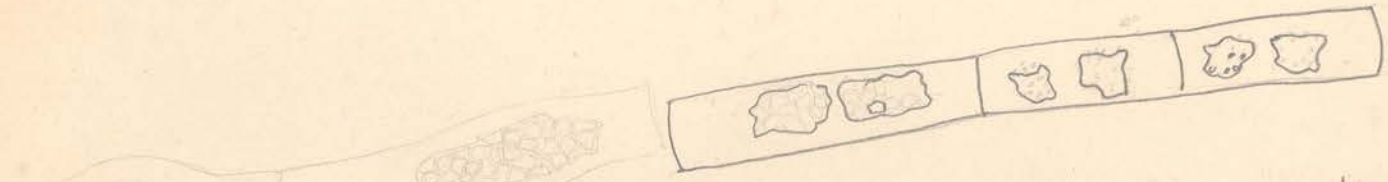


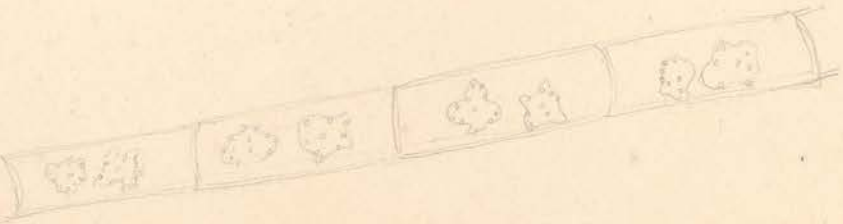


2. indica



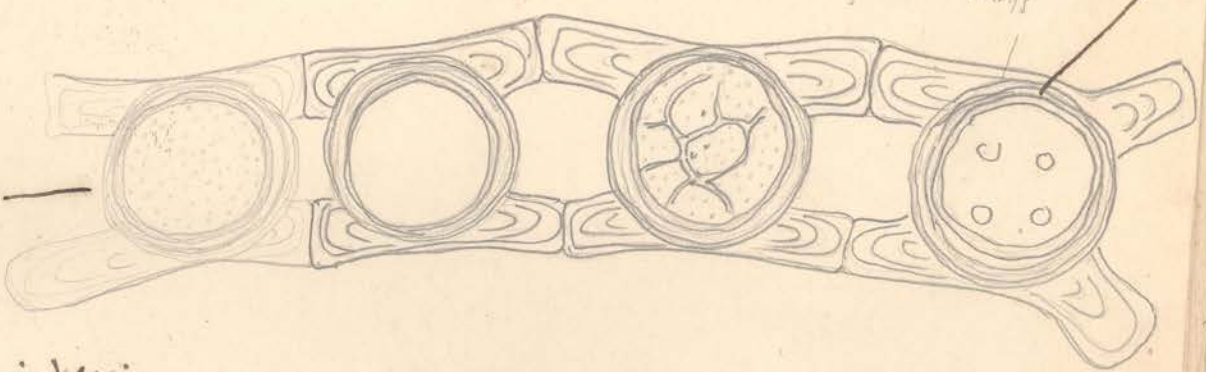




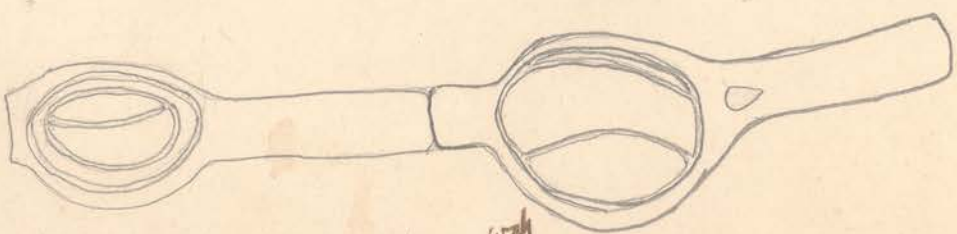


zygosphen. completely fill the
impression canals, the right zygosphen
winding into orbit wall of the
preceding one, which is lamellar
near its base.

