# AUSTRALIAN FRESHWATER FLAGELLATES.

By G. I. Playfair.

(Plates i. to ix.; and three Text-figures.)

In the present paper I have endeavoured to give some account of all those forms of microscopic life found in our waters, which are included under the class Flagellatae of the freshwater Algae. From the early days of my studies I have always felt a lively interest in the freshwater flagellates and looked forward to a time when I should be in a position to set forth some small attempt at a monograph of such as occur locally. The following notes therefore, dealing with almost all the commonly occurring species and with a large number of forms, also, which are not at all common, represent the gleanings of 15 years.

The more important part of the work, however, was accomplished during the period when, as a science research scholar of the University of Sydney, I was enabled to devote myself for some years to a more thorough investigation of Australian pond life than I had previously done. It is with pleasure, therefore, that I here express my heartiest gratitude to the Senate of the University for afforded me the opportunities which have resulted in my bringing a long-cherished desire to a successful issue.

In conjunction with these notes should be taken my earlier paper on "The Genus *Trachelomonas*." (These Proceedings, xl., 1915) which was written in advance, on account of the very large number of new forms observed in that genus. The title "Australian Flagellates" may perhaps be considered too grand when it is observed that all the gatherings were made in two localities only, viz.: —the suburbs of Sydney and the neighbourhood of Lismore. This, however, is not so, for the Flagellates are entirely cosmopolitan and the ordinary forms always very wide-spread. In moving from one district to another one merely picks up the same common form over and over again. The rarer varieties, on the other hand, are generally polymorphic forms without any local attachment whatever, but merely the result of unusual combinations of rain and shine, temperature, movement and stagnation in their habitat. It is for this reason that they are uncommon. They are entirely the product of their environment. In a very large number of cases also, they are simply stages of growth which have become fixed at that point either by the induration of the cell-wall or by the lack of any stimulus to further growth.

Given a suitable district the most advantageous course to pursue is to thoroughly exploit its treasures over a term of years, by repeated gatherings from every little pond, roadside puddle, or piece of swampy ground. All the forms marked "Lismore" in this paper were gathered within a circle no more than 2 miles in diameter, and yet after my having thoroughly ransacked this comparatively small area for eight years, two fine specimens, never previously recorded—*Mallomonas litomesa* Stokes and *Trachelomonas splendida*, n.sp.—make their appearance from pools already well searched (March, 1920). Compare my remarks in "New and rare freshwater Algae" (These Proceedings, xliii., 1918, p. 498). *Trachelomonas splendida* was obtained from the pool there referred to.

Mention is here made of 172 forms of flagellate life representing 39 genera; 105 being classed as species, 62 as varieties and 5 forms. Of these, 43 species, 48 varieties and 5 forms (96 in all) are considered to be hitherto undescribed. One genus, *Scintilla*, is proposed as new.

These figures, however, do not include the 104 forms of *Trachelomonas* previously recorded. When these are added, the total number of non-Volvocine Flagellates observed to date, stands at 276. The proportion of new forms may appear rather large, but it should be borne in mind that hardly any work has been done on the freshwater Flagellates of subtropical or tropical countries, and that it is exactly the higher temperatures prevailing there and the greater vicissitudes to which pond life is subjected, that are the cause of the much larger number of varieties to be observed.

The enlargement attached to the figures in the explanation of the plates is not the magnification used in observation of the living specimens but merely indicates the scale (somewhat reduced) used in drawing the figures for reproduction. Observations were made chiefly with a 1/6 inch holoscopic objective, N.A. .95, and 18 diam. ocular in a tube-length of 6 inches. These were assisted by a 1/12in. homogeneous holoscopic lens.

## FLAGELLATAE

### Protomastigineae.

### Fam. BICOECACEAE.

### Genus POTERIODENDRON Stein.

POTERIODENDRON PETIOLATUM Stein (Pl. i., fig. 1).

Lorica long. 17—22, lat. 8—11$\mu$.

Guildford (77); Lismore (260, 290, 298).

Stein, Der Organismus der Infusionsthiere, iii., H.i., T.xi., fig. 8—11; Senn, Flagellata, p. 123, f. 80; Kent, Infusoria, *Stylobryon petiolatum* (*non* Dujardin), Pl. xxiii., fig. 17—30; *Dinobryon petiolatum* Lemm., Gattung *Dinobryon*, p. 519.

The cupule has a slightly everted rim. I have never seen the zooid, but small sprays of the empty cupules occur very sparsely in my gatherings. They are generally faintly rufescent, differing in this from all forms of *Dinobryon*, the petioles inconspicuous and no longer than the cupules, so that the latter appear to be sessile. They may always be distinguished from *Dinobryon* by a minute refringent blob at the base, marking the head of the petiole which is there slightly dilated. Main petiole of a spray noted—55$\mu$ long. For *Stylobryon* Fromental (*see* Kent, *l.c.*, Pl. xxiii., fig. 29) the arrangement of the cupules in

the figure differs from both *Dinobryon* and *Poteriodendron*. *Dinobryon petiolatum* Duj. (Hist. Natur. des zoophytes Infusoires, p. 322, T.i., fig. 22) has nothing to do with *Poteriodendron*, as the author says "animaux verts."

Var. ABBOTTI (Stokes) mihi. (Pl. i., fig. 2.).

Cupules conical-campanulate, rim not everted, dimensions same as those of the type.

Sydney Water-Supply; Lismore (260, 290).

Syn. *Stylobryon Abbotti* Stokes, Infusoria of the U.S., p. 79, Pl. i., fig. 12; *Dinobryon sertularia* forma, Playf., Plankt. Syd. Water, p. 515, Pl. 57, fig. 5; *D. sertularia* var. *conicum*, Playf., Frw. Alg. Lismore, p. 315; *Cf.* Stein, *l.c.*

Stokes gives a good detailed account of this form and its zooid, but his figure is incorrect, as he says that the cupules are twice as long as the maximum breadth (true also of Stein's and of our own) whereas in fig. 12 the proportions are only 6:5. I find the two forms intermingled in the same spray.

## Fam. CRASPEDOMONADACEAE.

### Genus SPHAEROECA Lauterborn.

#### SPHAEROECA VOLVOX Lauterborn.

Coenob. diam. c.15$\mu$; cell. long. circa 5, lat. c. $\frac{3}{4}\mu$. Lismore.

*Cf.* Senn, *l.c.*, p. 126, f. 84B (after Lauterborn). Very rare, only once noted as a minute coenobium of hyaline cells radiating from a centre as in *Synura*. The cells were so small and the outlines so indistinct that even under a high magnification I was unable to make out the details. Senn gives the dimensions as, cells 8—12$\mu$ long, coenobium up to 200$\mu$.

### Genus SALPINGOECA Clark.

I do not think that there is anything characteristic of the species in the presence, absence or length of the petiole in this genus. Kent's figures, *l.c.*, Pls. v. and vi. seem to me to show this distinctly. Pl. v., f. 20, makes it quite clear also that the coenobium may simulate *Petiolatum* so that in the absence of the zooid one cannot be distinguished from the other.

#### SALPINGOECA AMPULLACEA (A. Br.) Stein. (Pl. i., figs. 3, 4).

Cell. long. 10, lat. $4\frac{1}{2}$—$6\frac{1}{4}\mu$. Lismore (302).

Syn. *Chytridium ampullaceum*, A. Braun, "On Chytridium," T. v., f. 24—27; Stein, *l.c.*, iii., H. i., T. xi., f. 6, 7. Quantities noted on one occasion on *Oedogonium*—rare, however, in my experience. Kent's figures of *S. amphoridium*, *l.c.*, Pl. v., f. 2, 5, at least, should be considered as representing this species, the long narrow tubular neck being characteristic. A minute peduncle may sometimes be observed and is probably very often present when not noticeable.

Var. CORDATA, n. var. (Pl. i., fig. 5).

Loricae corpore cordiforme nec globoso, inferne acuminato, lateribus levissime arcuatis. Long. 10, lat. $4\frac{1}{2}$—$6\frac{1}{2}\mu$. Lismore (302). Cum forma typica.

The body of the lorica is more or less heart-shaped, not globose, and runs to a point beneath. Kent describes and figures (*l.c.*, Pl. v., figs. 13—16), species *S. amphora* Kent and *S. urceolata* Kent, of somewhat similar shape, but without the long neck. On *Oedogonium* in quantity, mixed with the type.

SALPINGOECA AMPHORIDIUM Clark.

If I say that I do not know whether I have ever observed the type of this species, it is because Clark's original figures (Ann. Mag. Nat. Hist., Ser. iv., vol. i., 1868, p. 203) are difficult of access, the figures given by various authors all differ among themselves and, though typical forms are distinct enough, it is not always easy to say where *S. amphoridium* ends and *S. ampullacea* begins.

Lately, however, I have obtained good pencil sketches of Clark's type figures. He gives two, which are not in the least alike. The second has never, to my knowledge, been observed or figured since, and as it is far the most common form of *Salpingoeca* in this country, I have adopted it as var. *australica* (*infra*). The other is nearly, but not quite identical with Kent's figures (Infusoria, Pl. v., figs. 3, 4, and 7 only, especially fig. 4)—this, therefore, must be considered as the type. It has an almost exactly globose body, rounded below, somewhat produced and ovate above, but very little narrowed or constricted in the throat, the sides diverging upwards and outwards straight to the wide mouth, rim not everted. There is no distinct tubular neck. Kent's figures are all too narrowly constricted and some verge on *S. ampullacea*.

Var. AUSTRALICA mihi. (Pl. i., fig. 6).

Cellulae minutae, sessiles; inferne rotundatae, superne ovatae, haud vel levissime constrictae, lateribus ad os convergentibus, ore non everto, collo nullo vel haud distincto.

Cell. long. 8—14, lat. 4—6, lat. oris 1—2$\mu$.

Auburn; Guildford; Casino (189); Lismore (254, 260).

Our commonest form; found sessile on *Spirogyra, Hydrodictyon, Oedogonium,* more rarely on *Cyclops* (Entomostraca). The cells are ovate, rounded below, narrowed above, sides converging to the narrow mouth, only very slightly constricted, if at all, therefore with no formation of throat or neck except the very least straightening of the sides below the mouth, rim not turned out. Senn's figure of *S. amphoridium,* Flagellata, p. 128, fig. 85A (*after Francé*), has the same shape of opening as var. *australica,* but below is very strongly inflated, much more so even than in Clark's type. It might stand as var. *Francei.* Butschli's form with flat base, figured by Kent (*l.c.,* Pl. v., fig. 33) should rather, on account of the distinct neck and everted rim, be considered a variation of *S. ampullacea.*

SALPINGOECA STEINII Kent. (Pl. i., fig. 7).

Syn. *S. amphoridium* Stein (*non* Clark), *l.c.,* T. xi. f. 1—5. This form might well have been arranged as a variation of *S. amphoridium.* The lorica has the same characteristic wide mouth and throat but no neck. The body, however, instead of being globular, is drop-shaped with a minute protuberance beneath, acting as a peduncle.

Cell. long. 21; lat. corp. 7, constrict. 2½, oris 5$\mu$.

Fairfield (112). Out of weeds in a creek pool.

SALPINGOECA OBLONGA Stein. (Pl. i., figs. 8, 9).

Cell. long. 11—16; lat. 4½—6, lat. oris 3½; stip. long. 4—5$\mu$.

Guildford (77, 88); Lismore (260).

*Cf.* Stein, *l.c.,* T. x., fig. iv., 4. Zooid not observed. Stein's figure works out at long. corp. 21, lat. 7½; stip. long. 9$\mu$. Very rare here and position some-

what doubtful—it might be a form of *Poteriodendron*. Out of weeds in a creek pool, along with *Dinobryon* and *Poteriodendron*.

## Fam. PHALANSTERIACEAE.

### Genus PHALANSTERIUM Cienkowski.

#### PHALANSTERIUM CONSOCIATUM (Fres.) Cienk. (Text-fig. 1*a*).

Coenob diam. 100—440$\mu$.

Auburn (140, 149); Rookwood; Lismore (308).

Cienkowski, Beitr. z. Kenntn. mikrosk. organismen; Kent, Infusoria, Pl. xii., f. 5—9; Stein, *l.c.*, T. vii., fig. 1, 2. Generally met with in ground gatherings in swampy places. It occurs as irregularly circular or oval cushions with scalloped edges, consisting of a pale yellow or brownish mucus, minutely granular. In optical section at the edges the cushion shows as composed of a series of radiating wedges, each containing two cells near the margin. From above, the structure is irregularly polygonal.

## Fam. MONADACEAE.

### Genus DENDROMONAS Stein.

#### DENDROMONAS VIRGARIA Stein. (Text-fig. 2*e*).

Naturg. d. Flagell., H. i., T. vi., fig. 1—5. Very rare, noted only once, from the Richmond River at Lismore (186) as a spray of a large number of living cells, the latter 10 × 8$\mu$, agreeing in shape with those figured by Stein. Differs from *Anthophysa* in having a delicate branched coenobium, each cell being fixed at the end of a separate branch; *cf.* Senn. *l.c.*, p. 133.

