THE

PROCEEDINGS

OF THE

LINNEAN SOCIETY

OF

NEW SOUTH WALES

FOR THE YEAR

1923

Vol. XLVIII.

WITH FIFTY-TWO PLATES

and 438 Text-figures.

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(Issued 13th April, 1923.)

PART II. (No. 191.)

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PART III. (No. 192.)

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PART IV. (No. 193.)

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PART V. (No. 194.)

(Issued 15th February, 1924.)

LIST OF NEW GENERIC NAMES PROPOSED IN THIS VOLUME (1923).

CORRIGENDA.

Through an error in numbering, the first two plates accompanying the paper by Marjorie I. Collins in Part 3 of the Proceedings were numbered xv. and xvi., which two numbers had already been given to the two plates accompanying the paper by Professor A. Anstruther Lawson in Part 2.

Plate xlviii.—Reverse block of figure 4.

LIST OF PLATES.

PROCEEDINGS, 1923.

(*Issued 15th June, 1923.*)

Vol. XLVIII.
Part 2.

No. 191-193

THE

PROCEEDINGS

OF THE

LINNEAN SOCIETY

OF

NEW SOUTH WALES

FOR THE YEAR

1923

Part II. (*pp. 1-204.*)

CONTAINING PAPERS READ IN
MARCH-MAY.

WITH FOURTEEN PLATES
[Plates iii.-xvi.]

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NOTES ON FRESHWATER ALGAE.*

By the late G. I. Playfair.

(Thirty Text-figures.)

[Read 27th June, 1923.]

i.—Chlamydomonas globosa *Snow, and allied forms.*

It was during the summer of 1918 that I obtained a pure culture of this species under rather curious and interesting circumstances. A small enamelled-iron pie-dish, with scraps of fish adhering to its sides, had got adrift on an almost horizontal corrugated iron roof situated in the very heart of the business portion of Lismore (N.S.W.), where it was exposed to the full blaze of the sun throughout the greater part of the day. The month of March (summer) opening with alternate heavy rain and hot sunshine, on the 3rd the dish was noted to be full of rainwater, on the 10th the water showed a yellow tint which next day had deepened to pale yellow-green. Besides, there was a certain amount of yellow-green sediment at the bottom of the dish, and scum on the surface of the water.

An examination made on the 11th with a 1-12 homog. imm. objective revealed a culture of *Chlamydomonas globosa* Snow, easily recognized by its minute size, spherical shape and general delicacy of appearance. The cells were commonly of diam. 4-8μ, some motile, some non-motile, very transparent, the chloroplast very delicate and homogeneous, a few small amylaceous granules round the central core of the cell. A few cells were larger, diam. 10-12μ. Pyrenoid distinct; also stigma midway between the poles; cell-membrane very thin, invisible.

Here and there spherical mother-cells (diam. c. 25μ), with 4 autospores of diam. 7μ arranged tetrahedrically, revealed the method by which the rapid growth of the culture had been attained.

Chlamydomonas globosa was first noted in the plankton of Lake Erie and has generally been considered a distinctively plankton form. However I find it quite common after rain in all sorts of places, *e.g.*, roadside puddles, small pools, duck-ponds, swamps, and even enmeshed in filamentous tufts on grass lands or in fungoid growths on dead sticks in standing water. It is not any particular habitat that conduces to the development of plankton forms but an abundant

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[*The manuscript of this paper was completed by the author just before his death in October, 1922. The drawings, however, were not complete, only a number of rough sketches having been prepared. The figures illustrating the paper have been drawn from those rough sketches.—Ed.]

supply of water, either from the natural environment, or from rain, or from surface drainage.

The occurrence of a culture in quantity in a domestic cooking utensil which had never previously held even garden soil and which was far removed from any source of infection, shows how wind-blown the resting cells of the fresh-water algae may be.

Var. MACULATA, n.var.

Forma membranâ tenuissimâ; chloroplastidibus maculatis vel scrobiculis notatis. Cetera ut in forma typica. Specimina parva granulis (ut videtur) aspera. Diam. 10-12, vel 13-16μ.

Intermingled with the type were cells showing very distinctly a spotted or pitted chloroplast. The cell-wall being very delicate, this caused the smaller specimens to appear granulate.

CHLAMYDOMONAS OVATA Dangeard.

Mém. sur les Chlamyd., p. 147, f. 17; *cf.* Wille, Gatt. Chlamydomonas in Algol. Notizen, ix.-xiv., 1903, p. 133, T. iv., f. 3.

Var. PULCHRA, n.var.

Cellulae lenticulares, utroque polo subacutae; lateribus aequaliter arcuatis. Long. 18, lat. 9μ.

A still later examination of the culture revealed no new development, but brought to light this beautiful and interesting form which seems to be too near Dangeard's *Chl. ovata* to be separated from it.

Cells broadly lenticular in face view, with subacute ends and evenly arched sides, stigma not noted. From the shape of the mother-cell it would appear that this is a form produced by longitudinal self-division of a spherical cell into 4 parts. In Dangeard's original figure (reproduced by Wille, *op. cit.*) the chloroplast seems to be disarranged and to have shifted round to the side of the cell, probably with a view to a *transverse* division. There would thus be produced 2 spherical cells on a smaller scale. Self-division in two directions is common enough in the freshwater algae generally.

No dimensions are given for *Chl. ovata*, but the figures work out at:—Long. 19, lat. 8-8½μ.

CHLAMYDOMONAS SNOWII Printz.

Skr. Vidensk-Selsk. i. Kristiania, Mat.-Naturv. Kl., 1913 (1914), No. 6, p. 18.

Along with *Chl. globosa*, Miss Snow found and described (Bull. U.S. Fish. Comm., 1903, 22, p. 388, Pl. i.) another species, viz.: *Chl. communis* Snow. That name being preoccupied, the form has been renamed as above. The latter, however, is really an oval or oblong variation of *Chl. globosa*. I find them always together. In the above natural culture this form was present in quantity; dimensions long. 7-10, lat. 5-7μ, stigma a little above the centre and the cells oblong rather than oval.

It is quite the usual thing for a spherical species of *Chlamydomonas* to have an oval or oblong variation. Thus of *Chl. globulosa* Perty as commonly found here (diam. 14-25μ) Wille, *op. cit.* says "Die Zellwand der Zoospore ist kugelrund oder schwach ellipsoidisch" . . . . . I have myself figured that of *Chl. monadina* (Austr. Frw. Phytopl. These Proceedings, 1917, Pl. lvi., f. 16). Compare also

Chl. maculata Playf. (These Proceedings, 1918, Pl. lv., f. 15, f. 19 and f. 18); the last being obviously intermediate between the other two.

An ovate form of this type is described below.

Chlamydomonas taurangensis, n.sp. (*vide infra*) was present also.

ii.—*Examination of certain green fluffy growths.*

On February 13th, 1920 (summer) after heavy rains, my attention was drawn to certain green fluffy tufts adhering to grass blades in rainwater pools on a piece of meadow land previously quite dry. Minute observation of such growths often brings to light new, rare or interesting forms of life, besides affording much useful information.

a.—In this case the green tufts proved to have as a foundation a mass of infantile filaments of *Oedogonium* sp. so unformed as to be hardly recognizable, except by their characteristic flecked chloroplasts and a slight enlargement of one end of certain cells.

The *Oedogonium* cells began to form zoospores. One or two cells near the end of a filament twisted at right angles, the filament broke across and the contents of the cell gradually drew out. Occasionally the inner portion of the cytoplasm lagged behind but was later absorbed. There was no fusion of the cell-contents, they remained disposed exactly as in the cell with a small central nucleus plainly visible and a small pyrenoid at each end. In general, the shape of the zoospore is more or less oval or long ovate, but a cylindrical form was also noted. In front it is produced into a large ciliated papilla of clear homogeneous protoplasm. No stigma, no pulsating vesicle nor chlamydomonadine structure observed. Size of zoospores:—long. c. 30, lat. 15μ. They soon settled down to form new filaments.

In a gathering of *Cladophora* sp. made at Tauranga, N.Z., on January 3rd, 1922, the subsequent development of these zoospores was noted. They form *Characiopsis*-like resting cells, from the apex of which young *Oedogonium* filaments push out. Dimensions of resting cells:—long. 20-40, lat. 8-18μ; they are more or less oval, adhesive disc distinct, chloroplasts finely granular, sometimes obscurely divided into four parts, no pyrenoids visible. When devoid of contents they cannot be distinguished from *Characiopsis*.

b.—Entwined among the *Oedogonium* filaments, *Leptothrix* threads in quantities were busily breaking up into *Spirillum volutans*.

c.—*Chlamydomonas globosa*, vegetative cells in quantity attached to an almost invisible hyaline membrane; cells rapidly becoming motile; diam. 3-10μ, globular. Var. *maculata* mihi also present, as well as *Chl. Snowii* Printz (*see* above); dimensions:—long. 10, lat. 6μ, with huge pyrenoid (diam. 3μ), half the breadth of the cell.

d.—CHLAMYDOMONAS MUCICOLA Schmidle.