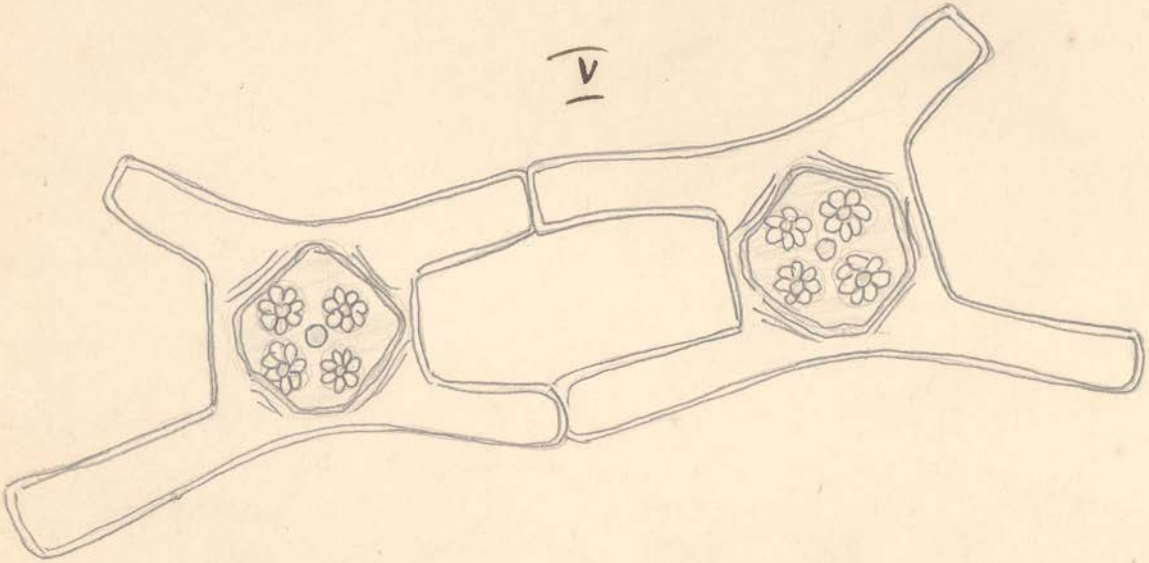
VII



VIII



V

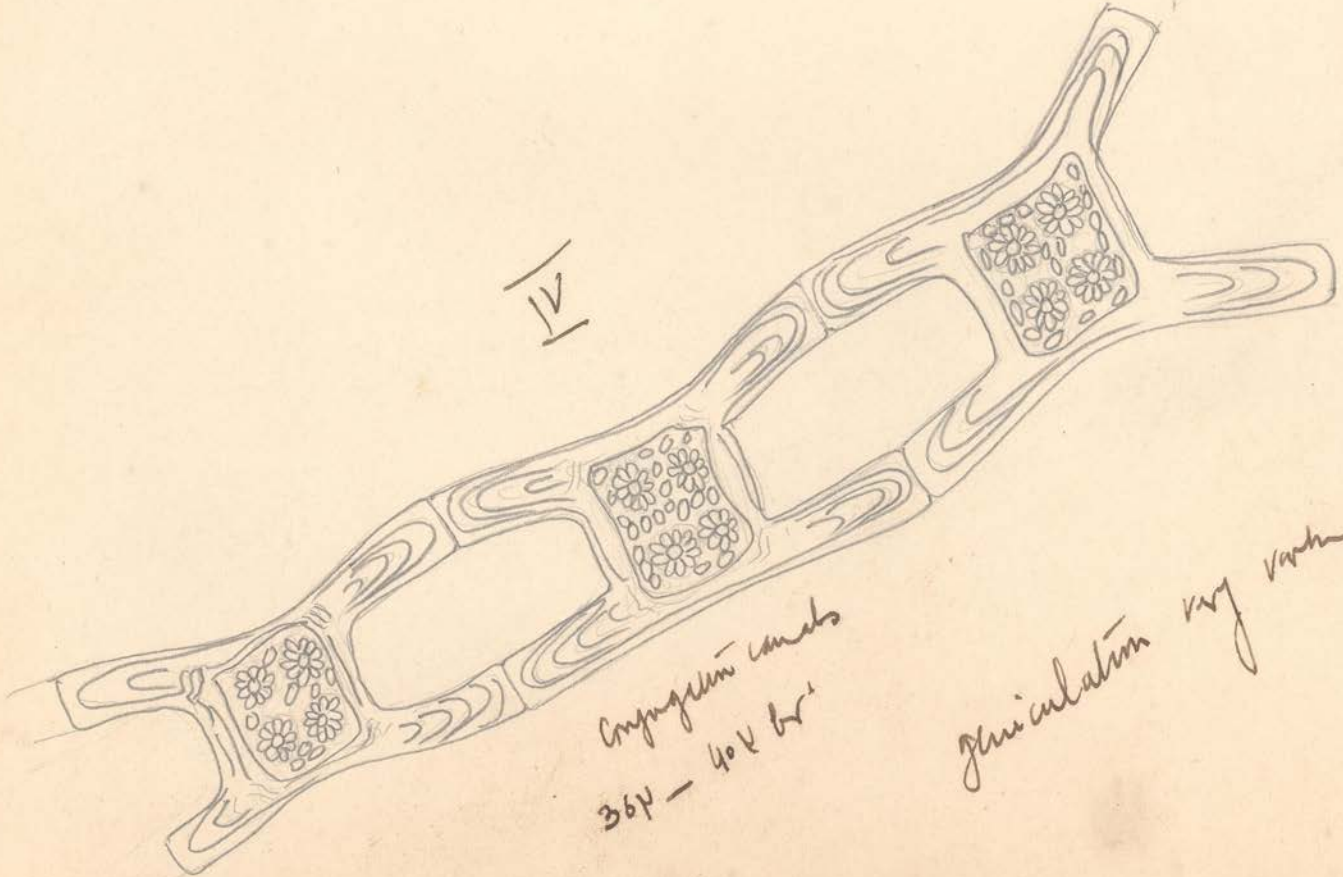


Conjugation canals = 46 μ long.

(II)

III

IV



Conjugation canals
36μ – 40μ broad

Circulation very rapid

11 = 18

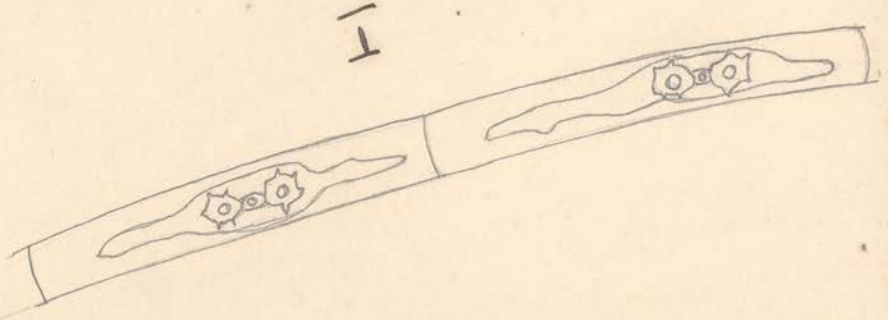
$$11 \overline{)144} \quad 13$$
$$11$$
$$33$$