### Genus ANTHOPHYSA Bory.

#### ANTHOPHYSA VEGETANS (O. F. Muller) Stein.

Coenob diam. 24—28; cell. long. 12, lat. 4—6$\mu$.

Auburn; Parramatta; Lismore (253, 260, 263).

*Cf.* Stein, *l.c.*, T. v., fig. 1—17; Senn, *l.c.*, p. 133, fig. 89c. This organism consists of a cluster of cuneate cells attached to stones or weeds by a very irregular mucous peduncle which gets gradually drawn out thinner and thinner by the movement of the flagellate cells until the cluster breaks away and becomes a free-swimming stellate coenobium. The shape of the cells seems to vary from pyriform to cuneate, generally the latter as far as my observation extends.

### Genus CEPHALOTHAMNIUM Stein.

#### CEPHALOTHAMNIUM CYCLOPUM Stein. (?) (Text-fig. 2*f*.)

Long. corp. 10, lat. 3; long. stip. 10; long. flag. c. 20$\mu$.

Canley Vale (128).

A few single zooids noted on the shell of an entomostracan.

They were hyaline and perhaps represent this species. Of course, each coenobium must begin with a single stipitate or sessile zooid. Cf. *Cephalothamnium caespitosum* Kent and *C. cuneatum* Kent; also *Anthophysa stagnatilis* Stokes, p. 83, Pl. i., f. 16, 17.

## Fam. BODONACEAE.

### Genus Bodo Ehr.

#### Bodo edax Klebs. (Pl. i., fig. 10).

Flagellatenstudien, Zeitschr. f. wiss. Zool., Bd. lv., 1892. *Cf.* Senn, *l.c.*, p. 135, f. 90A. Oval, more or less flattened on one side, pointed in front, rounded behind, with two distinct flagella near the anterior end, one at least, if not both, often directed backwards. A large coloured food ball often noticeable towards the hinder end. Contractile vesicle in front.

Long. 15, lat. 10$\mu$. Lismore. Rare.

#### Bodo saltans Ehr. (Pl. i., fig. 11).

*Cf.* Stein, T. ii., Abt. vi., f. 1—7 and Abt. v., f. 15; Kent (*Diplomastix*) Pl. xxiv., f. 11—12; Forbes and Richardson, Biol. Upper Illinois River, Pl. lxxxiii., f. 9 (after Kolkwitz). These authorities all agree in identifying this species with the minute drop-shaped flagellate which is commonly seen under the microscope *pecking* away at any dissolving mass of protoplasm. The body is slightly curved, broadly rounded behind and somewhat pointed in front. Here are attached two, long, distinct flagella which are turned backwards under the animalcule. Occasionally it fastens itself to some rotting organism by its pointed anterior extremity, holding on, no doubt, by the bases of the flagella. *Cf.* Stein, T. ii., Abt. v., f. 12 and f. 15, in which state it has been described as *Colpodella pugnax* Cienkowski.

The figure of *Bodo saltans* given by Senn, *l.c.*, p. 135, fig. 90B, would seem to belong to *Bodo caudatus* (Duj.) Stein, *l.c.*, T. ii., Abt. v., f. 1—14 (*Amphimonas caudata* Duj. *l.c.*, Pl. 7, fig. i.; *Diplomastix caudata* (Duj.) Kent, *l.c.*, Pl. xxiv., f. 1—10; *Heteromita putrina* Stokes, Frw. Infus. U.S., p. 105, Pl. ii., fig. 6, 7.)

Other figures that seem to represent this organism are *Heteromita rostrata* Kent, Pl. xv., fig. 18—28, *H. uncinata* Kent, Pl. xv., fig. 29, and *H. adunca* Meresch. in Kent, Pl. xv., f. 44.

## Fam. AMPHIMONADACEAE.

### Genus Rhipidodendron Stein.

#### Rhipidodendron huxleyi Kent. (Text-fig. 1*b*).

Not uncommon in bottom samples from swampy pools. The elegant pale yellow fronds of the coenobium attain to about 250$\mu$ in length. The animalcules themselves are minute and inconspicuous cells situated at the tips of the branches. *Cf.* Stein, T. iv.

Auburn; Grafton (265); Lismore (254, 308, 316).

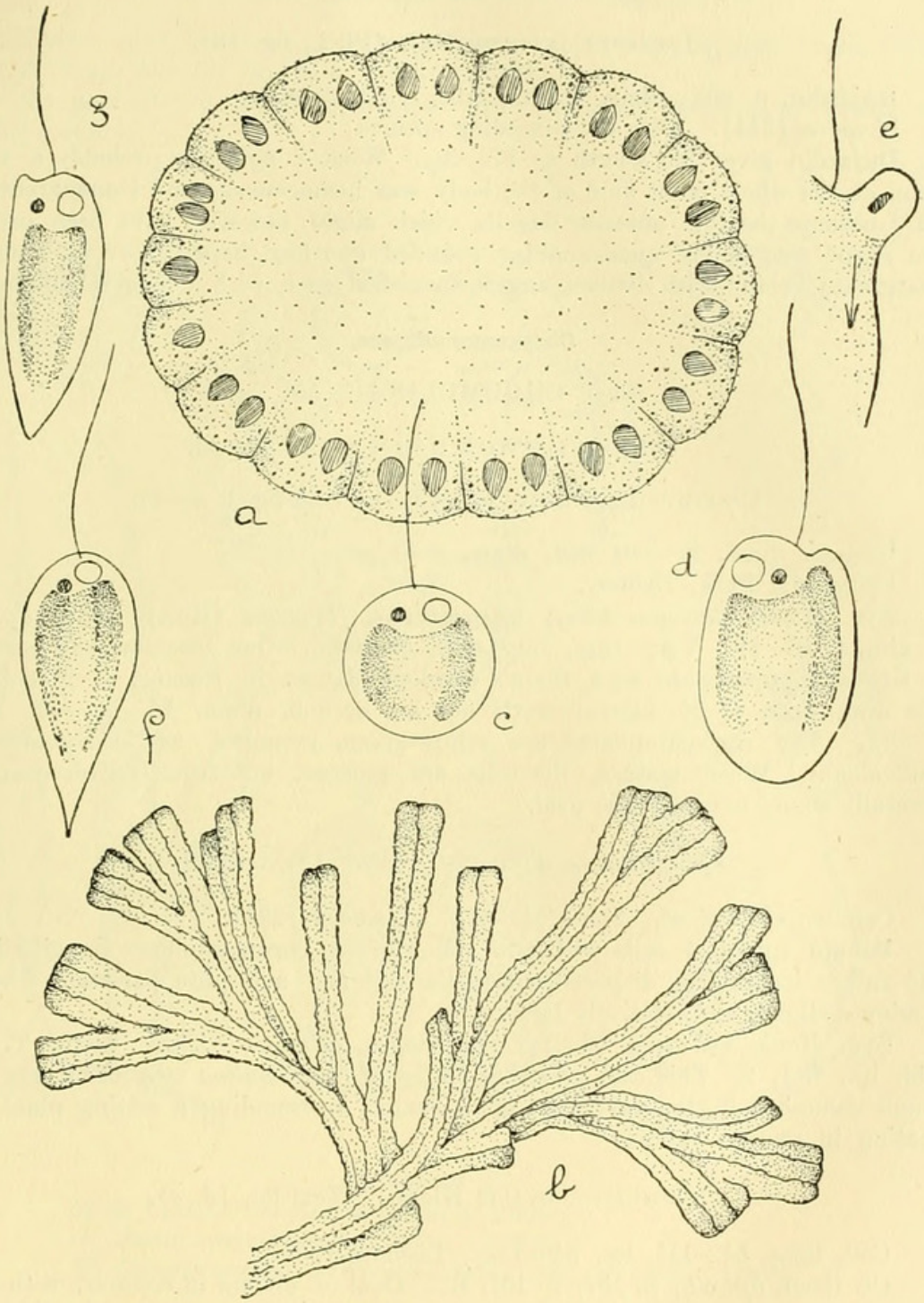
**Distomatineae.**

### Genus Trepomonas Dujardin.

#### Trepomonas agilis Duj. (Pl. i., fig. 12).

Dujardin, *op. cit.*, p. 294; Senn, p. 149, fig. 103C; Stein, T. iii., Abt. iii., f. 1—14.

Lismore (344). In the water of putrid swamps.




Text-fig. 1.

*(a) Phalansterium consociatum* (Fres.) Cienk. x 500; *(b) Rhipidodendron Huxleyi* Kent. x 375; *(c) Chromulina ochracea* (Ehr.); *(d) Chr. ovalis* Klebs; *(e) ditto* seizing a *Bacterium*; *(f) Chr. pyriformis*, n.sp.; *(g) Chr. cuneata*, n.sp.; *c–g* x 2000.

Genus HEXAMITA Dujardin.

HEXAMITA INFLATA Duj. (Pl. i., fig. 13).

Dujardin, p. 296; Stein, T. iii., Abt. iv., f. 1—6.

Lismore (344). With the preceding species.

Dujardin gives the length as 17—20$\mu$. What I figure is probably a young form, as the whole front half of the body was homogeneous and transparent, nor did I observe the four anterior flagella which might, however, have been present. The shape was almost quadrangular, rounded and bag-shaped in front, truncate-emarginate behind with distinct angles furnished each with a long flagellum.

**Chrysomonadineae.**

Fam. CHROMULINACEAE.

Genus CHROMULINA Cienkowski.

CHROMULINA FLAVICANS (Ehr.) (Text-fig. 2 *a—d*).

Coenob. diam. 20—60; cell. diam. 8—12$\mu$.

Centennial Park, Sydney.

Syn. *Monas flavicans* Ehr.; *Chrysomonas flavicans* (Ehr.) Stein, *op. cit.* T. xiii., f. 16—19. Very rare, only once observed. Our forms agree perfectly in size and appearance with Stein's excellent figures in Naturg. d. Flagellaten. The dimensions of his figures work out at: coenob. diam. 15—65, cell. diam. 7—10$\mu$. The chromatophores are yellow-green, arranged as in *Synura* and *Mallomonas*. When mature, the cells are globose, but from self-division are generally found more or less oval.

CHROMULINA OCHRACEA (Ehr.) (Text.-fig. 1*c*).

Cellulae sphaericae, diam. 5½—8½$\mu$. Lismore (294).

Minute spherical cells with two yellow-green chromatophores longitudinally and rather irregularly disposed within the cell and not quite parietal. There is a minute stigma and relatively large c.v.

Syn. *Monas ochracea* Ehr.; *Chrysomonas ochracea* (Ehr.) Stein, T. xiv., Abt. iii., f. 1, 2. This and all other forms of *Chromulina* mentioned here were found enmeshed in the mycelium of a fungus surrounding a rotting plant stem floating in swamp waters.

CHROMULINA OVALIS Klebs. (Text-fig. 1*d, e*).

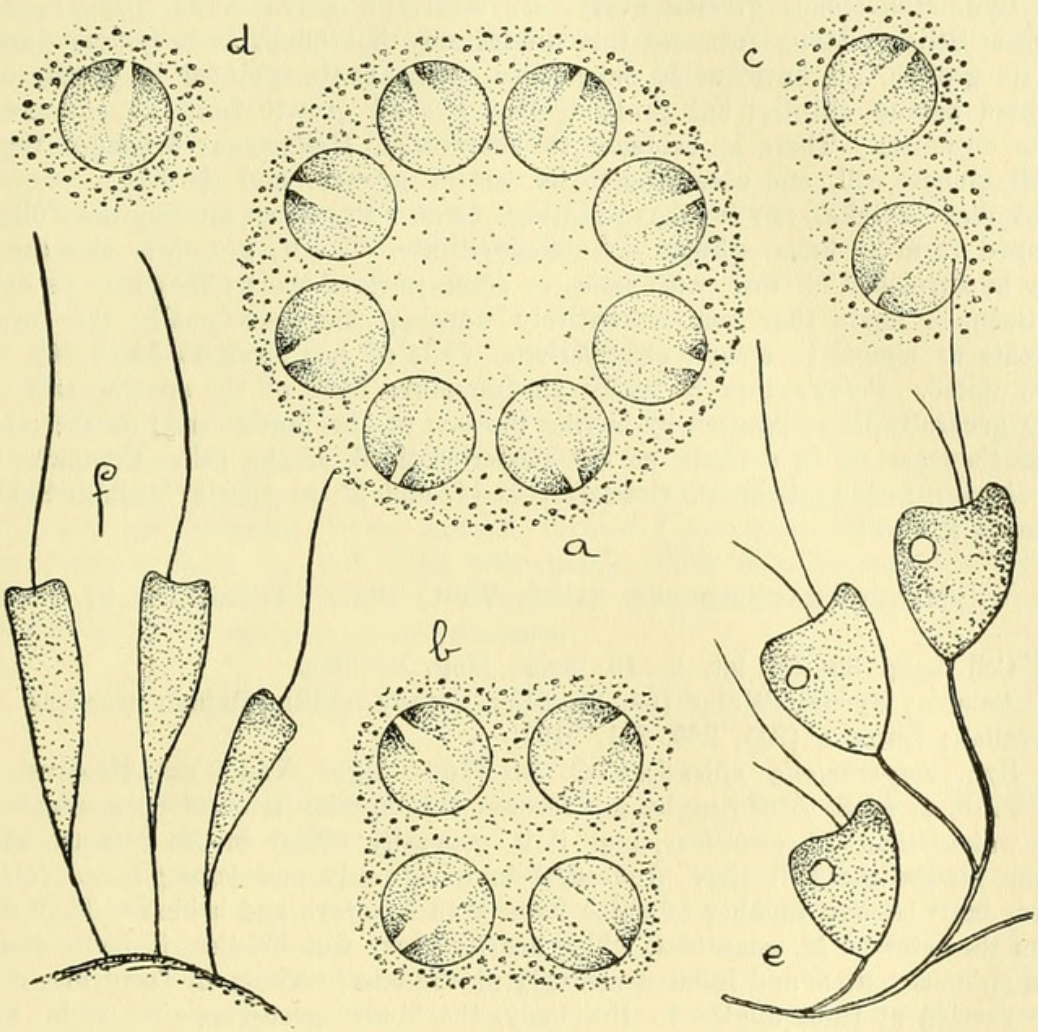
Cell. long. 8½—11½, lat. 5½—7½$\mu$. Lismore (294).