Algenflora d. Schwarzwaldes u. d. Oberrheins, vi., 1897, p. 17-19. T. ii., fig. 4-8; *cf.* Wille, Gatt. Chlamyd. (Alg. Notizen, xi., p. 136, T. iv., fig. 6).

Var. ROTUNDATA, n.var.

Forma cellulis sursum rotundatis, papillâ nullâ; stigmate distincto, paullo supra mediam; pyrenoidi maximâ ad latus dispositâ. Long. 9, lat. 4½μ.

Differs from the type in being rounded above, not acuminate, and without the apical papilla. A stigma too is distinctly visible a little above the middle and the pyrenoid very large, quite half the width of the cell. It does not lie in

the lumen of the cell (though it may appear to do so when the latter is in a certain position) but is placed laterally. This *Chlamydomonas*, which I now observed for the first time, was present in quantity, cells both motile and non-motile. The body is rather irregular in outline, varying from elliptic to long-ovate, often with unequally arched sides, probably the result of longitudinal self-division. Chloroplast bag-shaped, with pyrenoid median and lateral; and the nucleus at the hinder end of the cell. Schmidle gives as dimensions:—long. 6-8, lat. 3-4μ.

A very similar species is *Chl. Kuteinikowi* Goroshankin (Morph. u. System. d. Chlamyd., 1891, p. 117, T. ii., fig. 9-13) which has a thin laminar chloroplast and distinct median stigma, but is double the size. I hesitated for long whether or not to place our form under Goroshankin's type as the latter has priority. I was only decided by the dimensions.

e.—Spondylomorum quaternarium, var. *rostratum* Playf. (These Proceedings, 1918, p. 526, Pl. lvi., fig. 16, 17). Minute 8-celled coenobia noted, only 16μ in diameter.

f.—Euglena pisciformis var. *granulosa*, n.var.—(*See* Note xix., p. 223.)

iii.—*Ulothrix quaternaria*, n.sp. (Text-figs. 1-5.)

Ulothrix filamentis longam massam cericeam saturate viridem formantibus. Fila latitudine 7-9 (rarius 10-11) μ ad septa haud constricta; apicibus acute conicis; cellulis plus minus quadratis (7-12μ alt.) diametro 1-1½ plo longioribus; vel cylindraceis (17-28μ alt.) diametro 2-4 plo longioribus. Chloroplastides parietales, pyrenoidibus 2-4 (rarius 6) transverse geminatis dispositis (plerumque 4 per quadrum ordinatis). Zoosporae globosae, ovatae, vel fusiformes, long. 8-21, lat. 7-10μ; flagellis 4.

Forma angustissima; filis latitudine 4μ, cellulis cylindraceis (10-30μ alt.) diametro 2½-6 plo longioribus, polos adversus pyrenoidibus singulis.

This plant I noted first in January, 1918 (summer) forming deep green silky skeins in a cement water table near the Post Office, Lismore. There were yards of it, and it could be taken up by the handful; the water was quite warm to the touch. The filaments were 8μ in diameter (rarely 10μ) not constricted at the septa; cells varying from quadrate (12-15μ alt.) to cylindrical (generally 21-25μ alt.) 2½-3 times longer than the diameter. In general outline it very much resembled *Microspora stagnorum* (Kütz.) Lagerh. in Hazen, *Ulothric.* and *Chaetoph.* of the U.S., Pl. 24, f. 13. Besides it answered very well to the description of *Ulothrix subtilis* Kütz. (in Rabhenhorst, Fl. Eur. Alg., iii., p. 365) now considered a species of *Stichococcus*. However, on mashing up some filaments on a glass slip, no H-pieces showed in the broken cells which also refused to dissociate at the septa as in *Stichococcus*. The plant therefore seemed to be a species of *Ulothrix*. Apart from the size and shape of the cells its chief characteristic is the formation of a large number of pyrenoids, generally 4, arranged in a more or less regular square near the centre of the cell.

Soon afterwards I found it again in company with a lemon-yellow slime fungus scraped off the wooden supports of a tank and almost aerial in its surroundings, being merely wetted now and then with rain water. The filaments were again 8μ broad, cells alt. 14-16μ, 2 pyrenoids in each cell placed *transversely* and becoming 4 by division. This formation of pyrenoids would therefore appear to be a specific character.

A little later the plant came to hand in quantity from a cement water-table in Carrington Street in the waste water from the Electric Power House. Filaments then 7-9μ broad with acutely-pointed conical tips were noted. Cells either quadrate (alt. 7-12μ) or cylindrical (alt. 17-28μ); pyrenoids as before.

This sample being brought in late in the evening, was left uncovered on the lid of a tin all night. Next morning by 9 a.m. the exposed portion was actively engaged in forming zoospores. A thin-walled globose cyst developed in the cell and burst through the cell-wall on one side. Within this the zoospore formed (Text-fig. 1) and later broke forth, but often the cell-contents simply forced a way at once through the cell-wall and issued as a zoospore. The process took 2-3 minutes. I endeavoured to observe the origin *in the cell* of the pulsating vesicles but without success.

From each cell, whether long or short, one zoospore resulted. They are globose (diam. 8-10μ), ovate (15-19μ long by 7-10μ broad), or shortly fusiform (long 16-21μ, lat. 7-8μ) gradually becoming more or less linear (Text-figs. 2-5). The contents are arranged exactly as in the cell but the pyrenoids scattered here and there, no Chlamydomonadine structure, flagella 4, pulsating vesicles 2 alternating, no stigma. The shape is not permanent; even while motile the zoospores begin to grow, at once passing rapidly from one shape to another and becoming longer, narrower, and more attenuate behind.

Involved among the *Ulothrix* filaments were quantities of the following species.

CHLAMYDOMONAS SNOWII, var. OVATA, n.var. (Text-fig. 6.)

Forma ovata, sursum plus angustata, fronte modice acuminata. Long. 8-10, lat. 5-6μ.

One of the congeners of *Chl. globosa* Snow, some of which are generally to be met with in gatherings such as this (*see* Note i.). There the pyrenoid was remarkably large for the size of the cell, probably preparatory to longitudinal self-division of the cell, and in those under review here, many of the pyrenoids had actually divided. Cells somewhat obtuse in front are included in the type; these are more or less pointed. Chloroplasts bag-shaped or campanulate; stigma median.

There is no essential difference between thin laminar chloroplasts, those which are bag-shaped, and those which are campanulate; they are merely three degrees of development.

iv.—*Investigation of some green water from a duck-pond.*

On October 10th, 1921 (spring), being then at Tauranga, N.Z., a small quantity of green water was brought in to me from a neighbouring duck-pond. The colour turned out to be due to a small *Chlamydomonas* in the *Palmella*-state from the fine structureless mucus of which the cells were just breaking forth. As I know of no previously described form with which it can be identified I have named it after the township.

CHLAMYDOMONAS TAURANGENSIS, n.sp.

Cellulae parvae, oblongae, latitudine paene exacte duplo longiores, sursum et inferne rotundatae (interdum longeovatae vel inaequales, pone subtruncatae); lateribus arcuatis, saepe inaequalibus. Chloroplastis parietalis bursae-formis; stigmate hemisphaerico, distincto, mediano. Pyrenoidis magna, mediâ cellulâ ad latus disposita.

Long. 13-20, lat. 7-10μ. Tauranga, N.Z.

The cells were in immense numbers, both motile and non-motile. Small, and in general very irregular, they gave evidence in my opinion of having been formed by longitudinal self-division, one side being more arched as a rule than the other. Two of the largest (19 x 10μ) that I noted lying side by side in the mucus, were however perfectly formed, in outline elliptic-oblong with evenly arched sides and broadly rounded ends. Chloroplast parietal, bag-shaped. The chief characteristic of the type is the arrangement of the stigma, nucleus and pyrenoid transversely at the centre of the cell. Pyrenoid very large, quite half the breadth of the cell, and though sometimes appearing central, is really lateral. Irregular cells have a tendency to be subtruncate below.

I met with this form once before, in company with *Chl. globosa*, at Lismore, N.S.W. (*see* Note i.).

Examined again on October 18th, the phial having been kept for eight days exposed to a strong diffused daylight, the mucous stratum still showed quantities of the same type, mostly non-motile cells without stigma. Clear evidence was present of their origin as autospores from a minute spherical cell of 10-13μ diameter which is a large size of *Chl. globosa*. These with 4 autospores side by side were to be noted everywhere. Well-developed specimens of *Chl. globosa* (diam. 8-9μ) as 4 autospores in a mother-cell were present also.

But the most interesting item of the contents was a bizarre form of *Chlamydomonas* to which I have given the name of

CHLAMYDOMONAS NOVAEZEALANDIAE, n.sp.

Cellulae modice ovatae vel oblongae (interdum etiam subquadrangulares), in ambitu valde inaequales, permagnorum granulorum amylaceorum per membranam delicatissimam projicientum seriebus ternis formatae; granulis plerumque rotundatis, anterioribus medianisque maximis. Chloroplastis vix visibilis; stigmate nullo nec pyrenoidi; flagellis tenuibus, brevibus, binis.

Long. 5-8, lat. 3-6μ. Tauranga, N.Z.