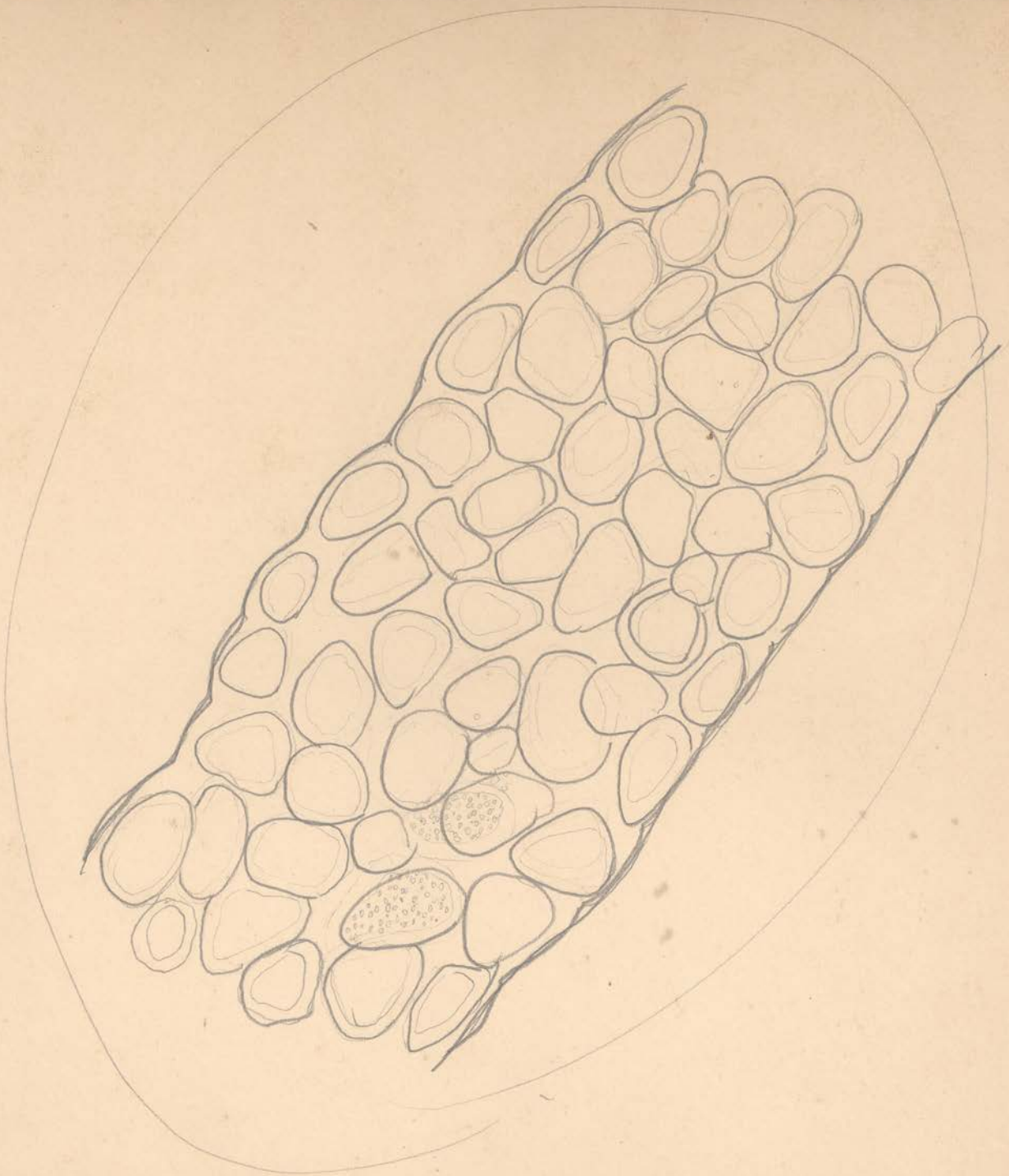
8 - 10

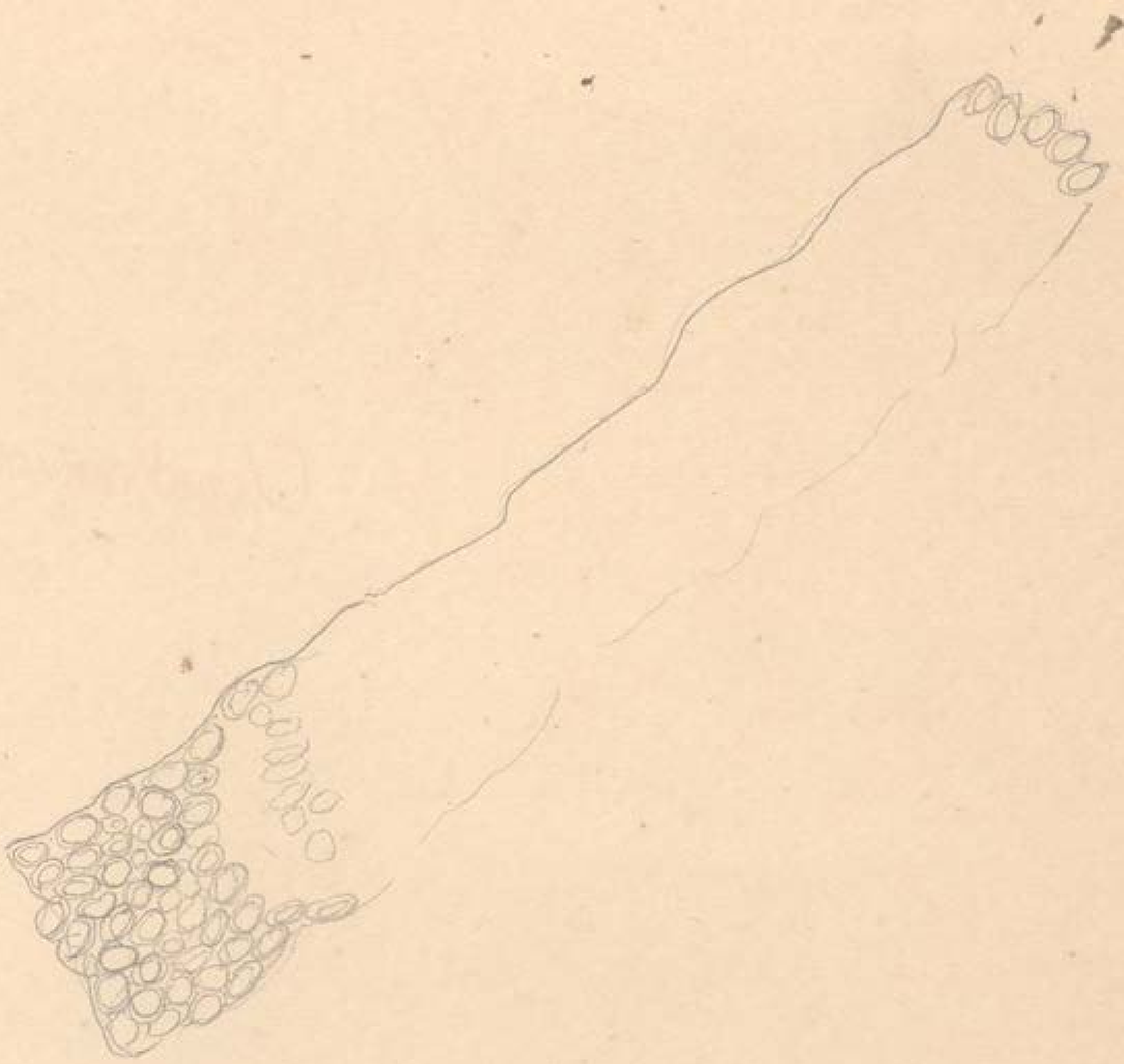
$$\frac{18}{11} \times 8 \qquad 11 \overline{)150} \quad 16$$
$$11$$
$$40$$