Cf. Senn, *op. cit.*, p. 154, f. 107, B2. Oval or oblong in contour, with a decided nick to one side in front from which the flagellum springs. At this point there seems to be a kind of protrusile or distensible pharynx. I noted one feeding on cells of *Bacterium termo*. These were worked down the flagellum and received with a globule of water (or plasma) which could be observed as a very distinct swelling passing down the side of the cell till it lodged in the posterior part of the cell. Exactly the same procedure is depicted by Senn, p. 119, in the case of *Oicomonas termo* Ehr. which this species of *Chromulina* very much resembles. Is it possible that one is a saprophytic form of the other?

CHROMULINA PYRIFORMIS, n.sp. (Text-fig. 1*f*).

Cellulae plus minus pyriformes, fronte rotundatae, postice acuminatae. Cell. long. 11—12, lat. $5\frac{1}{2}\mu$. Lismore (294).

Cells pear-shaped more or less, or ovate, broadly rounded in front, and pointed behind.




Text-fig. 2.
*(a–d) Chromulina flavicans* (Ehr.) x 900;
*(e) Dendromonas virgaria* Stein. x 1500;
*(f) Cephalothamnium cyclopum* Stein, (?) single zooids, x 2000.

CHROMULINA CUNEATA, n.sp. (Text-fig. 1*g*).

Cellulae prae latitudine longiores, cuneatae; fronte subtruncatae, postice acuminatae.

Cell. long. 12, lat. $3\frac{1}{2}$—$4\mu$. Lismore (294).

The cell is long and narrow, somewhat wedge-shaped, subtruncate in front with a notch to one side as in *Chr. ovalis* Klebs, sharp-pointed behind, sides slightly arched.

## Genus MALLOMONAS Perty.

### MALLOMONAS ACAROIDES Perty. (Pl. ii., figs. 1, 2).

Cell. long. 21—42, lat. 12—23; setae long. 12—30$\mu$.

Auburn; Guildford (84); Parramatta (136); Clyde; Wyrallah; Lismore (261, 287).

Syn. *Mallomonas Plosslei* Perty, *see* Kent, Pl. xxiv., f. 72, 73; *Lepidoton dubium* Seligo. Many forms of this species may be found, as it is very variable in its growth. I have noted subglobose, oval, ovate pointed in front, ovate pointed behind, elliptic; but probably they are all growth forms of one and the same organism. There is evidence to show that *Mallomonas* develops from a small globose cell, and according to its rate of growth, and the line of development that it takes, so is the resulting form. In every species the fully-developed form is linear-elliptic or oblong-elliptic. In *M. acaroides* also the cell may be furnished all over with setae, or some part of the surface may be devoid of them, or again they may be entirely wanting, and occasionally they are so delicate as almost to escape observation. Cells as low down as 14 × 10$\mu$ have been noted. Perty's type is really an immature form of the species, and these may generally be recognised by having the c.v. at the hinder end; in the mature form they are set in a circle at the posterior third of the cell. Compare here *M. elegans* Lemm., Schwed. Gewasser, f. 14, and *M. tonsurata* Teiling, Schwed. Plankt., i., fig. 3.

### MALLOMONAS SPLENDENS (G. S. West) Playf. (Pl. ii., fig. 3).

Cell. long. 30—56, lat. 9—13; setae long. 16—36$\mu$.

Auburn; Sydney Water (64, 80, 81); Botany (142); Botanic Gardens (3); Wyrallah; Lismore (241, 260, 261, 316).

Syn. *Lagerheimia splendens* G. S. West, Algae Yan Yean Reservoir, p. 74, Pl. 6, f. 4—8. Judging by my records this species is even more common in our waters than *M. acaroides*, and it is generally found in the mature shape, if not always the full size. Indeed, I know of only one young form (*infra*). There may be any number of setae from 2 to 4 before and behind. They differ from the setae of *M. acaroides*, which are like very fine bristles, in being stouter, of a spinous nature and inflated strongly at the base. Those in front are generally carried at right angles to the body, the hinder group project right back; they are capable of a slight amount of lateral movement.

Var. PUSILLA, n.var. (Pl. ii., fig. 4).

Forma multo-brevior, oblongo-ovalis, setis nullis observatis, membrana glabra, striis obliquis 3—4 decussatim dispositis ornata.

Cell. long. 10—17, lat. 8—12½$\mu$.

Sydney Water (80, 81); Centennial Park, Sydney; Byron Bay.

Probably a young form either in process of growth or fixed by incrassation of the cell wall before reaching maturity. It is much shorter than the type though almost as broad as a full-grown specimen. Oblong-oval in shape, membrane smooth, crossed by 3 or 4, very fine, obliquely disposed, criss-cross grooves having the appearance of striae. No setae in the specimens noted.

MALLOMONAS AUSTRALICA, n.sp. (Pl. ii., fig. 5).

Cellulae elliptico-cylindraceae; mediis lateribus fere rectis; apicibus late-rotundatis. Membrana hyalina incrassata, granulis parvis in seriebus transversis ordinatis ornata; setis nullis notatis.

Cell. long. 20—25, lat. 10$\mu$.

Botanic Gardens, Sydney (3); Botany; Guildford; Lismore (245).

A much rarer species than either of the foregoing. When mature it is oblong-cylindrical with broadly rounded ends, and crossed transversely but not obliquely by rows of small granules. No setae observed.

Var. GRACILLIMA, n.var. (Pl. ii., fig. 6).

Forma gracillima, magis stricte cylindracea; lateribus fere rectis, apicibus rotundatis. Membrana ut in forma typica; setis nullis.

Cell. long. 22, lat. 4$\mu$. Lismore.

Var. SUBGLOBOSA, n.var. (Pl. ii., figs. 7, 8).

Cellulae subglobosae vel ovales, plerumque fronte paullo angustatae; vesiculis contractilibus 4 juxta extremitatem posteriorem; ceteris ut in forma typica.

Cell. long. 21—27, lat. 16$\mu$. Lismore (316), from swampy ground.

These are probably young growth forms of the type, either still in process of development or, as I think more likely, which have become fixed by the hardening of the cell-wall due to stagnation. On either view they give us a glimpse of the life-history of the organism.

MALLOMONAS LITOMESA Stokes. (Pl. ii., fig. 9).

Cell. long. c. 25, lat. c. 5$\mu$. Lismore.

Stokes, Freshwater Infusoria of the U.S., Journal Trenton Nat. Hist. Soc., i., 1888, p. 92, Pl. i., f. 32.

Very rare indeed, only once observed. The body is linear-elliptic, membrane delicate and smooth (Stokes says however "Cuticular surface finely crenulate"), a few straight setae at the hinder end, but those in front are characteristic, being six in number springing from a small membraneous projection and curved back like the ribs of an umbrella. Chromatophores pale yellow-green, close to the cell-wall.

Var. CURTA, n.var. (Pl. ii., fig. 10).

Cellulae curtae, oblongae; pone late rotundatae sine setis; ceteris ut in forma typica.

Lismore, with the type.

This form is very short, oblong, broadly rounded behind where the setae are wanting; otherwise like the type. Size not noted. A narrower and more strictly cylindrical form, much less commonly met with. Sometimes at the anterior end there is a slight membraneous bi-papillate projection, and below the flagellum, just between the ends of the chromatophores, a dark granule may occasionally be distinguished. I have noticed the same in *Synura granulosa, cf.* New and rare freshwater Algae, p. 508, Pl. lvi., f. 1—3.

## Fam. PHAEOCAPSACEAE.

### Genus PHAEOCOCCUS Borzi.

PHAEOCOCCUS PLANKTONICUS W. and G.S. West. (Pl. ii., fig. 11).

Coenob. diam. 90; Cell. diam. 10$\mu$. Botany.

Obtained once only in a ground gathering of mixed microscopic life from Gardener's Road swamps, Botany. It was in the *gloeocystis* condition as a hyaline, structureless, mucilaginous coenobium containing 4 families of about 8 cells each. The cells were globose, with two yellow-brown parietal chromatophores disposed as in *Synura* or *Mallomonas*. Senn has no place for this genus in his "Flagellata"; I include it here from some resemblance to *Phaeocystis*, at least in its vegetative condition.

## Fam. SCINTILLACEAE.

### Genus SCINTILLA, n.gen.

Cellulae minutae, delicatissime, ovatae vel ovales; membrana tenuissima, glabra, hyalina, granulis nullis nec setis; chromatophoris 2 parietalibus per longitudinem dispositis; flagellis 2 tenuissimis; vesiculis contractilibus 2 postice instructae; stigmate nullo.

SCINTILLA CHLORINA, n.sp. (Pl. ii., figs. 12—14).

Cellulae ovatae subcuneatae, fronte angustiores, postice late-rotundatae; polo anteriori modice deplanatae et saepe levissime emarginatae; membrana delicatissima hyalina glabra; flagellis 2 tenuissimus; chromatophoris 2 luteo-viridibus; stigmate nullo.

Cell. long. 7½—21; lat. 4½—12½$\mu$. Byron Bay (324).

A very rare flagellate which I obtained in some quantity from the drained bog at Byron Bay soon after rain. In shape the cell varies from ovate to subcuneate, narrower in front, well rounded behind, sides often somewhat flattened towards the anterior end, which is subtruncate and slightly emarginate. Membrane very delicate and indistinguishable, smooth, hyaline, without markings or setae; flagella two. The cell contents are arranged as in *Synura* or *Mallomonas* with two, thin, yellow-green, parietal chromatophores disposed longtitudinally, starting in front and gradually developing right back to the hinder end. When the opposite edges of the chromatophores just overlap in the middle there appear to be four longitudinal chromatophores but this is an illusion. The posterior portion of the contents is a clear, transparent, homogeneous mass, generally surrounded by large amylaceous granules; no stigma, but there seem to be two pulsating vacuoles behind. With dilute formalin the cell crumples up at once to a shapeless mass, extruding the contents; this does not occur in *Synura* or *Mallomonas*. It is generally taken to indicate the entire absence of cell-wall, but of this I have my doubts. Cf. *Phaeocystis globosa* Scherffel in Lemmermann (Nord. Plankt., xxi.) Flagellatae, p. 2, f. 6.

SCINTILLA SPLENDIDA, n.sp. (Pl. ii., fig. 15).

Cellulae ovales, polos versus praecipne anteriore modice attenuatae, fronte levissime emarginatae; membrana glabra granulis nullis nec setis; flagellis 2 tenuissimis; stigmate nullo; chromatophoris obscure viridibus.

Cell. long. 31, lat. 19$\mu$. Lismore (347).

This species is half as large again as the foregoing and very different in appearance. It is elliptical-oval, not ovate, but the minute emargination in front may still be noted. The membrane is smooth and hyaline, showing no sign whatever of markings or setae. I examined a specimen with the 1/12th inch homogeneous immersion lens; the internal organisation is exactly as in *Synura* or *Mallomonas*, the anterior third consisting of very finely granular protoplasm, the posterior two-thirds of a globe of clear, transparent, homogeneous material surrounded by large amylaceous granules, the whole being enclosed by two delicate parietal chromatophores. The colour of the latter was very distinct, being neither yellow-green nor chlorophyll-green, nor brownish-green, nor blue-green, but a deep gray-green. Very little reliance, however, can be placed on the colour of the chromatophores in the *Chrysomonadineae* as a study of *Cryptomonas* soon shows. Two very delicate flagella noted, which seems to separate the organism from *Mallomonas;* I was not able to detect the pulsating vesicles, but from 2 to 4 will probably be found towards the hinder end of the cell.