The cells were, in general outline, ovate or oblong, sometimes verging on subquadrangular. They are chiefly characterised by 3 series of very large rounded paramylon granules projecting through the very delicate membrane which can only be detected as a faint tag at the apex of each granule. End view shows that these are all round the cell. The two upper series are the most distinct, but the shape is very variable. A faint colouration indicates the presence of a chloroplast, but stigma and pyrenoid were alike absent. I thought I detected contractile vacuoles and a minute central nucleus; two short delicate flagella quite certain.

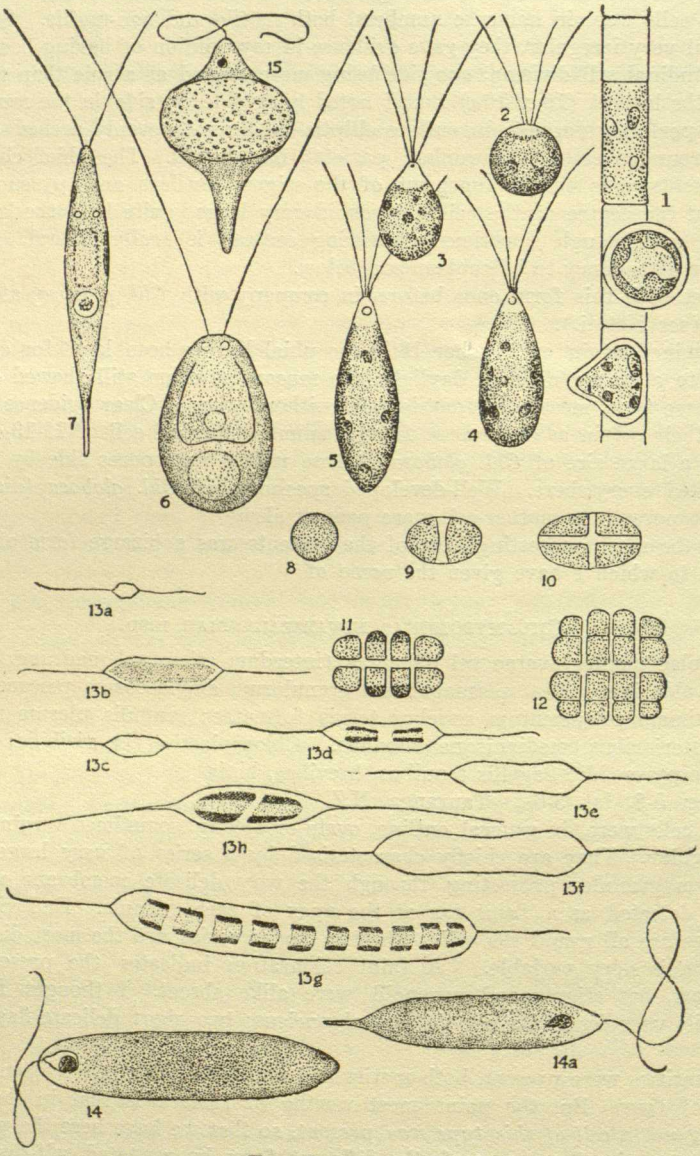
Quantities were present, both motile and non-motile, the latter often arranged in sets of four. But the point most worthy of remark is that in the original gathering *not a cell of this type was present*, so that we have here the production of a new species from a perfectly different form by repeated self-division and formation of autospores under pathological conditions.

v.—*On certain forms of* Chlamydomonas.

CHLAMYDOMONAS STELLATA Dill.

Die Gatt. Chlamyd., 1895, p. 17, T. v., f. 31-36; *cf.*, Wille, 1903, p. 134, T. iv., f. 4.

Form without anterior papilla, chloroplasts more attenuate inwardly, stigma



Text-figures 1-15.

1-5. *Ulothrix quaternaria*, n.sp. (1, x 800; 2-5, x 1100). 6. *Chlamydomonas Snowii*, var. *ovata*, n.var. (x 2400). 7. *Chlorogonium elegans*, n.sp. (x 1100). 8-12. *Gonium pectorale*. Development of the cells (*Palmella-state*) to form a 16-coenobia family. 13*a.-h.* *Ophiocytium capitatum* var. *longispinum*. 14, 14a. *Euglena australica*, n.sp. (x 750). 15. *Euglena australica*, var. *gibberosa*, n.var.

not observed; syn. *Chl. rotula* Playf. These Proceedings, 1918, p. 517, Pl. lv., f. 12.

Wille gives:—Long. 18-20, lat. 10-13μ; ours are 19-21 x 15μ, pyr. diam. 6μ.

Gloeocystis-states are *Asterococcus superbus* (Cienk.) Scherffel, 1908, Ber. d. Bot. Ges., Bd. xxvia (*cf.* Pascher, *op. cit.*, H. 5, p. 50, f. 302). *Oocystis rotula* Playf. (*antea*, 1916, p. 130, Pl. vii., f. 31); *Asterococcus limneticus* G. M. Smith, 1918, Trans. Wis. Acad., p. 627, Pl. 10, f. 3-6; Wisconsin Phytoplankton, 1920, p. 104, Pl. 20, f. 7-10.

CHLAMYDOMONAS STEINII Goroshankin.

Morph. u. System. d. Chlamyd., ii., 1891, pp. 112, 113, T. iii., f. 1-8, 29, 30; Wille, 1903, p. 134, T. iv., f. 5.

Form sometimes with a minute but distinct (1μ alt.) anterior papilla, and a pyrenoid at each end. The apical one seems to be rather an agglomeration of the anterior ends of the chloroplasts. Plenty noted in a floating *Euglena* scum. Goroshankin's dimensions are:—Cell. long. 18-30 (generally 24μ).

Cell. long. 21-23, lat. 12-13μ. Lismore.

CHLAMYDOMONAS OBSCURA, n.sp.

Cellulae oblongae, ubique rotundatae; lateribus levissime arcuatis; fronte papillâ hemisphaericâ distinctâ; chloroplaste crassâ bursae formi, cellulam paene complente; nucleo mediano; pyrenoidi nulla (in speciminibus notatis); stigmate hemisphaerico mediano distinctissimo.

Long. 12-15, lat. 7-8½μ. Lismore (N.S.W.); Tauranga (N.Z.).

A small form found in a wayside waterhole draining a swamp. Its general outline is oblong with broadly rounded ends, but sometimes verging on ovate from being narrowed anteriorly. A very distinct hemispherical papilla in front, at least in the motile specimens. Cytoplasm minutely granular, dense; chloroplast massive, almost filling the cell, leaving merely a narrow and sometimes irregular protoplasmic core. Nucleus central; no pyrenoid noted; stigma hemispherical, median, very distinct.

Gloeocystis-state observed:—subglobose, 16-celled, diam. 100μ. Cells without apical papilla, pyrenoid or stigma, but with the same dense finely granular cytoplasm and massive chloroplast.

Var. OVATA, n.var.

Cellulae ovatae, pone latissime rotundatae, fronte acutae; lateribus valde arcuatis. Cetera ut in forma typica.

Cell. long. 12-15. Tauranga (N.Z.).

Found with the type, both motile. This is a very decidedly ovate form, acute in front, broadly rounded behind, sides well arched. Breadth doubtful.

vi.—*Development of* Chlamydomonas *from resting cells.*

On July 24th, 1915, after several days' heavy rain my attention was directed to a small green flake about the size of a halfpenny floating on the surface of a muddy roadside pool. It proved to be composed of infantile non-motile forms of some species of *Chlamydomonas*. There were all shapes and sizes, lying in an irregular plexus, held together *on their sides* by a thin membranous pellicle. Three sorts might be noted, viz:—

a.—A comparatively few fairly well-developed cells, oval or ovate, long. 13-20, lat. 8-14μ, showing the usual bell-shaped chloroplast, very pale green and

homogeneous, with sometimes a pyrenoid or pyrenoidal locellus. The flagella might often be observed feebly fluttering.

b.—A much larger section consisting of smaller long-elliptic cells about 10 x 4μ. Chloroplast laminar, very slightly coloured indeed.

c.—A crowd of smaller cells very irregular in shape, up to 6 x 3μ in dimensions. Very often just a trace of chloroplast with barely any colour.

In no cell was any stigma noticeable, but even in the small ones contractile vacuoles were seen working. Even as I watched the cells under the microscope one or other would become active—a few slight movements—some more decided wriggles—and it broke free. It was curious that it was always the minute and often the more irregular cells which became active, very rarely, if ever, the well-developed ones. This is quite the rule among flagellates.

The stratum examined was not a *Palmella*-state where the cells are immersed in mucus, but a tough, though delicate, papyraceous membrane with the cells affixed by their sides. This membrane I believe to be formed on the drying up of the pool by very fine flocculent matter floating suspended in the water, while the Chlamydomonadine cells present evolve swarm spores which survive the drought as minute resting cells adherent to it.

Consulting, as I do, from time to time, Wille's most useful monograph "Uber die Gattung *Chlamydomonas*" I have been struck by the regularity of the reference to the zygote in every species. Nevertheless, though I have done a good deal of work searching just the places in which zygotes might naturally occur, I have never met with a single specimen, and, from the material I have found, have been forced to the conclusion that some alternative method of development such as I have suggested, must exist.

vii.—*The Genus* Chlorogonium.