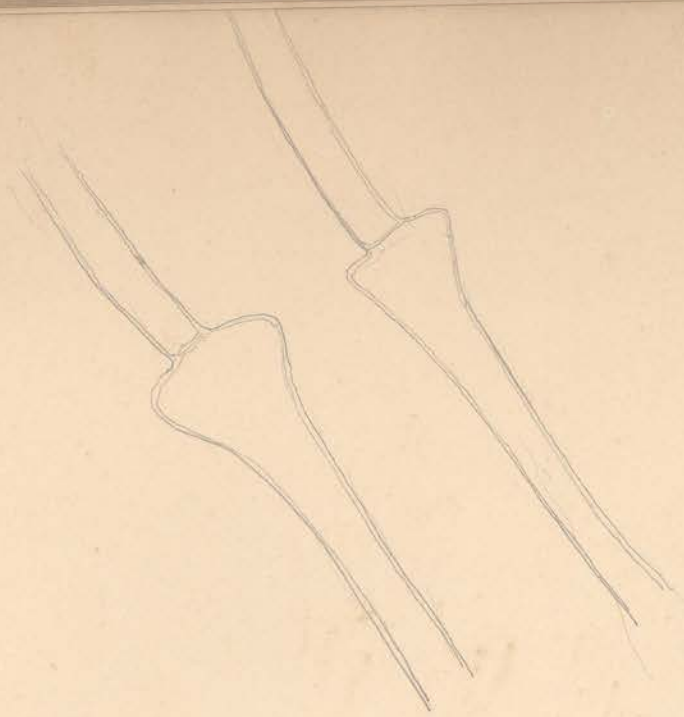
$$\frac{18 \times 16}{11}$$

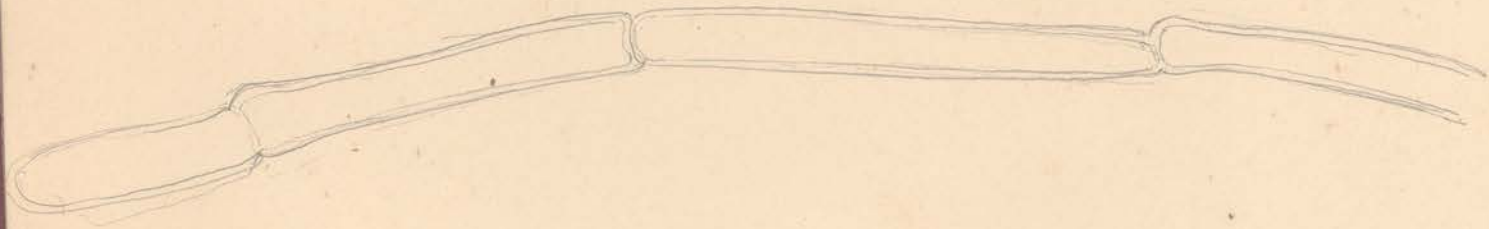
Vegetative allo 13 – 16 N broad
5 – 8 times as long