## Fam. TESSELLARIACEAE.

### Genus TESSELLARIA Playfair.

#### TESSELLARIA VOLVOCINA Playf.

See description and figures in "Freshwater Algae of the Lismore District" (These Proceedings, 1915, p. 315, Pl. xlv., f. 6, 7, under *Tessella*). Also a further note in "New and rare freshwater Algae" (*ibid.*, 1918, p. 508, Pl. lvi., f. 4). I have nothing to add to these notices except to remark that the organism is not as rare as I thought at first. I have obtained plenty during the last few years.

## Fam. HYMENOMONADACEAE.

### Genus SYNURA Ehrenberg.

#### SYNURA VIRESCENS (Bory). (Pl. ii., figs. 16—18).

Coenob. diam. ad. 137; cell. long. 22—24, lat. 7—9$\mu$.

Wyrallah; Lismore (242, 314).

Syn. *Uvella virescens* Bory, Encyclop., 1824 (*teste* Dujardin, p. 301); for figure *see* Kent, Pl. xxii., f. 24—26, but the chromatophores are contracted. In "Freshwater Algae of the Lismore District," p. 314, I recorded this species as *Synura uvella* Ehr. All the authors, however, who have figured the latter, show the cells as clothed with fine setae; cf. Stein, T. xix., Abt. i., f. 1—7; Kent, Pl. xxiii., f. 1, 2; Senn, p. 162, f. 116A; Klebs, Flagellatenstudien (Senn's fig. A2) and others.

This makes it plain that if *S. uvella* is found here it must be very rare, as in twenty-five years I have never seen a specimen of a *Synura* showing setae. This smooth species, *S. virescens* Bory, however, is occasionally met with, though by no means common either. I figure three forms which may all be noted either separately or intermingled in the same coenobium. The membrane is very thin and does not show as a double line; the chromatophores lie close to it. No stigma noted, but I think that one or more minute stigmata may occasionally be found, though rarely, in all forms of *Synura* and *Mallomonas*. Stokes (*op. cit.*, p. 117) records this species from U.S.A.

For descriptions and figures of *S. granulosa* Playf. and its var. *pusilla* Playf. *see* Frw. Alg. Lismore District (These Proceedings, 1915, p. 314, Pl. xlv., f. 3). Also New and rare freshwater Algae (*Ibid.*, 1918, p. 508, Pl. lvi., f. 1—3).

For *Synura australiensis* Playf. *see* These Proceedings, 1915, p. 315, Pl. xlv., f. 4, 5.

## Fam. OCHROMONADACEAE.

### Genus OCHROMONAS Wysotski.

#### OCHROMONAS ASPERA, n.sp. (Pl. i., figs. 14, 15).

Cellulae a fronte subcirculatae anteriore saepe truncatae, posteriore rotundatae, margine granulis aspera; a latere modice compressae, ovatae, anteriore acuminatae; membrana nulla vel tenuissima et indistincta; plasmate granuloso, chromatophoris (2?) luteo-viridibus, obscuris; flagello singulo; vesiculis contractilibus geminatis minutis uno latere juxta marginem anteriorem dispositis; stigmate nullo.

Cell. diam. c. 8—10$\mu$. Byron Bay (324).

A very minute flagellate composed of hyaline plasma studded with amylaceous granules which give a rough appearance to the surface, showing through the cell-wall if any is present as it is not noticeable. In shape the cell is sub-circular in front view, sometimes truncate above, and in side view somewhat compressed and ovate. There is an obscure patch of yellow-green chromatophore near the anterior end, a single flagellum and a pair of minute c.v. at one side near the front margin; no stigma. The animalcule can project outwards a large wave of membrane (?) or clear homogeneous plasma, and seize any particle of food in its vicinity.

#### OCHROMONAS CYLINDRACEA, n.sp. (Pl. i., fig. 16).

Cellulae cylindraceae, utroque polo rotundatae, in medio interdum paullo constrictae, margine granulis aspera; membrana nulla? vel tenuissima ?; plasmate granuloso; chromatophoris obscuris (2?) luteo-viridibus, juxta marginem anteriorem; flagello singulo; stigmate nullo.

Cell. long. c. 17, lat. 5$\mu$. Byron Bay (324).

Cylindrical in shape, rounded each end, slightly constricted in the middle, other details as in the preceding species. Both forms obtained along with *Scintilla chlorina* from small rainwater pools in the drained bog at Byron Bay.

### Genus DINOBRYON Ehrenberg.

#### DINOBRYON SERTULARIA Ehr. (Pl. i., figs. 17—21).

Cell. long. 26—38, lat. max. 9—10, lat. oris 8—10, constrict. 7—8$\mu$. Cyst diam. 14$\mu$.

Botany (2); Botanic Gardens (3); Sydney Water (22); Centennial Park, Sydney (133); Duck Creek, Clyde (74); Guildford (172); Fairfield (83, 143); Canley Vale (111); Wyrallah; Byron Bay; Lismore (332, 345, 307, 316).

Syn. *Dinobryon sertularia* var. *cylindricum* in Plankt. Sydney Water, p. 516, Pl. 57, fig. 6. Our common form answers exactly to Ehrenberg's type, but is apparently somewhat smaller. The usual size of the lorica here is long. 30—35, lat. max. 9, whereas for European specimens Lemmermann gives long. 44, lat. max. 13, lat. oris 13, constr. 10—11$\mu$. Stein's figures work out at an average of long. 46, lat. max. 12$\mu$.

I have met with none longer than 38$\mu$, and Bernard, Protococc. et Desm., p. 209, f. 570, gives 28—35 by 8—10$\mu$ for Javanese specimens.

Two shapes are found, (1) with blunt conical lower end, and (2) with the lower end drawn out and pointed; both are common and usually intermingled. The cyst which I have only noted twice is spherical with low broad collar, the membrane faintly and sparsely scrobiculate.

Var. ANGULATUM Seligo. (Pl. i., figs. 22—23).

Cell. long. 32—40, lat. 9, lat. oris 8—9, constrict. 7—8$\mu$.

Fairfield (83, 112, 143).

*Cf.* Seligo, Uber einig. Flagell. d. Susswasser, p. 6, f. 1. *Syn. D. cylindricum* var. *angulatum* (Seligo) Lemm., Gatt. *Dinobryon,* p. 518, T. 18, f. 24. Lemmermann has arranged this form under *D. cylindricum;* I find it here, however, in company with *D. sertularia* and of similar dimensions. *D. cylindricum* is a much larger form than any of ours, so I think it best to fall back on Seligo's original arrangement. Probably the same form is common to both species.

DINOBRYON CYLINDRICUM var. DIVERGENS (Imhof) Lemm. (Pl. i., figs. 24, 25).

Cell. long. 42—50, lat. max. 8—10. lat. oris 8—10. constrict. 6—7$\mu$.

Sydney Water (63, 64, 90); Centennial Park (133); Canley Vale (111); Fairfield (130).

Syn. *D. sertularia* var. *divergens* in Plankt. Sydney Water, p. 516, Pl. 57, f. 7. Nearly all the specimens I measured were either long. 44$\mu$ or long. 50$\mu$.

Var. SCHAUINSLANDII Lemm.

Cell. long. 44—50, lat. max. 9—10$\mu$.

Sydney Water (90); Canley Vale (111).

Syn. *D. sertularia* var. *Schauinslandii* in Plankt. Sydney Water, p. 516, Pl. 57, f. 8. Found in company with var. *divergens,* of which it is really only a form. Our specimens are so slightly wrinkled as to make separation difficult.

Subgenus EPIPYXIS (Ehr.) Lauterborn.

DINOBRYON UTRICULUS (Ehr.) Klebs. (Pl. i., figs. 26—27).

Cell. long. 20—25, lat. max. 7—8, lat. oris 4—5$\mu$.

Sydney Water (22); Guildford (77).

Syn. *Epipyxis utriculus* Ehr., Infus., p. 123, T. viii., f. 7; Stein, T. xii., f. 6—11; Klebs, Zeitschr. f. Wiss Zool., Bd. 55, p. 414; Lemm., *l.c.,* p. 512, T. xviii., *f.* 1. Our specimens are much shorter than the European; Lemmermann gives long. 30—46, lat. 7—10$\mu$.

Var. TABELLARIAE Lemmermann. (Pl. i., figs. 28, 29).

Lorica c. stip. 23—28, lat. max. 7—9, lat. orif. 4—5$\mu$. Cyst. diam. 14$\mu$.

Fairfield; Guildford (77, 124); Centennial Park, Sydney (133).

Lemmermann, Das Plankton schwedischer Gewasser, p. 119, T. i., f. 19. This pretty little form is not uncommon, growing on diatoms, waterweeds, etc. The cells are generally solitary or two together, rarely in clumps as in the figure. From the comparison of a number of individuals it is easy to see that the petiole is formed out of the cell wall by a gradual falling together of the lower end of the lorica. There seems to be a distinct disc to the footstalk, at least sometimes. The membrane differs from other species of *Dinobryon* in that it is

generally somewhat rufescent with a specially dark band across the middle. I have never seen the living animalcule. Lemmermann gives long. 22, lat. max. 8, opening 4—5$\mu$ as the dimensions of the lorica.

**Cryptomonadineae.**

Genus CHILOMONAS Ehrenberg.

CHILOMONAS PARAMECIUM Ehr. (Pl. ii., figs. 19—22).

Found in swamp waters almost everywhere; it seems to me very probable that it is a small saprophytic form of *Cryptomonas;* it has the same series of shapes as *Cryptomonas ovata.*

Cell long. c. 30, lat. c. 10$\mu$.

Genus CRYPTOMONAS Ehrenberg.

CRYPTOMONAS OVATA Ehr. (Pl. ii., fig. 23).

Senn (Flagellata, p. 169) remarks on the variability of the chromatophores in this genus and it is particularly noticeable in this species. I have noted the following colours:—Pale nut-brown, deep nut-brown, brownish-green, greenish-brown, yellow-green, pale chlorophyll green, deep chlorophyll green. Almost always to be found in swamp waters, but never in great quantities.

Cell. long. 25—40, lat. 10—18$\mu$.

CRYPTOMONAS AMPULLA, n.sp. (Pl. ii., fig. 24).

Cellulae quam in *C. ovata* majores, longe ovales, lateribus arcuatis; pone rotundatae, fronte oblique truncatae et infra, uno latere, valde excavatae. Chromatophoris fusco-viridibus.

Cell. long. 50, lat. 23, ap. 10½$\mu$. Lismore (327, 337).

A larger form than *C. ovata* and more nearly oval in shape, rounded behind, sides arched, obliquely truncate in front. Below the lower edge of the truncate portion there is a deep excavation, making the cell appear somewhat irregularly flask-shaped. Chromatophores brownish-green, more green than brown, however. The interior seems to be differently arranged from *C. ovata* also, as there is a wide bag-shaped pharynx, longitudinally striate with rows of minute punctulations. Not common.

CRYPTOMONAS MAXIMA, n.sp. (Pl. ii., fig. 25).

Cellulae maxime, plus minus oblongae, fronte modice attenuatae, postice rotundatae; uno latere aequaliter arcuato, altero juxta apices interdum inflatione instructae; chromatophoris plerumque fusco-viridibus.

Cell. long. 50—70, lat. 22—28$\mu$.

Botany (142); Lismore (261, 327, 337).

Double the size of *C. ovata* and much more irregular in shape. It is oblong in general outline, somewhat narrowed back and front, especially the latter. One side is fairly regularly arched, but the other has often a slight protuberance near each end. The chromatophores are generally brownish-green, but I have noted them pale-green and yellow-green.

CRYPTOMONAS NORDSTEDTII (Hausgirg) Senn. (Pl. ii., fig. 26).

Cell. long. 11—12, lat. 6—7$\mu$. Sydney; Lismore (345, 347).

Syn. *Croomonas Nordstedtii* Hausgirg, whose figure is reproduced by Senn,

p. 169, fig. 123c; the size works out at 9 × 5$\mu$. A minute form not uncommon here, but never before more than a few individuals at a time. The chromatophores are described as blue-green and I have once noted them that tint, but strong and often bright blue is the rule, and turquoise-blue may sometimes be observed. Occasionally what resembles a small pyrenoid is present near the centre of the cell, or two smaller, one above the other.

CRYPTOMONAS GEMMA, n.sp. (Pl. ii., fig. 27).

Cellulae ad *C. ovatam* ambitu valde accedentes, ellipticae, sursum uno latere oblique truncatae; hyalinae pellucidae in medio chromatophoris binis globosis cyaneis instructae.

Cell. long. circa 20$\mu$. Lismore (291).

This is a very curious form which I have met with only once, but it was present in much greater abundance than *Cryptomonas* generally is, four or five being in the field of view at one time. In shape like *C. ovata,* it is perfectly hyaline and pellucid, no internal markings at all being visible except the two chromatophores which were bunched up together in the centre of the cell in the form of two, sharply-defined, bright blue globules. All the specimens were alike. In movement they were very lively; flagellates with blue chromatophores generally are.