Chlorogonium euchlorum Ehr.

The form that seems to have been generally accepted in Europe as the type is Dangeard's figure reproduced in Chodat, Algues vertes de la Suisse, Bd., i., H. 3, p. 40. It is very broadly fusiform, merely acuminate behind, acutely rounded and only slightly rostrate in front. The dimensions, *l.c.*, p. 139, are given as:—long. 30-50μ; lat. 8-12μ.

The nearest approach to such a form that I have observed was a single specimen from the Botany Water Reserve, acuminate at each end, without rostrum or tail. It was alive and active in spite of the fact that the cytoplasm was divided into 8 oval autospores. Long. cell. 30, lat. 12μ.

Chlorogonium elegans, n.sp. (Text-fig. 7.)

Cellulae graciliores, fronte acute-rostratae, pone acutissimae, sensim sensimque attenuatae.

Long. 36-55, lat. 6-10μ. Botany. Lismore.

More slenderly fusiform than *Chl. euchlorum* and more gradually attenuate to each end. In front more acute and rostrate, behind very acutely drawn out almost into a spine. Chloroplast a thin parietal lamina without pyrenoids. Stigma orange-brown, wick-shaped when showing at any rate (probably, however, a delicate flat circular disc in face view) a little in front of centre. A pair of contractile vesicles about the anterior fourth. Nucleus a little behind the

centre, closely surrounded by a locellus. Cytoplasm occasionally retracted from the tail.

CHLOROGONIUM STEINII, nom. nov.

As in Stein, Naturg. d. Flag., H. i., T. xviii., f. 6. The figure works out at:—Long. 123, lat. 12μ.

I came across a pure culture of this large species in an iron saucepan in a fowl-yard. Both active and non-motile cells were present in abundance, the latter (as is usual in both Volvocine and Euglenoid flagellates) fixed in clumps by the anterior end of the cell to pieces of flocculent debris where they had evidently developed from resting cells. Under the microscope the vegetative cells continued to become motile.

Compared with the breadth they were very long; in front produced into a long rostrum, posteriorly drawn out into a very acute tail devoid of cytoplasm. Two flagella proceed at right angles to the rostrum just below the extreme tip and a pair of small pulsating vacuoles indicate what may be considered the base of the rostrum. About the centre of the cell a small nucleus surrounded by a locellus almost as wide as the cell itself. I did not note any stigma. Chloroplast a delicate parietal lamina with 8 small pyrenoids arranged in a longitudinal spiral above, and 8 below the nucleus.

Cell. long. 62-93, lat. 7-10; lat. rostr. 1½μ. Lismore.

CHLOROGONIUM MINIMUM Playf.

New and rare frw. Algae. These Proceedings, 1918, p. 521, Pl. lv., f. 26.

Cell. long. 30, lat. 2-3μ.

Var. CURTUM, n.var.

Cellulae breviores, et fronte atque pone minus protractae.

Cell. long. 24, lat. 4μ. Lismore.

A shorter more immature form, less produced both in front and behind. Only a very delicate homogeneous parietal chloroplast noticeable, and a very distinct orange-brown stigma somewhat forward of the centre. Almost certainly a developing stage of the type; plenty were present in a Euglenoid scum from a roadside pool, March 12th, 1920, at Lismore.

Var. OBESUM, n.var.

Cellulae brevissimae, obesae, inaequaliter longe-ellipticae, et fronte atque pone obtusae; uno latere arcuato, altero deplanato.

Cell. long. 12-14, lat. 3μ. Tauranga, N.Z.

From a duck-pond (Oct. 18th, 1921). An extremely lively plump little growth form, distinctly green. Chloroplast very delicate, parietal; two flagella; stigma in the anterior portion easily noticeable; no other details.

With this form was noted what looked like the *Palmella*-state:—narrowly cylindrical cells in pairs, pale green homogeneous contents; cell. long. 8, lat. 2μ.

What were probably sessile vegetative specimens of the zooid, affixed to some animalcule I obtained from a pond in the Botanic Gardens, Sydney (June 30th, 1910). Cells linear-elliptic, long. 12, lat. 3μ; chloroplasts bright green; they became motile on being broken loose from the host.

viii.– *Development of* Pandorina *and* Gonium.

Pandorina.

In September, 1909, I obtained quantities of small freshwater Algae by shaking out heads of *Elodea* and *Myriophyllum* growing in a dense mass close to the surface of the water in a tank at the Botanic Gardens, Sydney. Among them were numbers of *Pandorina morum,* exhibiting the various stages of development by subdivision of a single resting cell. All the forms were noted in a single drop beneath the microscope at one time and might therefore easily be compared.

a.—Undivided resting cell. The smallest seen were diam. 10-14μ surrounded by hyaline mucus 2μ wide. Cytoplasm very pale green, finely granular.

b.—Undivided resting cell. Larger size, diam. 16-18μ, ring of mucus 2μ wide. Cytoplasm a shade darker green, finely granular.

c.—Cell subdivided into a *globular* coenobium, non-motile; diam. about 24-30μ. No flagella or pores visible. Cytoplasm still very pale green, finely granular with darker grains here and there.

d.—Oval coenobium, non-motile, long. 31-38, lat. 25-34μ. No flagella, but pores visible. Cytoplasm darker green.

e.—Larger oval coenobium, non-motile, long. 48-52, lat. 44μ; no flagella, but pores visible. Cytoplasm darker green.

Compare *P. morum* var. *tropicum* Playf. (These Proceedings, 1915, xl., Part 2, p. 336, Pl. xliv., f. 18). It seems to me quite unreasonable to suppose that these irregular polygonal cells remain so and I feel more inclined than ever to believe that they become regularly spherical and form *Eudorina elegans.*

Pandorina morum var. coelastroidea, n.var.

Coenobium minutum globosum, *Coelastro microporo* consimile; e cellulis minimis paene appressis exstructum; locello centrali sphaerico (ut videtur) instructum. Cellulae in quincuncem (6 + 1) dispositae, e vertice visae hexagonae, e latere cuneatae fronte rotundatae.

Coenob. diam. 23μ; cell. diam. 4; locell. centr. diam. 8μ. Lismore.

An unusual form which, owing to the extreme tenuity of the investing mucus, looks like a flagellate specimen of *Coelastrum microporum.* The edge is crenate as the outer margin of the cells is rounded. The cells are very small (diam. 4μ) almost regularly hexagonal from above and nearly appressed, arranged quincuncially 6 round 1. There appears to be a central globular locellus 8μ in diameter. Flagella distinct and the pores indicate the presence of a mucous investment.

Development of Gonium.

In the gathering mentioned above, I was able to trace all the vegetative stages of *Gonium sociale* from a single resting cell. But how did the resting cell originate? Unfortunately, I did not obtain their dimensions but the smallest may be taken as diam. 5μ.

a.—Undivided pale green cell with very narrow mucous investment.

b.—Cell-division in one direction; cytoplasm pale green.

c.—Cell-division in a second direction, thus forming 4 angular cells.

d.—Cells become globular (see my remarks under *Pandorina*).

e.—Cells a diameter apart. Later they develop flagella and the coenobium becomes motile. Sometimes the cells take on an oval or ovate form. Cf. Chodat, Algues vertes, p. 148, f. 73.

ix.—*Development of* Selenastrum *and* Coelastrum.

In the same gathering (September, 1909, *supra*) was a series of cells without mucous investment showing the development of *Selenastrum Bibraianum* from a single minute globose cell.

a.—Minute globose cell, diam. 6μ.

b.—Larger globose cell, diam. 12μ; chlorophyll regularly diffused.

c.—Globose cell with chlorophyll lunately disposed, diam. 12μ.

d.—Cell growing out laterally in a lunate manner, long. 20, lat. 10μ.

e.—Still more lunate, apices sharply pointed, diam. from point to point 24μ, lat. max. 10μ.

f.—A variant, long. 32, lat. max. 14μ.

g.—Fully developed cell, long. 24μ, lat. max. 10μ.

In nature the mature cell divides along the plane of the apices and body. The new cell twists at right-angles to the first and remains attached by the centre of the body at the back. Two cells are often to be seen like this.

Coelastrum.

A gathering at Lismore (December 13th, 1912), among other things, supplied me with material showing how small coenobia of *Coelastrum* are often built up from a single cell by a process of self-division in two directions.

a.—Single cell, diam. 5μ.

b.—Self-division in one direction, long. 10, lat. 5μ.

c.—Self-division in a second direction; diam. coenob. 16, cell. 8μ.

d.—An arched plate of six cells (5 + 1); diam. coenob. 22, cell. 8μ.

Cells beautifully deep transparent green; a large pyrenoid in each.

Small complete coenobia in same sample.

x.—*Rejuvenescence in* Gonium *and* Botryococcus. (Text-figs. 8-12.)

On two separate occasions when making observations with the microscope I was so fortunate as actually to witness this process. In the first instance it was in *Gonium pectorale.*

The matrix of a coenobium having become old and stiff, it had evolved a new and larger mucous plate attached to the old coenobium. The cells had lost the flagella and become vegetative. One by one with an explosive action they left their old settings and took up positions at even distances apart in the fresh mucous cushion. The resultant condition was Palmelloid.