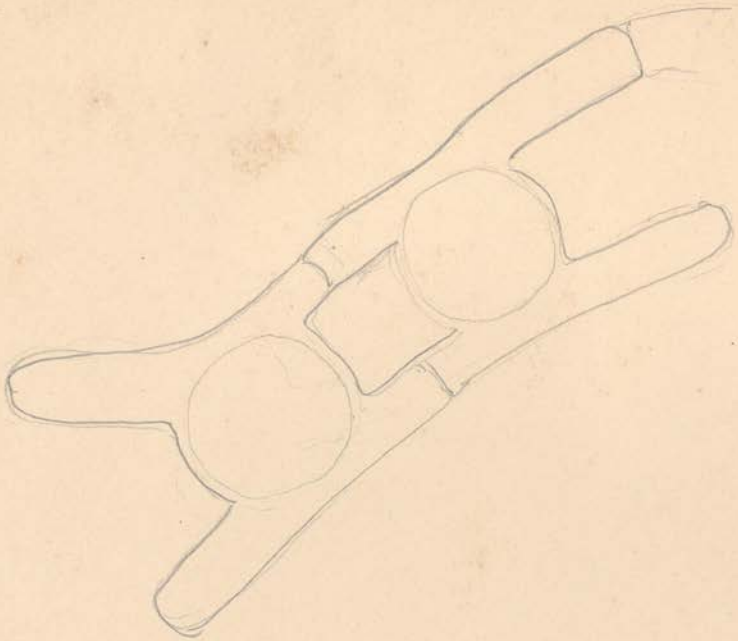


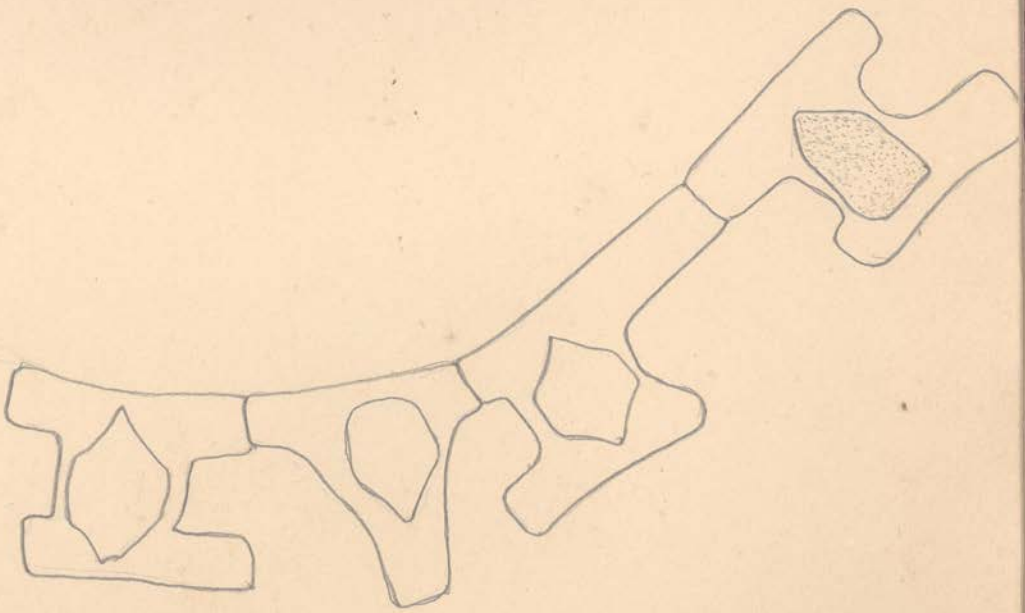






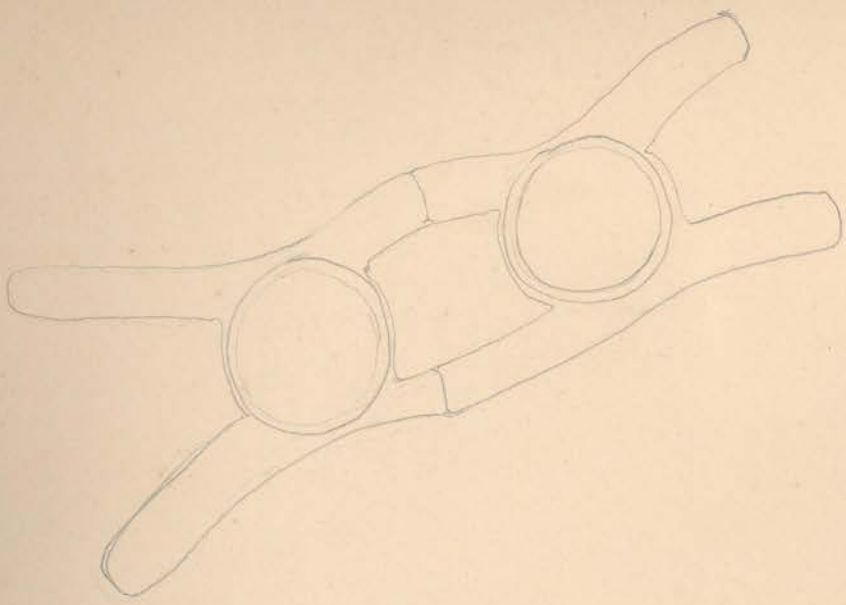
Z. sphaerospora · sp. nov.