CRYPTOMONAS OBLONGA, n.sp. (Pl. ii., fig. 28).

Cellulae minutae oblongae, utroque polo rotundatae, sursum haud truncatae; lateribus parallelis subrectis; chromatophoris dilute aeruginosis 2; stigmate nullo; c.v. subapicali.

Long. 11, lat. 6$\mu$. Lismore.

A minute oblong form with rounded ends, not truncate in front, sides more or less straight. There were two pale blue-green chromatophores and a subapical c.v. but no stigma. A little below the centre what looked like a pyrenoid or elaeoplast. I saw only one flagellum but probably there were two, as the pyrenoid and the colour of the chromatophores indicate *Cryptomonas* and not *Mallomonas*. Non-motile at first, the cell became motile while under observation.

**Euglenineae.**

Fam. EUGLENACEAE.

Genus EUTREPTIA Perty.

EUTREPTIA VIRIDIS Perty. (Pl. iii., fig. 1).

This is a rare flagellate; I have only met with it in one gathering, where, however, it occurred in good numbers. I am not quite certain whether ours is the same as the European form. It is like *Phacus moniliata* var. *suecica* Lemm. with the body slightly elongated and produced below into a long blunt tail. Daugeard, who figures it (Recherches sur les Eugleniens, p. 103, fig. 24) makes no mention of any granules, whereas our specimens are finely puncto-granulate in spiral lines running obliquely and transversely from left to right. In side view it is elliptic, compressed. Differs from *Phacus* in having no amylaceous plates.

Cell. long. max. 58, caud. 21, lat. corp. 25, apic. 10$\mu$. Botany (95).

### Genus CRYPTOGLENA Ehrenberg.

#### CRYPTOGLENA AUSTRALIS, n.sp. (Pl. v., fig. 18).

Cellulae late-ovatae, posteriore latiores, paene subglobosae, postice vix acuminatae, fronte quam levissime deplanatae. A latere ellipticae.

Cell. long. 13, lat. 10$\mu$. Lismore.

*Cryptoglena pigra* Ehr., the only species hitherto described, is shield-shaped, triangular, broadest above and very pointed below. Cf. Daugeard, *op. cit.*, p. 139, f. 44; Senn, p. 176, fig. 127B. Our form is very broadly ovate, almost subglobose, widest below, hardly pointed beneath and very slightly flattened above. The usual deep furrow runs down one face. In side view elliptic, slightly pointed below and flattened above. One long flagellum; stigma to one side of the furrow; chloroplasts laminar, a brilliant green. Very rare.

#### CRYPTOGLENA PHACOIDEA, n.sp. (Pl. v., fig. 19).

Cellulae orbiculares, inferne modice angustatae, utroque polo ob sulci extremitates emarginatae; a latere plano-convexae lenticulares.

Cell. long. 21, lat. 17$\mu$. Lismore (351).

Another very rare form which seems to connect *Cryptoglena* with *Phacus*, for it shows two amylaceous plates, one large and the other small. The general shape in face view is subcircular, a little narrowed below. There is a broad furrow down the centre, the ends of which show as an emargination at each pole. The stigma lies to the left of the furrow as usual and there is the customary single long flagellum. In side view the cell seems to be lenticular, plano-convex, showing gibbous where the furrow runs. I have an idea that this is a juvenile form of *Phacus*, the furrow being eliminated with growth, the last vestiges of it persisting as the overlap of the two wings above, and the slight tail below; also the central longitudinal ridge in *Phacus triqueter*. *Cf.* too *Phacus inflatus* (*infra*).

### Genus COLACIUM Stein.

#### COLACIUM VESICULOSUM (Ehr.) Stein. (Pl. iii., figs. 2, 3).

Cell. veg. long. 9—15, lat. 5—11$\mu$. Motile zooid not noted.

Lismore (291, 307). On *Cyclops*, *Macrothrix* (*Entomostraca*).

#### COLACIUM ELONGATUM, n.sp. (Pl. iii., figs. 4—6).

Cellulae vegetativae cylindraceae, fronte conicae, postice rotundatae, apicibus stipite mucosa affixae. Zoosporae angustae cylindraceae, medio modice constrictae, apicibus attenuatis acuminatis; stigmate lineari luteo-fusco subapicali; vesiculis contractilibus 2 subapicalibus; flagello singulo, chloroplastidibus dilute viridibus ellipticis.

Cell. veg. long. 12—23; lat. 5—11$\mu$. Zoosp. long. 15—18, lat. 4$\mu$.

Lismore (291, 294, 316, 327).

The vegetative form of *C. vesiculosum* is shortly ovate, that of *C. elongatum* is more or less cylindrical, rounded behind and conical in front where it is fixed to the host by a short stalk of almost invisible mucus. The host is nearly always *Cyclops*, *Macrothrix* or some other of the Entomostraca. From 2 to 4 cells are often found in a clump. What seem to be the zooids of this species are cylindrical, constricted in the middle, attenuate, and pointed at each

end; chloroplasts pale green, irregularly oval, disposed more towards the hinder end; flagellum single; c.v. two, apical; and a yellow-brown, wick-shaped, sub-apical stigma. A stigma of this shape and colour is extremely rare among the *Euglenineae*, though not uncommon in *Chlamydomonas* of the *Volvocaceae*.

Genus EUGLENA Ehrenberg.

EUGLENA VIRIDIS Ehr. (Pl. iii., fig. 7).

Of medium size; when young fusiform in shape (cf. fig. 9), but with growth tending to become cylindrical; blunt in front and rapidly attenuated behind where it is drawn out into a minute tail. No flagellum, or only the useless stump of one. Amylaceous granules irregular in shape and size, generally forming a large central mass in front of and behind the nucleus. Membrane smooth but very fine spiral striae can generally be detected with a high power lens on all species of *Euglena*. A few minute digitate chloroplasts are usually visible in the hinder part of the cell, but the usual discoid chloroplasts form with age, principally in the central portion, leaving the ends hyaline. From Daugeard's description and figure (Recherches sur les Eugleniens, p. 43, fig. 1A, D) the young fusiform specimens are characterised by a stellate bundle of digitate chloroplasts radiating from the centre of the cell. The dimensions he assigns are long. 68—80, lat. 14—16$\mu$. This is perhaps more nearly Ehrenberg's type. That which I figure here is the older cylindrical form: long. c. 110, lat. 14$\mu$.

This species develops in the globular vegetative cell in a manner peculiar to itself. Both head and tail are turned in under the body, on the same side, to form a ball. When the mucus in which this globular cell is involved gets sufficiently thin for the creature to get free, it simply unrolls head and tail and straightens itself out.

Var. SANGUINEA (Ehr.).

*Euglena sanguinea* Ehr. This red form is usually found in company with the type, especially when, as often happens, the organisms form a powdery crust on the surface or on the half-dry bed of a pool. It is probably due to the action of sun and air. Under the microscope the colour will be seen to be due to the gradual conversion of the chloroplasts into orange or brick-red globules of haematochrome (lipochrome). This is known to take place in the *Protococcaceae* also.

Var. PURPUREA, n.var.

A rarer and very striking form. The chlorophyll has become converted into a wine coloured substance disposed to all appearances in fine grains.

EUGLENA SOCIABILIS Daugeard. (Pl. iii., figs. 8, 9).

Very like the young form of *Euglena viridis*, but broader and more clavate in front. It may always be recognised by the digitate chloroplasts regularly disposed from front to back. Amylaceous granules irregular in shape, arranged in a mass before and behind the nucleus and below the chloroplasts. Membrane smooth, finely striate spirally and obliquely from left to right. With or without a flagellum.

Long. 92—95, lat. 21—28$\mu$. Lismore (254, 293, 308, 316, 327).

*Cf.* Daugeard, *op. cit.*, p. 86, fig. 15; for dimensions he gives 85 $\times$ 25$\mu$. This species almost certainly develops into the cylindrical form of *Euglena viridis* mentioned above. It is really the young *aquatic* form, while *E. viridis*

type is the *aerial* form, when the organism develops in surface crusts. *Euglena sociabilis* living and growing altogether under water has a characteristic method of development and a series of vegetative stages entirely its own. Yet without a doubt it reaches the same objective.

The vegetative cell is generally involved in a wide and often stratified globe of clear mucus.

EUGLENA AMBLYOPHIS (Ehr.) mihi. (Pl. iii., figs. 10, 11).

Syn. *Amblyophis viridis* Ehr. It has generally been considered that there is nothing in this form to justify Ehrenberg's genus *Amblyophis;* at the same time I cannot agree with those who would make it merely a tail-less form of *Euglena viridis*. For one thing, the disposition of the cell-contents is different. Also the latter is a comparatively small species (the type at any rate), whereas *Euglena amblyophis* is one of the very largest forms. It is strap-shaped, rounded behind and attenuated in front, membrane smooth, finely and spirally striate, body very transparent, no paramylon granules or rods (in this respect also very different from *E. viridis*), no flagellum. Specimens from three localities fairly wide apart are all in agreement.

Long. 200—300, lat. 20—25$\mu$.

Botanic Gardens, Sydney (137); Kyogle (216); Lismore (286).

EUGLENA DESES Ehrenberg. (Pl. iii., figs. 12—14).

This species is narrowly strap-shaped and very plastic, slightly attenuate in front and usually coming abruptly to a sharp point behind, but sometimes very gradually narrowed to a subacute tip; no tail and only a very weak flagellum or none at all. Membrane smooth, striae not noted. In most *Euglenae* the striae are very delicate and need the 1-12th inch homog. immersion lens for their detection. The same is true of the chloroplasts except in certain species of which this is one. Here, on the other hand, they are nearly always very distinct, especially at the sides where they show as little lenticular cushions, and are characteristic of the species. No paramylon granules or rods as a rule.

Long. 100—180, lat. 10—18$\mu$.

Coraki; Wyrallah; Lismore (237, 254, 258, 293, 295, 347).

In a mucous stratum of *Spirulina major* gathered on the river-bank at Coraki, there were numbers of *E. deses* developing out of the vegetative cell, from which (Pl. iii., fig. 14) it was evident that they are formed by direct growth out of the original cell itself.

Var. MINUTA, n.var. (Pl. iii., fig. 15).

Dimensionibus quam in forma typica dimidio minoribus; long. 70, lat. 6$\mu$. Lismore.

Var. GRACILIS, n.var.

Forma gracilior, chloroplastidibus haud distinctis; long. 120, lat. 8$\mu$. Casino.

It seems probable that *E. deses* is the base form from which both *Euglena spirogyra* and *E. acus* are developed. Along with this narrow form was another of similar size and shape, but exhibiting the granulate striae of *E. spirogyra* and at the same time the acutely pointed tail of *E. acus*. Upon another occasion I noted a form with the shape and conspicuous chloroplasts of *E. deses*, but with the series of paramylon rods characteristic of *E. acus*, and with a tail end evidently a compromise between the two species. *Cf.* Daugeard, *op. cit.*, p. 93,

fig. 18, var. *intermedia*, Klebs and p. 94 where he says: "cette variété est charactérisée par la présence au-dessus et au-dessous du noyau de quelques longs bâtonnets de paramylon assez gros." (Pl. iii., fig. 16).

EUGLENA OXYURIS Schmarda. (Pl. iii., fig. 17).

One of the largest species. It is a strap-shaped form, sometimes slightly twisted round the long axis. The spirals and striae (the latter are coarser and more conspicuous than usual) run from *right to left* obliquely downwards, focussing the upper surface. This is unusual, not to say unique, in the genus. From two to four stout paramylon rods in a single series; no flagellum; a short stout spine behind. The chloroplasts are brick-shaped ($4\mu$ long) following the lines of the striae. Stigma very large, pale, and indistinctly outlined.

Long. 250—400, lat. 22—$46\mu$. Coogee (4); Botany (91).

*Cf.* Daugeard, *l.c.*, p. 100, fig. 20, who gives long. 490, lat. 30—$40\mu$, also Stein, T. xx., f. 4, 5 (not f. 6, which is *E. tripteris* Duj.).

A smaller form may also be met with:—long. 156—250, lat. 20—$22\mu$.

Var. HELICOIDEA (Bernard) mihi. (Pl. iii., fig. 18).

So strongly twisted as to show three nearly equal lobes, in other details like the type.

Syn. *Phacus helicoideus* Bernard, Protococc. et Desm., p. 206, Pl. xvi., f. 563.

Long. c. spin. 360—400, lat. 40—60, spin. long. c. $40\mu$. Guildford; Kyogle (219); Lismore (237, 260, 271).

Var. GRACILLIMA, n.var. (Pl. iii., fig. 19).

Forma gracilior, minime torta. Long. c. spin. 253, lat. 17, spin. long. $42\mu$. Lismore.

A very rare slender form. Hardly twisted at all and, curiously enough, in reverse direction to the type, though the striae run the usual way. The paramylon rods in this species are really flattened links, in which the central space has become filled up by gradual thickening of the sides. Its position is still indicated by a faint central line.