Each cell undergoes self-division, first in one direction then in a second transversely, until finally a family of 16 perfect coenobia is produced (Text-figs. 8-12). Such I have noted on more than one occasion and once was so fortunate as to obtain such a family showing all the stages of development. But the cell-division as observed in nature does not altogether follow the lines laid down by Chodat in Algues vertes, p. 42.

Botryococcus.

The case of *Botryococcus Braunii* was similar. The cells were oval and seemed to be longitudinally divided, each being surrounded by a layer of stiff mucus. Attached was a cushion of newly formed clear hyaline mucus into which, as I watched, the cells bursting from their investment passed with a sudden and explosive jerk, becoming young and globular and settling down at about equal distances apart. The newly formed condition was Palmelloid and the old membrane fell away. Each cell should now divide to form a new coenobium. But

of what character? For it is evident that *Botryococcus* is a pathological condition of some other alga caused by the drying up of its habitat.

xi.—Arthrocystis ellipsoidea W. & G. S. West.

Welwitsch's African Algae, Journ. Bot., 1897, p. 238, T. 370, figs. 1, 2. *See* Wille, Conj. u. Chlor., in Engler u. Prantl., Die naturl. Pflanzenfamilien, 1909, p. 39, fig. 19F.

This organism is probably the daughter-coenobium of *Volvox tertius* Meyer. There is an oval form of that species, and in it the daughter coenobia are generally oval also, and whether enclosed or free, the cells of the latter are often represented by a fragmented chloroplast without flagella. Compare my notes in Frw. Algae of the Lismore Distr. (These Proceedings, 1915, pp. 340, 341, Pl. xliv., fig. 2, 3) under *Volvox tertius* var. *tesselatus*. These daughter-coenobia, with parietal laminar chloroplast fragmented in a tessellate manner, are common enough in tropical and subtropical districts.

xii.—*Note on the horns of* Pediastrum.

Dealing with the genus *Pediastrum* (in Chlorophyceae, ii., Heft 5, of Pascher's Die Süsswfl. Deutsch. 1915) Brunnthaler remarks, p. 89, that, according to Lemmermann, these processes (the horns) are hollow and open (fig. 50) and allow a thin filament of plasma to stretch forth. Lemmermann's observation refers to *P. simplex*. Chodat (*op. cit.*, 1902, p. 227, f. 152a) has remarked the same circumstance in *P. duplex* v. *reticulatum*.

In 1909 I noted it also in living specimens of *P. duplex* var. *clathratum* A.Br. obtained from the plankton of the lagoon in Parramatta Park. The filaments are extremely tenuous, sometimes as many as three from each horn, and occasionally vary their direction.

A. Braun however (Alg. unicell., 1855, p. 67, footnote 1) traces this observation back to quite early microscopists. He quotes Turpin (Mém. du Mus. d'hist. nat., xvi., 1827, p. 320) as saying: "Lorsqu'on observe cette production dans un lieu chaud, il n'est pas rare de voir plusieurs des cornes muqueuses lancer, de leurs extrémités une poussière de globules." Turpin therefore must have convinced himself that the horns were hollow.

Braun goes on to say (*ibid.*, p. 67) that Ehrenberg, relying on Turpin's observation, holds the opinion (Infus., p. 155) that the horns are perforated by small orifices.

I watched long and carefully for Turpin's "poussière de globules" but never saw anything pass from the horns.

xiii.—Ineffigiata neglecta W. & G. S. West.

This plant is generally found as small irregular masses of a brownish-green or yellow-green colour out of pond weeds. I obtained it also from the Sydney Water Supply in large conglomerations, the pieces being connected by what were evidently strings of dried mucus. The cells are said to be disposed side by side as in *Botryococcus* but within the investing membrane.

I gathered a peculiar and unusual form of this plant from Canley Vale in some quantity. The membrane of each piece seemed to be covered with perforations through each of which protruded very slightly a low rounded papilla of hyaline transparent mucus. From the apex of these proceeded a very long delicate pituitous thread in length equal to twice or thrice the diameter of the

mass. Those threads were of quite a different character from the coarse membranous strands often found joining these masses, and under a high magnification showed no signs of being composed of *Bacterium* cells. The interior of the mass seemed to be replete with a number of large hyaline refringent bodies; one was distinctly visible through a rent in the membrane and by putting the microscope a little out of focus the position of others was indicated (as is often the case) by a refringent glow. Quantities of the usual minute pieces of the plant were observable in the same gathering:—green, yellow-green, orange and even brick-red in colour. One mass measured 50μ long and broad.

xiv.—*On certain species of* Oocystis.

Oocystis Borgei Snow.

Plankton of L. Erie, Bull. U.S. Fish. Comm., 1903, p. 379, Pl. 2, fig. vii. Syn. *O. gigas* var. *Borgei* Lemm.; *Oe Novae Semliae* var. *australica* Playf. (These Proceedings, 1916, p. 123, Pl. vii., figs. 13-17. I have lost my copy of Snow's memoir, but the identification is certain, as my figures agree perfectly with that given by A. Pascher in Süssw. flora Deutschlands, H. 5, "Anhang," p. 234, f. 38. The dimensions for American specimens are:—Long. 9-17, lat. 9-13μ; European: Long. 13-17, lat. 9-13μ; Australian:—Long. 13-20, lat. 10-14μ. Ours are from the plankton of the lake in Parramatta Park and from the Richmond River at Lismore. The chloroplast is laminar, parietal, irregularly fragmented.

Oocystis crassa Wittrock.

Syn. *O. crassa* var. *Ostenfeldii* Playf., *forma,* These Proceedings, 1917, p. 839, Pl. lviii., f. 1; *O. crassa* var. *elongata* Playf., *pro parte, ibid.,* p. 839, Pl. lviii., f. 2.

The original figure of *O. crassa* being so irregular in shape and of such doubtful characteristics, the form generally accepted as typical is broadly biconvex, not incrassate or tuberculate at the poles, with 8 chloroplasts each with a pyrenoid. Our specimens as figured agree with G. S. West's in Brit. Frw. Algae, p. 227. In regard to size W. and G. S. West give long. 18-24, lat. 13-15.5μ for British specimens; European are recorded at:—Long. 14-26, lat. 10-20μ; ours are long. 20-25, lat. 13-15μ.

O. crassa var. *Ostenfeldii* Playf. has 4 *rounded* discoid chloroplasts arranged generally longitudinally. My fig. 3 (Pl. lviii., *l.c.*) cannot be included under *O. crassa,* but had better be considered as *O. solitaria* Wittr. though it does not possess the polar incrassation *within* the membrane, characteristic of that species.

Oocystis lismorensis, n.sp.

Cellulae latissime ovales, ad polos quam levissime acuminatae non autem apiculatae vel incrassatae; chloroplastidibus disciformibus vel plusminus inaequaliter polygoniis (c. 6-7 utrinque visibilibus) vel circulatis minoribus (diam. 4-5μ).

Dimensions 43 x 35, 38 x 31, 36 x 30, 31 x 25μ. Lismore.

A form rather difficult to place otherwise than by making it a distinct type. It is far too small to arrange under *Eremosphaera* (*cf. Erem. viridis* var. *acuminata* Playf., *antea,* 1916, Pl. ix., f. 3). *O. gigas* Archer is oblong, not oval, with uninterrupted outline, as also is *f. minor* W. West. The cells in this species are very broadly oval, the least bit acuminate at the poles, but neither incrassate there nor furnished with an apiculus or papilla. The chloroplasts are some-

times large, irregularly polygonal, 6-7 a side, or smaller and circular. The axial ratio of the cells measured averaged 1 to 1.22.

xv.—*On two species of* Ophiocytium.

OPHIOCYTIUM CAPITATUM var. LONGISPINUM (Möb.) Lemm. (Text-fig. 13, *a-h.*) Hedwigia, Vol. 38, 1899, p. 32, Pl. 4, figs. 21-25.

Syn. *Reinschiella longispina* Möbius; *Schröderia belonophora* Schmidle (Beitr. z. Kenntn. d. Plankt., 1900); *Centritractus belonophorus* (Schm.) Lemm. (Beitr. z. Kenntn. d. Plankt., ix., 1900, p. 273).

In plankton from the lake in Parramatta Park and from Enoggera (Brisbane) I observed a complete series of forms showing the growth from the initial spherical cell to a well-developed cylindrical one with 10 distinct band-shaped parietal chloroplasts.

a.—Cell diam. 7μ, setae long. 26μ.

b.—Cell long. 16, lat. 7; setae 26μ. Chloroplast a single parietal lamina.

c.—Cell long. 18, lat. 8; setae 33μ.

d.—Cell long. 25, lat. 9; setae 57μ.

e.—Cell long. 36, lat. 8; setae 32μ.

f.—Cell long. 99, lat. 8; setae 33μ.

g.—Cell long. 135, lat. 8; setae 35μ.

h.—Very small specimen, pond plankton, from Lismore. Cell long. 11, lat. 4, setae 23μ, irregular in outline but showing 2 chloroplasts distinctly.