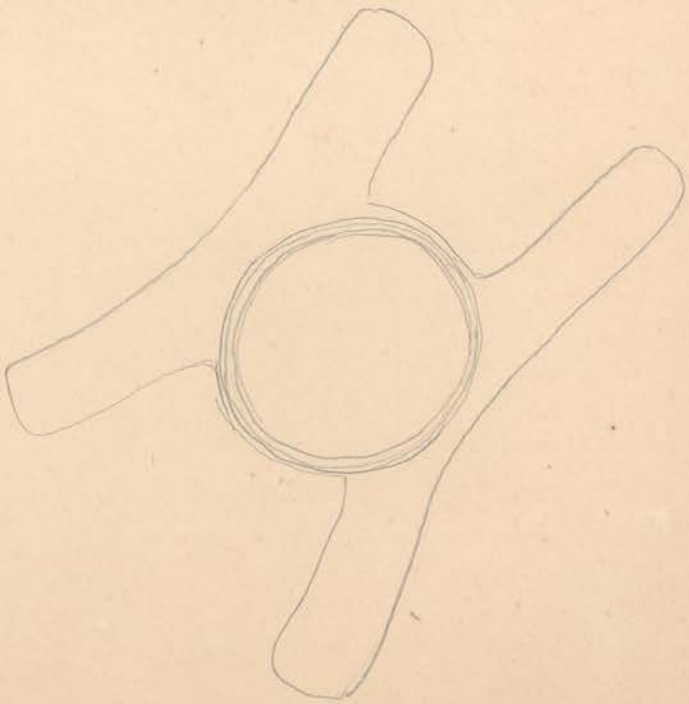




Zygnemopsis sphaerospora.

s/s-no v



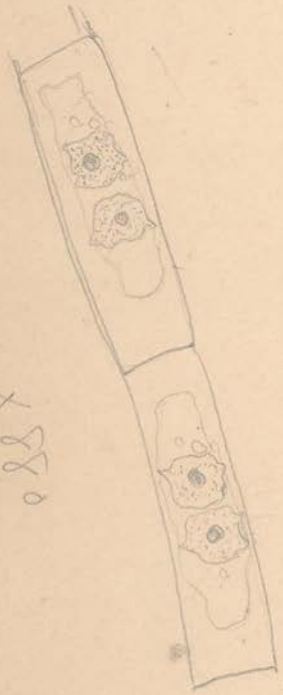


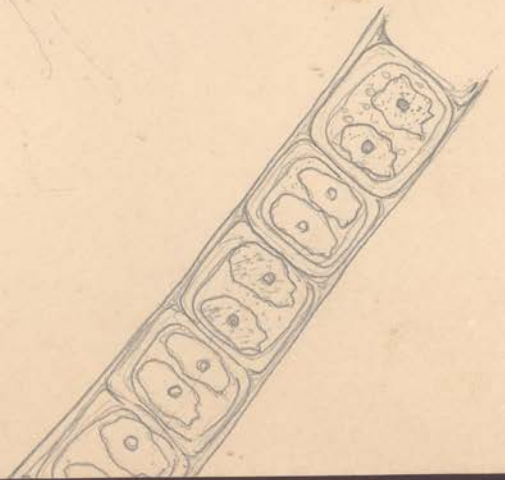
spores chocolate.