EUGLENA TRIPTERIS (Duj.) Klebs. (Pl. iv., fig. 1).

In spite of its great likeness to *Euglena oxyuris* v. *helicoidea*, this is a very distinct form, very much smaller, more common, and one that retains its characteristics remarkably well. It generally has a long flagellum. The only note I have of the twist is that it is from left to right, the opposite of *E. oxyuris*. Compare Dujardin, p. 338, Pl. v., f. 7, whose figure the generally accepted form does not very closely resemble; he gives long. 65—$80\mu$; also Stein, T. xx., f. 6, who considers it a young form of *E. oxyuris*.

Syn. *E. torta* Stokes, *l.c.*, p. 86, Pl. i., f. 20.

Long. 70—150, lat. 10—$15\mu$. Wyrallah; Lismore (237, 254, 258, 286, 293, 310).

EUGLENA SPIROGYRA Ehr. (Pl. iv., fig. 2).

Easily recognized by the characteristic granulate striae which, in this species, are very much in evidence and, as a rule, run obliquely from left to right. The typical form (*cf.* Stein, T. xx., f. 7) seems to be cylindrical, slightly attenuate in front, but rapidly narrowing behind into the short acute tail. Membrane somewhat rufescent giving the specimens a yellow-green colour.

Another form, however, which I have found in great quantity, is broadly strap-shaped, not at all, or very slightly, attenuate in front where it is broadly truncate; behind narrowing rapidly to the short acute tail. The membrane in this form is generally very rufescent, the specimens appearing greeny-brown. I have no figure of this form, though it is very common. On decomposition the skin often splits up into a wisp of longitudinal fibres, the striae, which are then seen to be composed entirely of the granules, showing as minute brick-shaped cylinders set on end side by side.

Long. 160—250, lat. 18—36, long. caud. 25—30$\mu$. Sydney; Wyrallah; Lismore.

Forma. (Pl. iv., fig. 3).

Cylindrical, rounded in front, and attenuate behind into a short tail. An interesting form showing beyond a doubt that the membrane may be at first smooth, the granules developing by degrees. Specimens indeed are often noted in which every second or fourth row of granules is more strongly marked, the intermediate series being of later growth. Paramylon rods link-shaped in this species as in *E. oxyuris*.

Var. ELEGANS, n.var. (Pl. iv., fig. 4).

Forma anguste cylindracea, fronte minime attenuata, postice in caudam brevem acutam producta. Membrana hyalina tenuissima, striis delicatissimis, minute granulatis. Flagello nullo.

Long. 110—136, lat. 8—12, long. caud. 10—16$\mu$. Casino (223); Lismore (293).

A small and very slender cylindrical form, almost truncate in front and rapidly narrowed behind. The membrane clear, delicate and very finely striate with minute puncta-granules. No flagellum and no paramylon rods. On others in the same gathering no granules at all could be detected. Out of mud from the edge of a lagoon.

EUGLENA ACUS Ehr. (Pl. iv., fig. 5).

Fusiform, subrostrate in front, very gradually attenuate behind, where the lines of the body merge uninterruptedly into the long, acutely pointed tail. Generally active, with a long flagellum. Membrane very smooth, no striae visible. A long series of 6—10 paramylon rods is characteristic, though not always present.

Long. 150—210, lat. 10—12½$\mu$. Auburn; Lismore (258, 327).

*Cf.* Stein, *op. cit.*, T. xx., f. 10—12; Daugeard, *l.c.*, p. 101, f. 22. I doubt whether I have ever seen a typical specimen of this species (as distinct from *E. acutissima* Lemm.). The figures cited are more distinctly fusiform than anything I have met with. Stein's specimens have the appearance of being distorted, and the rostrate tip does not seem correct. Daugeard's figure is better in this respect, but the tail is not nearly long enough to represent our forms. The only difference between this and the succeeding species is the slightly greater breadth and the wealth of paramylon rods. The chloroplasts are often little oblong cushions.

EUGLENA ACUTISSIMA Lemmermann. (Pl. iv., fig. 6).

Lemmermann, Plankt. Schwed. Gewass., p. 122, T. i., f. 27, who gives long. 123, lat. 7, flag. long. 25$\mu$. This is really a slender, more cylindrical form of

*E. acus,* and is the form commonly found in our waters. I include in it specimens over 100$\mu$ long. and up to 8$\mu$ in diameter.

Long. 110—150, lat. 7—8$\mu$. Guildford (45, 146); Lismore (237, 241, 258, 259, 260, 295).

Var. PARVA, n.var. (Pl. iv., figs. 7, 8).

Forma brevior. Long. 54—94, lat. 6—8, long. caud. 4—16$\mu$. Lismore (237, 258).

A short form, less than 100$\mu$ long, sometimes blunt ended behind.

Var. HYALINA, n.var.

Forma hyalina, chloroplastidibus nullis, nec stigmate.

Long. 150—200, lat. 8—10$\mu$. Rookwood; Guildford; Wyrallah; Lismore.

*Euglena acus* has also a var. *hyalina* Klebs..

EUGLENA PISCIFORMIS Klebs. (Pl. iv., figs. 9—11).

A small form, but one of the most active and frequently met with. In shape it varies somewhat, but generally it is shortly fusiform, with the likeness to a fish from which it derives its name, subrostrate in front and acutely pointed behind, without a tail. No amylaceous rods or granules. The specimen shown in Pl. iv., f. 11 is more globose in the centre than usual. It has probably just developed out of the globular vegetative cell, the shape of which it still partly retains. The long flagellum enables this form to swim very rapidly. Compare Klebs, Flagellatenstudien, p. 302; Daugeard, *l.c.*, p. 89, f. 16A; the latter gives dimensions long. 30, lat. 6—7$\mu$. It is doubtful, however, if his figure represents the type.

Long. 30—32; lat. 6—12$\mu$. Casino (223); Lismore (221, 237, 258, 260, 263, 295, 327, 344, 348).

EUGLENA TEXTA (Dujardin) Senn. (Pl. iv., fig. 12).

Syn. *Crumenula texta* Dujardin, p. 339, Pl. v., f. 8; *Euglena viridis, pro parte,* Stein, T. xx., f. 26—33; *Trachelomonas torta* Kellicott, in Stokes, Infusoria of U.S., p. 87, Pl. i., f. 24.

The type is oval, somewhat attenuate in front. This species seems to me to be merely the vegetative cell which has increased in size and become motile with hardly any alteration in shape. It has nothing to do with *Lepocinclis ovum;* and *Trachelomonas torta* Kellicott is simply the empty membrane, with the striae of both upper and lower face put in at the same time. This is a plankton form, generally to be found among weeds in deep water. The chloroplasts are disc-shaped, irregularly circular or polygonal, and close together; they are much more distinct than in any other species. Membrane smooth and covered with the usual fine spiral striae, with difficulty visible except on the empty cell. Cytoplasm granular; a large stigma and long flagellum, movement active. Dujardin gives long. 50$\mu$.

Long. 50, lat. 40$\mu$. Lismore (352).

Var. OVATA, n.var. (Pl. iv., fig. 13).

Forma ovata, fronte attenuata, pone rotundata; ceteris ut in forma typica.

Long. 38—50, lat. 25—32$\mu$. Duck Creek, Clyde; Lismore (261, 337, 347, 348).

The most common form here; distinctly ovate, not oval.

Var. OBESA, n.var. (Pl. iv., fig. 14).

Forma fere sphaerica, superne quam levissime producta.

Long. 55, lat. 52$\mu$. Lismore.

A rare form, almost exactly spherical, but produced a little above and notched at the opening of the pharynx.

Var. BULLATA, n.var. (Pl. iv., figs. 15, 16).

Forma subglobosa, sursum in protuberationem conicam producta, pone bullâ latissimâ instructa.

Long. 53—55, lat. 42—46$\mu$. Lismore (328).

This form is globose but more produced above into a distinct conical protuberance, while below it is furnished with a low wide boss.

EUGLENA GUTTULA, n.sp. (Pl. iv., fig. 17).

Euglena minima, fere sphaerica; fronte bulla conica instructa; pone rotundata, interdum quam levissime acuminata; flagello longo; cytoplasmate interdum granulato.

Long. 18—19, lat. 14—17, lat. ap. 2—3$\mu$. Guildford (146); Lismore.

Another free-swimming species, found among weeds in deep water, smaller and rarer than *Euglena texta* and its forms. It is globular, with a conical projection in front. The chloroplast seems to be in a single, thin, parietal, equatorial band; flagellum long, movements lively.

Var. ELONGATA, n.var. (Pl. iv., fig. 18).

Forma modice oblongo-cylindracea, medio paullo constricta, sursum leviter attenuata, fronte rotundata acuminata, postice globosa. Cytoplasmate hyalino; in medio zona chlorophyllacea; flagello longo; vesiculo contractili subapicali; pone macula fusca magna (stigmate?) instructa.

Long. c. 19—22, lat. c. 10$\mu$.

Seems to be an outgrowth of the type. In shape oblong-cylindrical, somewhat constricted in the middle, narrowed in front and conical, running to a point, globose behind. A subapical c.v. noted, and, in the centre of the posterior half of the cell, a large pale-brown spot or globule which might be a stigma, though I have never before seen the stigma in such a position in *Euglena*. As in the type, there is a thin median parietal band of chlorophyll. Flagellum long, movements very active.

EUGLENA VIVIDA, n.sp. (Pl. iv., fig. 19).

Euglena minima, lineari-elliptica, fronte acute-rotundata, postice rapide attenuata et acuminata; cauda nulla; chloroplastidibus parietalibus singulis, utrinque pyrenoidibus magnis singulis; stigmate parvo; flagello longo; granulis amylaceis nullis nec baculis.

Long. 30—32, lat. 7$\mu$. Lismore (293, 347).

A minute but most energetic species, swimming rapidly, turning and twisting at a great rate. *Euglena vivida* is very distinct and clear-cut in appearance, linear elliptic, acutely rounded in front and rapidly narrowed behind into a sharp point, but without a tail; very much more resembling a fish than *Euglena pisciformis*. There is a single parietal laminar chloroplast (or two), with a large distinct pyrenoid on each side at the posterior third. Stigma small; flagellum long; no paramylum rods or granules. Not common, but I have known gatherings where it was plentiful.

EUGLENA PUSILLA, n.sp. (Pl. iv., figs. 20, 21).

Euglena minima, cylindracea, utroque fine attenuata, fronte conica, postice abrupte acuminata, caudâ minimâ instructa; baculis amylaceis singulis maximis.

Long. corp. 26—30, lat. 9—10; long. caud. 3—4$\mu$. Lismore (260).

Another minute species, in shape something like *E. vivida,* but very different in details. The body is cylindrical, narrowed at each end, conical in front and abruptly acuminate behind, where there is a short tail. The chloroplasts seem to be scattered flakes, sometimes connected with an irregular paramylum granule; a single, very large and stout paramylum rod in the centre; flagellum?

Var. LONGA, n.var. (Pl. iv., fig. 22).

Forma pisciformis, uno latere fere recto, altero arcuato, fronte attenuata, pone spinâ praedita, baculis amylaceis binis validis.

Long. c. sp. 74, lat. 16; sp. long. 12$\mu$. Lismore (237, 238).

Another very fish-like form, longer than the type, attenuate in front, furnished with a spine behind, one side nearly straight, the other arched. Two stout paramylum rods present. This variation was plentiful in gathering 238; both it and the type have stout membranes and are not metabolic.

? EUGLENA sp. (Pl. iv., fig. 23).

I have seen but one specimen of the form here figured, but, although I was able to observe all details, I regard it with too much suspicion to name or describe. It is a minute form with a long flagellum, and very vivacious in its movements, as these small forms generally are. Several indications point to the possibility of its being the zooid of *Trachelomonas* escaped from a broken lorica. This is not impossible, but I have no knowledge as to whether *Trachelomonas* will remain active under these conditions. The size and shape are exactly those of *Tr. ampullula* Playf. ("The genus Trachelomonas," p. 16, Pl. ii., f. 6); unfortunately, I have no note on the constitution of its zooid. The huge, square, pale stigma, however, is more general in *Trachelomonas;* the subglobose nucleus *at the hinder end* of the cell I have never observed in *Euglena* before, and it usually points to a loricate animalcule (compare the Rhizopoda); the chlorophyll diffused through the outer layer of cytoplasm is frequent in *Trachelomonas,* but rarely, if ever, found in *Euglena.* Compare *Tr. splendida,* Pl. vii., f. 1.

Genus PHACUS Nitzsch.

PHACUS PLEURONECTES (Muller) Duj. (Pl. v., fig. 1).

Long. corp. 36—56, lat. 27—42; long. caud. 7—14$\mu$.

Auburn (68); Rookwood; Botany (91); Guildford (45, 77); Casino; Wyrallah; Lismore (187, 258, 260, 295).