OPHIOCYTIUM ELONGATUM W. and G. S. West.

Freshwater Algae of Burma, Pl. xi., f. 11-13.

The Burmese type is a remarkably long irregular serpentine filament. One end is already beginning to coil, however, and f. 13 shows a specimen closely spiral. No length is given, but the thickness of the cell is stated to be 5-5½μ. This Australian specimen if uncoiled would certainly be as long as the type, if not longer.

Crass. cell 6μ. Spira 90 x 30μ. Guildford.

xvi.—*Some rare forms of* Scenedesmus.

SCENEDESMUS BIJUGUS (Turpin) Lagerh.

Nuova Notarisia, 1893, p. 158.

Syn. *Achnanthes bijuga* Turpin; *Scenedesmus bijugatus* Kütz.

The form I figure here is the type as given by Kützing in Synopsis Diatomacearum for his *Sc. bijugatus* and which he makes equivalent to *Sc. bijugus* Turpin. The cells, as he figures them, are oblong-cylindrical with rounded ends and sides flat or nearly so; 2, 3 or 4 parallel in a single series. I have only noted it once. It is a form evidently very rare, as another shape broadly oval (see Brunnthaler in Pascher, *op. cit.*, H. 5, p. 164, f. 233) has obtained general recognition. See also G. M. Smith, Wisconsin Phytoplankton, Pl. 37, f. 18-20.

Var. DUPLEX, n.var.

Cells divided transversely (not obliquely) exactly across the middle. Semicells slightly conical outwardly and one above the other. Each vertical pair of semicells 16 x 10μ. From Fairfield, with the type.

Var. IRREGULARIS, n.var.

Cellulae interiores 2 transverse ordinatae.

Coenob. (4-cell) 14 x 12, 18 x 10; cell. long. 6-9, lat. 4-5μ. Botany Water Reserve. Fairfield.

The two inner cells are arranged more or less at right angles to the other two.

Var. ARCUATUS (Lemm.) W. & G. S. West.

Syn. *Sc. arcuatus* Lemm. in Plöner Forsch., vii., 1899, p. 17, T. i., f. 2-4. *Sc. bijugatus* f. *arcuata* (Lemm.) W. & G. S. West in Plankt. of some Irish Lakes, 1906, p. 106, Pl. x., f. 12-14.

Coenob. (8-cell.) 12-20 long., 12-18 alt.; cell. long. 6-12, lat. 2-6μ. Botany Water Reserve. Fairfield.

Our specimens are small; Lemmermann gives:—cell. long. 13-18, lat. 7-9½μ. The slightly arched form of the coenobium is too insignificant a detail to found a species on; it is very often absent, the coenobium being flat.

Var. DISCIFORMIS Chodat.

Algues vertes de la Suisse, 1902, p. 213. "Cellules polyedriques par compression"—Chodat, *l.c.*

Coenob. (8-cell.) 18-29½ long., 18-25 alt.; cell. long. 9-15, lat. 4-7μ. Botany Water Reserve. Fairfield. Lismore.

SCENEDESMUS RALFSII, nom. nov.

Cellulae ovatae alternantes, longo spatio inter se intermisso, in seriebus binis ordinatae.

Cell. long. 16, lat. 8μ. Collector.

Syn. *Sc. obtusus* Ralfs (*non* Meyen), Brit. Desm., T. 31, f. 16. Ralfs' figures do not answer to any of Meyen's types which, also, never having been properly described, cannot be accepted. The coenobium consists of 2 alternate series of ovate cells rounded at one end and acuminate at the other and separated by a considerable interval.

SCENEDESMUS ANTENNATUS Bréb.

In Ralfs' British Desmids, 1845, p. 222, T. 35, f. 27.

Cell. long. 24, lat. 5μ. Botany Water Reserve.

Compare J. Brunnthaler Protococcales (*op. cit.*, H. 5, pp. 163, 164, f. 211) who gives the size of the cells as:—long. 12-13, lat. 2.5-4μ. See also *Sc. Bernardii* G. M. Smith, Wisconsin Phytoplankton, 1920, Pl. 38, f. 5-9, dimensions 8-17 by 3-6μ.

SCENEDESMUS RENIFORMIS, n.sp.

Cellulae reniformes, inter se distantes, in seriebus binis ordinatae.

Coenob. (8-cell) 23 x 15; cell. long. 7½, lat. 4μ. Lismore (327).

A family of eight coenobia observed. A very rare type; the cells are perfectly reniform, arranged in pairs one above another and facing opposite ways, each pair separated by an interval of about half a diameter.

SCENEDESMUS CURVATUS Bohlin.

Die Algen d. erst. Regnell Exp. i., Protococcaceen, 1897, p. 23, T. i., f. 41-44, 52.

Very rare everywhere apparently; noted here only from Botany Water Reserve (Nos. 50, 95); plentiful however in the latter gathering.

Coenob. (4-cell) long. 30, alt. 40; cell. long. 20-22, lat. 7-9μ.

Coenob. (8-cell) long. 34-62, alt. 26-44; cell. long. 12-24, lat. 4-10μ.

SCENEDESMUS INCRASSATULUS Bohlin.

Bohlin, Protococcaceen, *op. cit.*, p. 24, T. i., f. 45-51.

Cells shortly fusiform with a minute incrassation at each end. Very rare; seems to be known only from Brazil and Burma. Bohlin gives 17-24 by 5-8μ for the type.

Cell. long. 12-20, lat. 5-6μ. Centennial Park, Sydney. Botany (Gardener's Road).

xvii.—*Notes on various species.*

ULOTHRIX AUSTRALICA, n.sp.

Filaments at the base very narrow, rapidly increasing to 70μ broad with cells transversely oblong, alt. 24-100μ. Upper portion of filaments 70-130μ broad with palisade cells, alt. 18-24μ. Cells not constricted or inflated. Membrane 3μ thick a short distance above the base, soon attaining 10μ, at which figure it remains constant. Inner surface of the membrane marked with delicate irregular longitudinal and transverse lines (evidently ridges) which coalesce here and there. A single homogeneous parietal chloroplast filling each cell. No pyrenoids or amylaceous granules.

Lismore (352). In company with the two following forms.

ULOTHRIX ZONATA (Weber et Mohr) Kütz.

Fil. diam. 27-45, cell. alt. 11-38, membr. crass. 2-5μ.

Var. VALIDA (Näg.) Rabh.

Fil. diam. 42-70, cell. alt. 11-32, membr. crass, 3-6μ.

GOLENKINIA ACULEATA, n.sp.

Cellulae sphericae, aculeis paucis arcuatis brevibus munitae.

Diam. corp. 20; acul. long. c. 7μ. Sydney Water Supply (66).

All my specimens of *Golenkinia* come from that source. This form is distinguished by being armed with a few short, stout, arcuate prickles, about 16 visible at a time.

FLAGELLATAE.

xviii.—*Study of a red-brown surface film.*

The film was first noticed on March 12th, 1920 (Autumn), as a thin reddish-brown pellicle with dark purple-black ripple lines where the wind had piled it. Mottled green patches showed here and there. It turned out to be the matrix of a species of *Euglena* which I have not been able to identify with any published form. The film broke with a vitreous fracture and the locelli which had contained the vegetative cells were scattered irregularly throughout it. Circular in shape viewed from above (with delicate spiral lines showing), in side view they appeared elliptic so that the Euglena-cells were tabloid-shaped. I have named this species:–

EUGLENA AUSTRALICA, n.sp. (Text-fig. 14.)

Cellulae subcylindraceae, lateribus plus minus parallelis, vel cylindrico-fusiformes; fronte attenuatae conicae, apicibus rotundatis; pone attenuatae conicae acuminatae, spinâ brevi aut nullâ. Corpore metabolico.

Long. c. 45-55, lat. 10-12μ. Lismore.

When liberated from the locelli of the film, the *Euglena*-cell is tabloid-shaped. The anterior and posterior portions grow out from the centre of the broad face on either side. At this stage the cell often becomes motile, stopping

every now and again to knead itself into shape. I observed all these forms to pass from one to the other under the microscope. Each had a long flagellum and was very active. I distinguish this stage of development as:—

Var. GIBBEROSA, n.var. (Text-fig. 15.)

Corpore transverse ovali; superne in projectionem conicam, inferne in caudam triangularem acutam producto; metabolico. Cytoplasma plerumque flavo-viridi, denso; chloroplastidibus minutis digitis transverse dispositis; stigmate subapicali.

Long. c. 36, lat. c. 30μ. With the type.

It may be asked: why describe and name the stages of development in these metabolic forms? To prevent them from being erected into new species by other observers who come across them casually. For instance, I met with this bizarre form three years ago (April, 1917) in a gathering from another pond. It exhibited then the same characteristics:—tabloid-shaped body, conical anterior prominence and triangular tail-piece both hyaline. Cytoplasm dense, yellow-green; chloroplasms minute flecks disposed transversely; stigma in the anterior prominence distinct; nucleus not visible. Body metabolic. I had myself a mind to describe it as a new species. Other observers found species on the other transition forms and thus what constitute the life-history of a single organism get strung out into a series of conventional types.