14-16 P N w
45-50 N long

14 N — 20 P long
20 N — 22

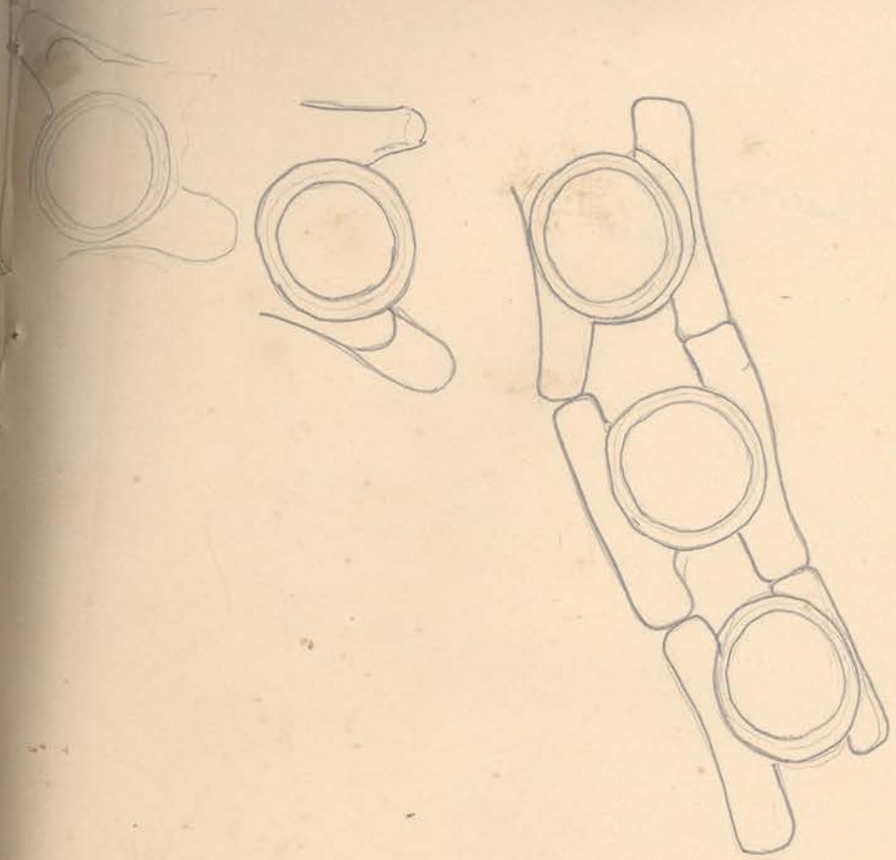
No abnormalities.





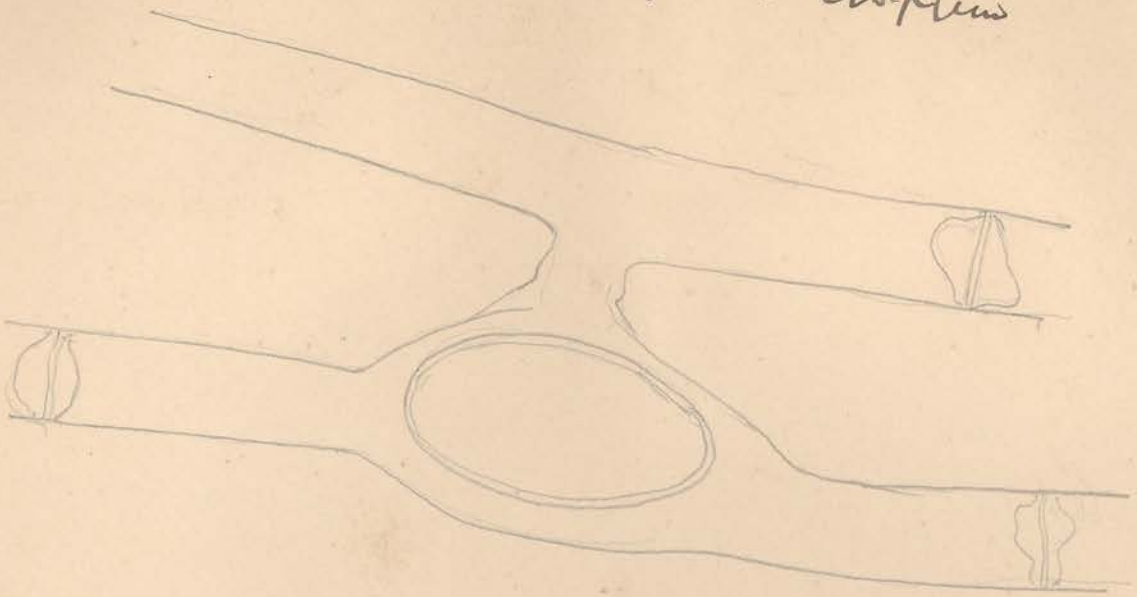
Zygnemopsis sphaerospora
sp. nov.

34- 38 P br.



2. Sphaeroplea sp. nov.

S. undaliscalus



22421