Dujardin, *op. cit.,* p. 336, Pl. v., f. 5, gives for dimensions, long. 40—45, lat. 22½—30$\mu$, which is a fair average size.

Var. MINUTUS, n.var. (Pl. v., fig. 2).

Quam forma typica dimidio minor. Long. 20—28, lat. 11—22$\mu$.

Botanic Gardens, Sydney (3); Wyrallah; Lismore (260).

Half as large only as the type and much less common.

Var. AUSTRALIS, n.var. (Pl. v., fig. 3).

Forma magis ovalis, duplo major. Long. 90, lat. 53$\mu$. Guildford (114).

Very rare indeed; more regularly oval than the type and about twice the size. In all these forms the chloroplasts are minute parietal discs scattered over the central part of the cell.

PHACUS HISPIDULUS (Eichwald). (Pl. v., fig. 4).

Long. corp. 30, lat. 22; long. caud. 10$\mu$. Lismore (328, 332).

Syn. *Euglena hispidula* Eichwald; *Chloropeltis hispidula* Stein, T. xix., f. 41—44.

Very rare here. It is without the overlap at the apex, but instead is furnished with a small papilla. The membrane is ornate with small teeth, pointing backwards, disposed in longitudinal lines. The tail is straight.

PHACUS MONILATA var. SUECICA Lemmermann. (Pl. v., fig. 5).

Long. corp. 30—34, lat. 23—24, crass. 6; long. caud. 7—8$\mu$.

Casino; Wyrallah; Lismore (241, 258, 350, 351).

*Cf. Chloropeltis monilata* Stokes, p. 91, Pl. i., f. 30. This species is really a variant of *Phacus hispidulus*, the teeth being replaced by granules as in many forms of *Trachelomonas*. I have not met with the type which is figured by Stokes with granules irregularly disposed. Not uncommon here. Compare Lemmermann (Plankt. Schwed. Gewass, T. i., f. 15) who gives size as 36 × 22½$\mu$.

PHACUS LONGICAUDA (Ehr.) Dujardin. (Pl. v., fig. 6).

Long. corp. 53—90, lat. 40—65; long. caud. 67—90$\mu$.

Botanic Gardens, Sydney (150); Guildford (45); Lismore (258, 295, 347, 350).

*Euglena longicauda* Ehr. Our specimens have sometimes very long tails. Dujardin only gives 92$\mu$ *with the tail.* This is the typical, flat form.

Var. ——— Lemmermann. (Pl. v., fig. 7).

Long. corp. 62—80, lat. 40—54; long. caud. 20—40$\mu$.

Botanic Gardens, Sydney; Wyrallah; Lismore (258, 260, 347).

Syn. *Ph. pleuronectes, pro parte,* in Bernard, Protococc. et Desm., Pl. xvi., f. 561 only. This twisted variety has a much shorter tail than the type. Lemmermann has given it a name, but I cannot lay my hand on the reference.

PHACUS TRIQUETER (Ehr.) Dujardin. (Pl. v., figs. 8—11).

Long. 38—44, lat. 25—32$\mu$. Lismore (348, 350, 351).

Dujardin, *l.c.*, p. 338; Stein, T. xix., f. 55—57. Compare *Cyclanura orbiculata* Stokes, p. 89, Pl. i., f. 27; and *Phacus acuminatus* Stokes, p. 90, Pl. i., f. 28. Rather rare, it may be recognised by the ridge running longitudinally down one face.

PHACUS INFLATUS, n.sp. (Pl. v., figs., 12, 13).

Phacus minimus, ad *Ph. pleuronectem* accedens, quasi autem e lobis inaequalibus binis tumidis exstructis; uno lobo per longitudinem, altero transverse inflato; lobo longiore cauda brevi praedito.

Long. corp. 25—32, lat. 22—23; long. caud. 4—6$\mu$. Lismore (236, 237, 295).

A very small form something after the style of *Phacus pleuronectes,* but as if constructed of two inflated lobes joined down the central line. The lobes are unequal in size and shape, one being longitudinally inflated, the other trans-

versely. A short tail on the longer lobe. Membrane longitudinally striate, a large paramylum plate present, stigma distinct, flagellum long. Very rare, but numerous in certain gatherings.

PHACUS LISMORENSIS, n.sp. (Pl. v., fig. 14).

Phacus magnus, longe-ovatus, uno latere paullo infra apicem levissime excavatus (deinde pharynge oriente ac flagello longo); sursum subacute rotundatus, inferne sensim sensimque attenuatus et in caudam longam acutissimam, oblique dispositam, protractus; membrana per longitudinem striata. A latere, corpore lineari, arcuato; lateribus parallelis; postice caudâ longâ, ad angulo recto deflecta.

Long. corp. 54, lat. 18; long. caud. 40$\mu$. Lismore (260, 344, 348).

A very distinct, well-marked species, known only from Lismore. The body is flat like a leaf, not lenticular; long ovate, rounded above, and gradually narrowed below into a very long sharp-pointed tail set obliquely (in front view). The opening of the pharynx is situated in a little indentation on one side at some distance below the apex. From here also, of course, arises the long flagellum. Membrane longitudinally striate; the chloroplasts small, oblong flakes lying along the striae. From the side, the body is seen to be somewhat arched, the sides parallel and close together, the tail set at right angles.

PHACUS PYRUM (Ehr.) Stein.

*Euglena pyrum* Ehr. I have never come across the exact European type as figured by Stein, T. xix., f. 51—54, and other authors; but the following forms of it are found here and always retain their distinctive characteristics.

Var. OVATUS, n.var. (Pl. v., fig. 15).

Forma corpore ovato fere ovali, sursum late-rotundata, inferne attenuata, cauda brevi acutissima hyalina praedita.

Long. corp. 19, lat. 13; long. caud. 6$\mu$. Botany (142); Lismore.

The type is somewhat narrowed above and excavated apparently below the apex on one side. Our nearest form is quite rounded above, in shape like a peg-top, slightly attenuated below, where it is furnished with a short hyaline sharp-pointed tail. There are 6 or 7 coarse spiral costae running from left to right.

Var. AUSTRALICUS mihi. (Pl. v., fig. 16).

Forma ad v. *ovatum* accedens sed crassior, et costis pluribus ornata.

Long. corp. 22—32, lat. 18—24, long. caud. 8—10$\mu$. Lismore (197, 242).

Syn. *Lepocinclis Steinii* v. *australica* Playf., Biol. Richmond River, p. 141, Pl. viii., f. 6. A more inflated form of the foregoing, and with more numerous costae which are rounded also, not sharp-edged. End view circular in both forms.

Var. RUDICULA, n.var. (Pl. v., fig. 17).

Forma corpore conico sursum truncato-rotundata, inferne attenuata, lateribus arcuatis; postice cauda brevi praedita. A latere valde compressa, lateribus parallelis. Membrana costis rotundatis 4—7 ornata.

Long. corp. 24—35, lat. 15—26, long. caud. 14—18$\mu$.

Lismore (241, 258, 260, 285, 286).

The type and preceding forms are circular in cross section; this form, on the other hand, is strongly compressed. In shape conical, truncately rounded

above, narrowed gradually beneath, and furnished with a short sharp tail. Membrane with 4—7 spiral corrugations wound from left to right.

Genus LEPOCINCLIS Perty.

LEPOCINCLIS OVUM (Ehr.) Lemm. (Text-fig. 3*a*).

Long. 23—30, lat. 17—21, long. caud. 2—10$\mu$.

Guildford; Lismore (242, 299).

Syn. *Euglena ovum* Ehr., *Chloropeltis ovum* Stein. This species is rather rare here, I have only met with a few isolated specimens. In shape the type, according to Stein (T. xix., figs. 45, 46, 49, 50), is broadly oval-oblong with an anterior prominence and a short, pointed, triangular tail, membrane finely striate spirally. Forms found here are not infrequently more oblong than oval, and often lack the anterior prominence, sometimes the tail as well. I might remark that these are *generic* characteristics in *Lepocinclis;* it is no use founding species on their presence or absence.

Var. AUSTRALIS, n.var. (Text-fig. 3 *b, c*).

Forma oblonga, ubique rotundata, anteriore haud producta, postice caudâ obtusa brevi papilliformi, vel longa bacilliformi, instructa. Membrana delicatissime spiraliter striata.

Long. 23—30, lat. 17—21, long. caud. 2—11$\mu$.

Guildford (146); Lismore (328).

A decidedly oblong form, rounded on all sides, with no anterior prominence in the specimens so far noted, furnished behind with a short nipple-shaped tail, or more rarely a long, blunt-ended, rod-like one. Membrane finely striate spirally.

Var. COSTATA, n.var. (Text-fig. 3*d*).

Forma oblonga, ubique rotundata, prominentiâ anteriori nulla nec cauda. Membrana costis spiralibus 9—10 ornata.

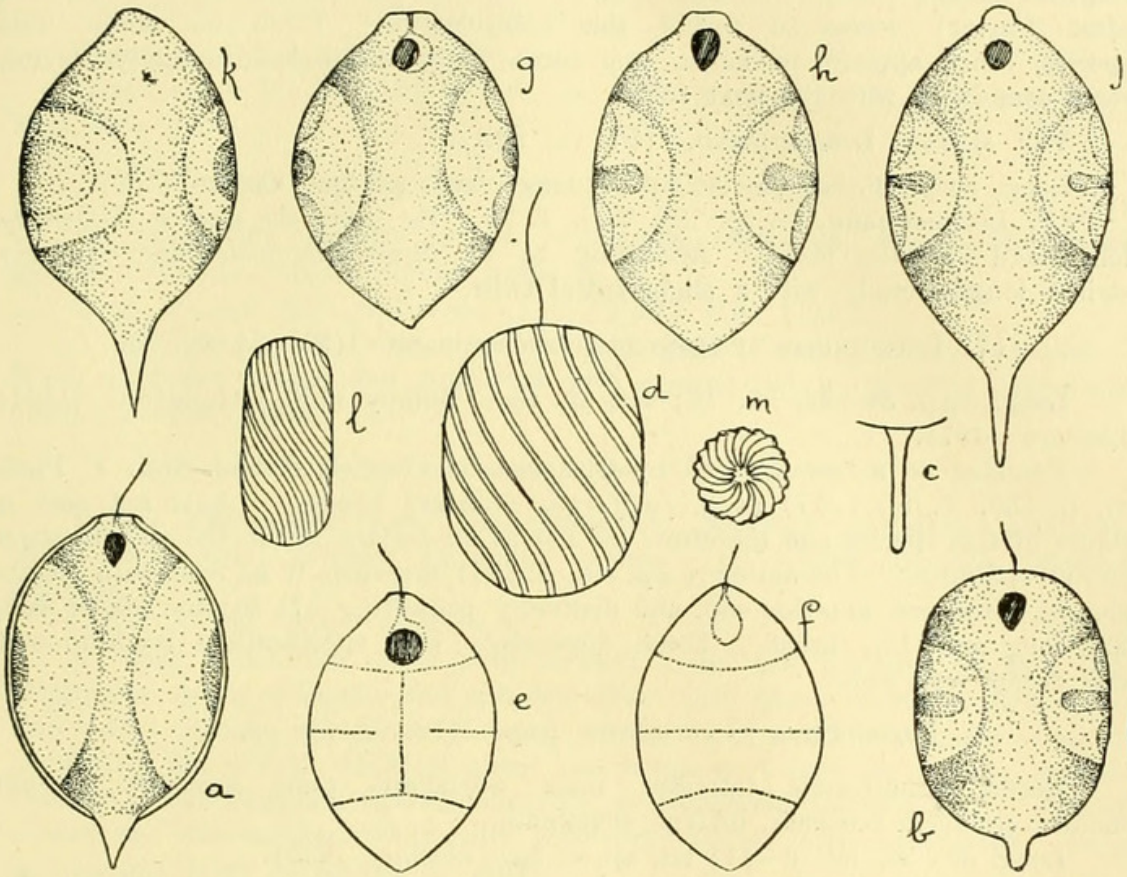
Long. 24, lat. 18$\mu$. Guildford (60).

The oblong form, without either anterior prominence or tail, though of course these might be present, either one or both, in other specimens, membrane with 9—10 costae spirally wound.

LEPOCINCLIS FUSIFORMIS (Carter) Lemm. (Text-fig. 3*e—h*).

Syn. *Euglena fusiformis* Carter; *Euglena zonalis* Carter, according to Kent, Pl. xx., f. 58 (after Carter). The name is somewhat misleading, as one expects a spindle-shaped cell to be much longer in proportion to its width than this is. The type is broadly lenticular, pointed above and below, apparently without anterior prominence or caudal prolongation of any sort, half as long again as broad in our specimens, but these are not always typical. The figure of *Euglena zonalis* given by Kent works out at 58 × 30$\mu$; it is probably just a slightly more slender form than is typical. Our specimens, while being generally pointed beneath (sometimes even showing a minute papilla or caudal prolongation) are very rarely pointed above, having at least a flattened apex (lat. 3—4$\mu$) and sometimes a slight prominence of the same width. Almost all forms of *Lepocinclis* have a pair of discus-shaped paramylum plates closely appressed to the inner surface of the cell-wall. In this species, by continual deposition of fresh material, these gradually grow round the cell, and meet with a vertical line at each side; the central space of each plate fills up at the

same time, till only a horizontal line marks its position, and thus the two plates form a single broad band of paramylum all round the middle of the cell. In front view this band shows as three faint lines simulating the equator and tropics on a geographical globe.