This inflated form does not persist long, breaking down gradually into:—

Var. CLAVIFORMIS, n.var. (Text-fig. 16.)

Cellulae claviformes; corpore metabolico, anteriori latissimo, inflato, pone conico acuminato; posteriori subcylindrico, fronte rotundato; paramylo nullo.

Long. c. 40, lat. c. 14μ. With the type.

Syn. *Euglena pisciformis* Dangeard (*non* Klebs) in These Proceedings, 1921, p. 121, Pl. iv., f. 9-11. The shape of the cell is here club-shaped, simply inflated a little below the centre, acuminate behind and more or less conical in front. Much more common than the other forms. The chloroplast in all tends to be confined to the median portion of the cell, leaving the front and hind parts hyaline. It seems to be diffused or else composed of minute flecks. The nucleus is not observable and there are no paramylon rods or granules.

A smaller form:—Long. 30-32, lat. 10-12μ is often found.

xix.—*On* Euglena pisciformis *Klebs.* (Text-fig. 17.)

In note ii. (on the examination of certain green fluffy tufts, *supra*) I recorded the occurrence of a form of *Euglena pisciformis* Klebs. Having just lately obtained Klebs' original figure and description it is evident that mine in Austr. Frw. Flagell. is not correct.

EUGLENA PISCIFORMIS var. GRANULOSA, n.var.

Differt a formâ typicâ pyrenoidibus geminatis, cellulae ad tertiam partem pone dispositis; parte anteriore magnis amylaceis nucleis digitatis repletâ.

Cell. long. c. 32, lat. 8μ. Lismore.

Compare Lemmermann, Eugleninae (in Pascher, *op. cit.*, H. 5, p. 125, f. 182 after Klebs). The type is torpedo-shaped, rounded in front and drawn out by degrees evenly behind to a sharp point. The internal arrangements are very characteristic as the cell is furnished with 2 clear, transparent, homogeneous, parietal chloroplasts which are very distinct and each contains a large pyrenoid, one fore and the other aft of the centre of the cell. The dimensions are given

as 25-26μ long, 7-8μ broad. A smaller form, var. *minor* Hansgirg is quoted at 18-20μ long, 4½-5μ broad.

Our specimens differ from the type in having the two pyrenoids side by side at the posterior third of the cell, while the portion anterior to them is crowded with distinct digitate amylaceous granules lying side by side at right angles to the cell-wall. The nucleus I did not see but the C.V. showed up more plainly than usual close to the stigma and pharynx. The vegetative cell is subglobose, diam. 16μ, and very often the characteristic chloroplasts and pyrenoids are visible in it. It is generally surrounded by a delicate irregular mucous or membranous investment. I have not observed the stages of growth.

A type very close to *Eu. pisciformis* Klebs is *Eu. vivida* Playf.

xx.—*Development of* Euglena sociabilis *Dangeard.* (Text-fig. 18.)

Eu. sociabilis would seem to be a very rare species as Lemmermann says of it:—"Bislang nur aus Frankreich." I was so fortunate as to obtain (May, June, 1917 and even as late as October in the same year) a perfect series of its vegetative stages leading up to the motile form reproduced by me in Australian Frw. Flagellates (These Proceedings, 1921, p. 117, Pl. iii., f. 8, 9). The cell undergoes development within a wide transparent hyaline investment (schleimhulle) often obviously stratified. The forms and dimensions are as follows:—

a.—Cell spherical, diam. 25-38μ; mucus diam. 95-126μ. Cytoplasm finely granular, chlorophyll diffused, stigma generally distinct. Syn. *Gloeocystis* (*Chlorococcum*) *infusionum* Schrank.

b.—Cell as in *a* but subglobose, long. 30, lat. 25μ; mucus spherical, diam. 120μ.

c.—Cell oblong, slightly pointed behind, with a small nick in front, long 53, lat. 36μ; mucus spherical diam. 160μ. Cytoplasm finely granular, chlorophyll diffused, stigma subapical. In these stages of development the characteristic digitate chloroplasts are not yet formed.

d.—Cell oblong, somewhat attenuate posteriorly, acuminate behind, a small nick in front, sides very slightly retuse, long. 63, lat. 30μ; mucus spherical, diam. 160μ. Chloroplasts digitate, stigma subapical.

e.—Cells subcylindrical, somewhat attenuate behind, subcapitate in front, sides lightly retuse, long. 74, lat. 21-27μ, one to four in a mucous sphere diam. 160-250μ. Chloroplasts digitate, directed obliquely backwards, central lumen of the cell full of globular paramylon granules; pharynx expanded into a small nick in front; stigma distinct. (Text-fig. 18.)

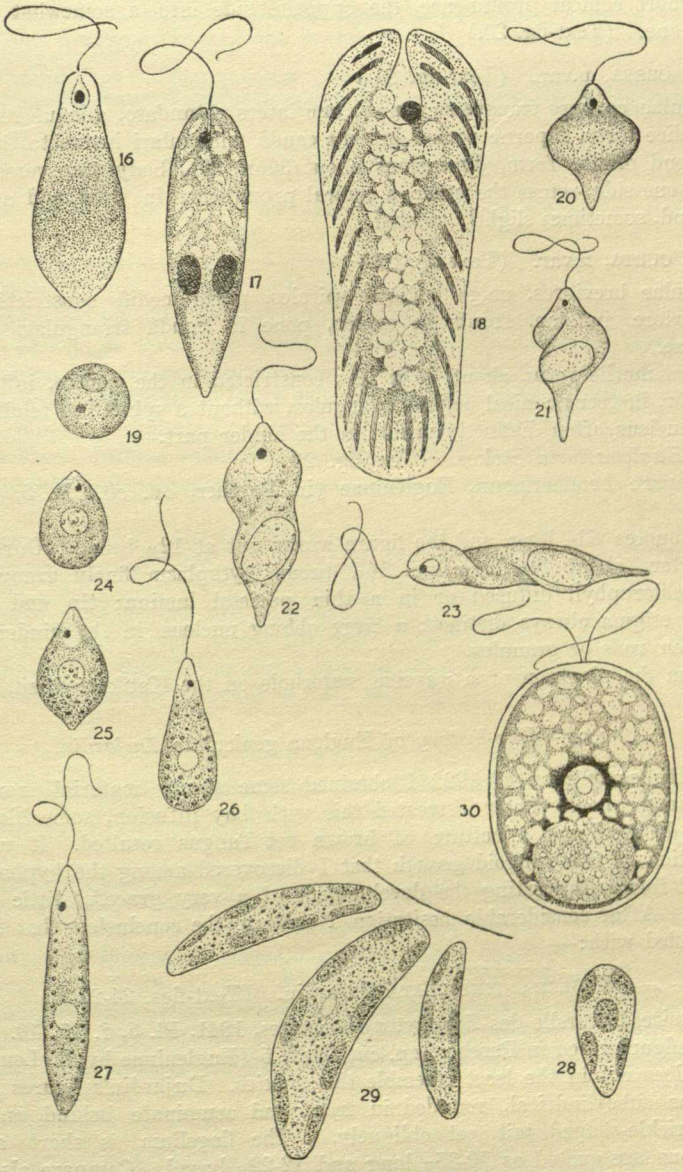
This series of vegetative forms leads up to Dangeard's zooid type, long. 85-95, lat. 21-28μ and it seems very probable that my undescribed specimen, *l.c.*, Pl. iii., f. 7, is really a more highly developed stage of this species. The disposition of the cytoplasm is the same, with the exception of the anterior chloroplasts which, as I did not observe them, are very likely disciform. Dimensions long. 110, lat. 14μ.

xxi.—*Life-history of* Euglena torta *Stokes.* (Text-figs. 19-23.)

On February 11th, 1922, I gathered abundance of a floating Palmella stratum of *Euglena* vegetative cells in course of development.

a.—Spherical resting cells, diam. 25μ, cytoplasm finely granular, chloroplasts irregular patches, stigma distinct. (Text-fig. 19.)

b.—First motile form, the centre of one side of the resting cell is produced



Text-figs. 16-30.

16. *Euglena australica* var. *claviformis*, n.var. (x 800). 17. *Euglena pisciformis*, var. *granulosa*, n.var. (x 1200). 18. *Euglena sociabilis* (x 800). 19-20. *Euglena torta Stokes.* (x 400). 21. *Euglena torta* var. *obesa*, n.var. (x 600). 22. *Euglena torta* var. *curta*, n.var. (x 800). 23. *Euglena torta* Stokes. 24-25. *Euglena geniculata* (x 600). 26. *Euglena geniculata* var. *guttula*, n.var. (x 600). 27. *Euglena geniculata* var. *juvenlis*, n.var. (x 600). 28. *Colacium ovale*, n.sp. (x 1000). 29. *Colacium arcuatum*, n.sp. (x 1000). 30. *Exuviella lima* (x 800).

into a short conical prominence, the opposite side into a somewhat longer triangular one. (Text-fig. 20.)

c.—Var. OBESA, n.var. (Text-fig. 21.)

Cellulae corpore transverse conico, uno latere rotundato, alioque retuso, interdum modice torto, superne conico inferne caudâ triangulari instructo.

Second motile form, dimensions about 30 x 20μ, body transversely conical, rounded one side, retuse the other, a conical prominence in front and a triangular tail behind, sometimes slightly twisted.

d.—Var. CURTA, n.var. (Text-fig. 22.)

Cellulae breviores, magis oblique spirales, parte mediâ constrictâ anteriore et posteriore inflatae, fronte in conico, pone in caudâ triangulari sine spinâ protractae.

Third motile form, about 35 x 12μ, constricted in the centre, inflated above and below, in front conical behind triangular, without a spine. A relatively large oblong nucleus often distinctly visible in the hinder part.

e.—*Euglena torta* Stokes. (Text-fig. 23.)

Compare Lemmermann, Eugleninae (in Pascher, *op. cit.*, H. 5, p. 130, f. 191).

He quotes 63μ long, and the figure works out at 12μ broad. Our specimens are shorter, about 40μ long and 14μ broad, cytoplasm finely granular in all forms; chlorophyll diffused or in a thin parietal lamina; tip and tail often hyaline; stigma always distinct; a large oblong nucleus in the hinder part; no paramylon rods or granules.

From the plankton of a wayside waterhole on the Katikati Road, Tauranga, N.Z.

xxii.—*Life-history of* Euglena geniculata *Dujardin.*

In the early part of 1922 I obtained some scanty material from a roadside drainage pool. Later I treated this with hay infusion, some blowflies fell in and decayed and a culture of brown rot fungus resulted. It was in the examination of this fungoid growth that I discovered among the hyphae a whole series of forms illustrating the development of a very graceful little species of *Euglena*. After considerable hesitation I came to the conclusion that this should be identified with:—

EUGLENA GENICULATA Dujardin. (Text-figs. 24-27.)

Histoire Naturelle des Zoophytes Infusoires, 1841, Pl. 5, f. 15, 16.

The figure given in Pascher, *op. cit.*, Heft 5 (Eugleninae by E. Lemmermann, f. 206) does not in the least resemble this species. Dujardin's figures are strap-shaped or subcylindrical, rounded in front and acuminate behind, ending in a small prickle-shaped tail set obliquely. The flagellum is short and weak. Dimensions are quoted as 70-85μ long and 12-22μ broad. Compare also *Euglena mutabilis* Schmitz (*l.c.*, p. 131, f. 203) which however is produced behind into a long spinous tail.

With these essential details our specimens agree. The chloroplast appears to be a thin parietal lamina; nucleus median and globose with a cylinder of paramylon fore and aft of it. In the interspaces a few scattered granules. Stigma small but distinct. Membrane spirally striate obliquely from left to right.

Cell. long. 100, lat. 12μ. Tauranga, N.Z.

Three successive non-motile vegetative forms:

a. (Text-fig. 24).—Broadly ovate, adherent by the slightly pointed apex, long. 21μ, lat. 17μ, develops forward and backward along the antero-posterior axis.

b.c. (Text-fig. 25).—Cell pointed and produced in front, sometimes also behind, long. 30μ, lat. 16μ. Internal details of all these and the succeeding forms are the same.

d.e.—Var. GUTTULA, n.var. (Text-fig. 26.)

Cellulae guttulae formes vel clavatae, fronte acutae valde attenuatae; pone latissimae, rotundatae vel levissime acuminatae. Cytoplasma granuloso. Chloroplastides laminae parietales tenues. Nucleus globosus in mediâ cellulâ. Stigma parvo distincto.

Cell. long. 34, lat. 14μ. Cum prioribus tribus. Tauranga, N.Z.

These two more developed forms noted both motile and non-motile. Cell drop-shaped or clavate, rapidly attenuated and sharp-pointed in front, broadest towards the rear where it is either broadly rounded or conical and acuminate. Cytoplasm minutely granular. Chloroplast a thin parietal lamina. Nucleus globular median. Stigma small but distinct. C.v. often visible.

f.—Var. JUVENILIS, n.var. (Text-fig. 27.)

Cellulae fusiformes, subcylindricae, fronte rapide attenuatae, acutae; pone conicae acuminatae, interdum spinis minutis singulis instructae. Cetera ut in var. *guttulâ*.

Cell. long. c. 50-60, lat. 10-12μ. Cum priori. Tauranga, N.Z.

A young form of the type; the apex still undeveloped, being much attenuated and acute; the nucleus lies a little below the centre; the terminal spine which in the type attains a length of 12μ, was only occasionally noted. All these forms were present in quantity.

xxiii.—*On two new forms of* Colacium.

Among other organisms observed in the *Euglena*-film that formed the subject of investigation in Note xviii. were Entomostraca bearing great numbers of *Colacium*.

COLACIUM OVALE, n.sp. (Text-fig. 28.)

Cellulae primum ovales, deinde longe-ovatae. Zoosporae lineari-ellipticae, lateribus paene parallelis, fronte acute-rotundatae; pone levissime acuminatae. Chloroplastis in fragmentis inaequalibus dispositae. Stigmate nullo.

Cell veg. long. 10-18, lat. 8μ. Zoosp. 24 x 6μ. On a *Copepod*. Lismore.

Cells at first oval, then long-ovate as in *C. elongatum* Playf. (These Proceedings, 1921, p. 116, Pl. iii., f. 4-6). The zooid however was not the same shape, being linear-elliptic, acutely rounded in front and slightly acuminate behind. The chloroplasts were irregularly fragmented, and neither stigma, nucleus, c.v., nor pyrenoids were visible.

COLACIUM ARCUATUM, n.sp. (Text-fig. 29.)

Cellulae arcuatae uno latere quam levissime concavae paene planae, altero latere modice convexae; apicibus acute-rotundatis. Cytoplasma minute granuloso; chloroplastidibus in fragmentis inaequalibus dispositis. Nec stigma visibile fuit, nec nucleus, neque c.v.

Cell. long. 16-36, lat. 5-10μ. On a species of *Copepod*. Lismore.

Only the vegetative cells were seen, attached as usual by a mucous pedicel singly or in clusters of 2-4. They were very slightly arched, being almost flat on one side and more or less convex on the other. Cytoplasm finely granular. Chloroplasts in irregular fragments. Neither pyrenoid, stigma, nucleus nor c.v. visible.

I lost the specimens before I had a chance to detach any of the vegetative cells, otherwise a few minutes would have sufficed for them to develop into zoospores. It is noteworthy that though the cells become motile and produce flagella when detached, they show no more internal detail than was originally present.

DINOFLAGELLATAE.

xxiv.—*On* Exuviella lima (*Ehr.*) *Schutt.* (Text-fig. 30.)

In 1909, when I gathered this organism alive from the creek at Canley Vale, my simple student's 1-6 in. obj. was not sufficiently powerful to show the necessary detail. On taking up work with better objectives in the Richmond River District which is very rich in all kinds of flagellates, I had great hopes of coming across it again, but in vain. My notes therefore in "Peridineae of New South Wales" (These Proceedings 1919, pp. 817, 818) had to be written on preserved material. It is curious then that on starting work with the microscope in New Zealand this organism should be the first living thing to meet my eye, adding a new record to its distribution in freshwater.

Shape.—Our New Zealand specimens are oblong, rounded off at all points; those from the suburbs of Sydney are generally somewhat narrowed towards the flagellate end. Subcircular specimens and truncate forms may also be noted, such being the result of transverse self-division. In side view the cell is much compressed and generally slightly arched.

Cytoplasm.—The contents of the cell, and its disposition, are so obscured by a layer of large irregular (paramylum ?) granules lying close together over the surface of the cell-wall, that it is difficult to see internal details.

Chromatophore.—Yellow-brown or yellow-green in colour, apparently a delicate parietal lamina.

Nucleus.—A large globose or transversely oblong body occupying the posterior end of the cell and extending forward as far as the pyrenoid. It has the appearance of being punctate or finely granular as shown by Penard in *Gymnodinium mirabile* and *G. helveticum* (Les Peridiniacées du Lac Leman).

Flagella.—There are two flagella, one stout and up-standing, about the length of the cell. The other, corresponding to the transverse flagellum in *Peridinium*, is very delicate and wavy and lies close to the margin of the cell. A notch in the front valve, not found in the other, gives exit to both flagella.

Pyrenoids.—A large pyrenoid occupies the centre *of each valve*, being pressed close against the cell-wall to the exclusion of the granules, hence showing up very clearly. From their appearance in side-view they seem to be either plano-convex, or disciform with slightly retuse centre.

Contractile vacuole.—I have not been able to locate this, even with the 1-12 in. obj.

Stigma.—None, nor have I ever seen the red oil-drop sometimes present in *Gymnodinium*, etc.

Habitat.—Noted as a marine organism from the Parramatta River and salt-water swamps at Newington (Sydney), both the ordinary size and var. *major* Playf., *l.c.*, p. 818. In these marine specimens the membrane was quite smooth, not even punctate.

Dimensions.—Freshwater, 25-36μ long, 20-26μ broad. Var. *major* 42-56μ long, 32-45μ broad.

Suburbs of Sydney (N.S.W.); Tauranga (N.Z.).