Text-fig. 3.

*(a.) Lepocinclis ovum* (Ehr.) Lemm. x 1200; *(b.c.) L. ovum* var. *australis*, n. var. x 1200; *(d.) L. ovum* var. *costata*, n. var. x 1200; *(e.f.) L. fusiformis* (Carter) Lemm. x 560; *(g.h.) ditto*, forma. x 800; *(j.) ditto*, var. *caudata*, n. var., face view. x 800; *(k.) ditto*, another specimen, ¾ face. x 800; *(l.) L. rugulosa*, n.sp. x 800; *(m.) ditto*, end view.

Long. 38—50, lat. 24—35, lat. apic. 3—4$\mu$. Auburn (135); Guildford; Botany (17); Rookwood; Botanic Gardens, Sydney (137); Lismore (233, 236, 241, 295).

Var. CAUDATA, n.var. (Text-fig. 3*j*, *k*).

Forma magna, inferne caudâ longâ, superne bullâ conicâ vel rectangulari praedita.

Long. corp. 32—43, lat. 21—28; long. caud. 10—16, lat. max. 4$\mu$. Lismore (242, 236, 259, 295).

A rarer variety with a long tail and generally some sort of anterior prominence, conical or rectangular.

LEPOCINCLIS STEINII Lemmermann.

This species has been erected by Lemmermann (Das Plankton schwedischer Gewasser, p. 123, notes) to include Stein's two figures of *Lepocinclis* (*Chloropeltis*) *ovum* (T. xix., f. 47, 48) which are too slender to be typical of that species. Stein, in his explanation of the plates, considers these as representing *Euglena zonalis* Carter, but Kent's figure of the latter (Infusoria, T. xx., f. 58, after Carter) seems to forbid this identification. I do not know this species, which appears to be an oval form, finely striate longitudinally, having some connection with the next form.

Var. SUECICA Lemmermann. (Pl. vi., fig.1).

Long. corp. 26, lat. 11; lat. ap. 3, long. caud. ad 3$\mu$. Casino (189).

*Cf.* Lemmermann, *l.c.*, p. 123, T. i., f. 20. He gives the size as 24.5—26$\mu$ long. and 9.5—12$\mu$ broad. According to his figure the membrane is finely striate longitudinally with a slight spiral twist.

(?) LEPOCINCLIS SPHAGNICOLA Lemmermann. (Pl. vi., fig. 2).

Long. corp. 30—32, lat. 12; lat. ap. 3$\mu$. Botany (109); Guildford (114); Lismore (197).

Founded on a form figured by O. Zacharias (Forsch. d. biol. Stat. z. Plon, x., p. 259, T. ii., f. 17) as *L. fusiformis* (Carter) Lemm. I have not seen a figure of this species and therefore am not at all certain about the identification of our specimens. The author ( *op. cit.*, p. 124) describes it as oval with collar-shaped, produced anterior end, and distinctly projecting (?) hyaline hinder end, 33$\mu$ long and 12$\mu$ broad. These dimensions and specifications seem to suit our forms very well.

LEPOCINCLIS CYMBIFORMIS, n.sp. (Pl. vi., figs. 3, 4).

Forma cymbiformis, lateribus nunc deplanatis nunc arcuatis, sursum modice producta truncata, inferne acuminata.

Long. 30—34, lat. 8—11; lat. ap. c. 3$\mu$. Lismore (225).

This species includes certain somewhat irregular boat-shaped forms, sides either flattened or arched; body a little produced above, truncate; acuminate behind. Membrane striate longitudinally?

LEPOCINCLIS CAPITATA, n.sp. (Pl. vi., figs. 5, 6).

Forma anguste fusiformis, superne et inferne paene aequaliter attenuata; anteriore producta truncata, maxime capitata; postice in caudam brevem acutam protracta. Membrana per longitudinem costata, costis c. 6—8 visibilibus.

Long. 45—60, lat. 10—14, lat. ap. 4$\mu$. Botany (92, 142); Botanic Gardens, Sydney (150); Lismore (225, 260, 299).

A very pretty and distinct species characterised by its slender, regularly fusiform body, produced above into a truncately-rounded capitate prominence, and below into a short tail which continues the lines of the body. The membrane is costate longitudinally, 6—8 costae showing.

LEPOCINCLIS COSTATA, n.sp. (Pl. vi., figs. 7, 8).

Forma late-elliptica, fere ovalis; sursum levissime deplanata, haud producta; inferne caudâ brevissimâ triangulari praedita. Membrana costis 8—10 per longitudinem dispositis ornata.

Long. corp. 26, lat. 10—12, lat. ap. 3, long. caud. 3—4$\mu$. Auburn (135); Guildford (146); Wyrallah; Lismore (236, 259, 293).

A broadly elliptical, practically oval form, without any anterior prominence (none observed at any rate), but slightly flattened in front; behind furnished with a very short triangular tail; membrane costate longitudinally, with 8—10 costae visible.

Var. OBESA, n.var. (Pl. vi., fig. 9).

Forma prae longitudinem crassior.

Long. corp. 26, lat. 14—15, lat. ap. 3, long. caud. 3—4$\mu$. Lismore (242, 236, 237).

LEPOCINCLIS PAXILLIFORMIS, n.sp. (Pl. vi., figs. 10, 11).

Forma minima, corpore conico, fronte late rotundata, prominentiâ nullâ; postice attenuata, caudâ minutâ praedita.

Long. 20, lat. 8$\mu$. Guildford (114); Pott's Hill (113).

A small *Lepocinclis*, somewhat conical in general shape, broadly rounded in front, narrowed behind and furnished with a short tail, no anterior prominence noted. A rare species.

LEPOCINCLIS RUGULOSA, n.sp. (Text-fig. 3*l*, *m*).

Forma cylindracea, polis late-rotundatis, lateribus parallelis; membrana striis (vel costis) obliquis spiralibus ornata. A vertice circulata, margine rugulosa.

Long. 25, lat. 15$\mu$. Rookwood.

A small cylindrical form with straight sides and broadly rounded ends. Membrane striate obliquely and spirally either with coarse striae or fine costae. End view circular, the striae showing as about 15 small corrugations on the margin. I am a little doubtful about the genus, as I have no note on the cell-contents. The flagellum figured, however, is Euglenoid and not as in *Sphenomonas*, and the motion "continually revolving" agrees with *Lepocinclis*. Noted in quantity from Rookwood in 1910.

Genus TRACHELOMONAS Ehr.

A detailed account of the principal types of this genus occurring in our waters has already been given in "The Genus Trachelomonas" (These Proceedings, 1915). Here it will only be necessary, therefore, to describe forms noted since then, and to confirm those of rare occurrence by new records.

TRACHELOMONAS VOLVOCINA var. PLANKTONICA, n.var. (Pl. vi., fig. 12).

Forma collo exteriore distincto instructa. A distinct neck round the orifice is very rare in this species. Only noted twice, in both cases from water-supply samples.

Diam. 15; coll. lat. 3, alt. 2$\mu$. Brisbane Water Supply; Sydney Water Supply (115).

Var. SCABRA, n.var. (Pl. vi., fig. 13).

Forma collo brevi; membrana aspera. The membrane is usually very smooth and shiny; in this form it is slightly rough with minute irregularities, not regularly granulate; a short neck present.

Diam. 12$\mu$. Guildford (45).

Var. CORONETTA, n.var. (Pl. vi., fig. 14).

Forma ore membranâ lata circumcincto. A very pretty and distinct form. The lorica does not seem to be always perfectly spherical, but produced above a little. The orifice is surrounded by a delicate and somewhat irregular, membranous collarette which stands out at a wide angle, edges smooth. In one specimen the chloroplasts were very regular, distinct and strongly marked. They were of the usual Euglenoid type, viz., small circular discs, but this is the only occasion on which I have noted this in *Trachelomonas*. In this genus the chlorophyll is arranged in three different ways: (1) apparently regularly diffused through the outer layer of cytoplasm; (2) disposed in a few, large, oval discs, widely separated and often more or less of irregular shape; (3) irregularly reticulated in patches with connecting threads.

Diam. 16, coll. diam. 10$\mu$. Lismore (365).

Var. PUSTULOSA, n.var. (Pl. vi., fig. 15).

Forma plerumque hyalina, collo nullo; membrana pustulis latis pulviniformibus, minute granulatis, vestita.

Diam. 12$\mu$. Sydney; Lismore.

Lorica generally hyaline and covered with broad disc-shaped pustules which are themselves minutely granulate. About 6 pustules across the face.

TRACHELOMONAS BOTANICA var. BOREALIS, n.var. (Pl. vi., fig. 16).

Forma modice oblonga, collo lato divergente praedita; membrana punctata.

Long. 36, lat. 30½; lat. oris 8, papill. 4$\mu$. Lismore (303).

A more oblong form than the type, with a wide dentate collarette round the orifice. The distinguishing mark of this species is the minute papilla at the hinder end. Only known hitherto from Sydney—*antea*, 1915, p. 9, Pl. i., f. 9.

TRACHELOMONAS OVALIS Playfair. (Pl. vi., figs. 17, 18).

Long. 23—35, lat. 19—23$\mu$. Murwillumbah; Lismore (328, 350).

Out of weeds in a surface-water drainage ditch at Murwillumbah in quantity. It is a form rapidly developed where there is a current of water. The lorica is thin, smooth, generally colourless or almost so, and transparent. The figures show the chlorophyll disposed either in regular discs, or irregular reticulations.

TRACHELOMONAS TERES Maskell, forma. (Pl. vi., fig. 19).

Long. corp. 27, lat. 18; coll. lat. 4, alt. 3$\mu$. Lismore (285).

Cf. Maskell, On Freshwater Infusoria, Trans. N.Z. Institute, vol. xx., N.S., 1887. *Tr. teres*, type, is long oval, with a slight collar round the orifice, membrane smooth—the author gives long. 35$\mu$. This form is not quite typical, being more oblong in outline. Four different necks are given which have been noted in this form.

TRACHELOMONAS BULLA var. AUSTRALIS Playf. (Pl. vi., fig. 20).

Long. corp. 40, lat. 23; coll. long. 8, lat. 6$\mu$. Centennial Park, Sydney (133).

Only previously noted from Lismore. This specimen makes our form practically equal in size to Stein's type (50 × 21$\mu$), but the shape is different.

TRACHELOMONAS OBLONGA Lemmermann. (Pl. vi., fig. 21).

Noted both with and without a neck. This is what I take to be Lemmermann's type, but I have not seen the figure.

Long. 17, lat. 12; coll. long. $2\frac{1}{2}$, lat. $1\frac{1}{4}\mu$. Centennial Park (133).

TRACHELOMONAS PULCHERRIMA var. MINOR Playf. (Pl. vi., fig. 22).

Long. 17—19, lat. $10\mu$. Plenty in the swampy corner of a field in company with *Tr. pusilla* Playf. Lismore (344).

TRACHELOMONAS VOLZII var. SULCATA, n.var. (Pl. vi., fig. 23).

Forma parte anteriore sulcis 10—12 (5—6 visis) per longitudinem dispositis ornata.

Long. 31—32, lat. 21; lat. coll. 3, alt. $1\frac{1}{2}\mu$. Botany (108).

A form having the shape of the type, but with 5 or 6 sulcae running down the face as far as the centre. Var. *pellucida* and var. *cylindracea*, previously known from Sydney only, are here recorded from Lismore also (328, 358).

TRACHELOMONAS AMPULLULA var. MAJOR Playf. (Pl. vi., fig. 24).

Forma scrobiculata, lateribus minime angulatis, postice haud mammillata.

Long. 34—36, lat. 17—19; coll. alt. 2—3, lat. $5\mu$. Lismore (344).

This large form of *Tr. ampullula* is not always retuse and mammillate as previously described (*antea*, 1915, p. 17, Pl. ii., f. 7). In this case also the membrane was coarsely but faintly scrobiculate, and the general outline only very slightly angular.

Var. GRACILIS, n.var. (Pl. vi., fig. 25).

Forma major sed gracilior, lateribus levissime arcuatis, haud angulatis.

Long. 40, lat. 15; coll. alt. 3, lat. $4\mu$. Guildford (70).

A slender form of var. *major*, with arched, not angular sides, the mammillate end very distinct.

Var. ELLIPTICA, n.var. (Pl. vi., fig. 26).

Forma parva, gracillima, corpore perfecte elliptico, pone acute rotundato, lateribus haud angulatis.

Long. $25\frac{1}{2}$, lat. $10\frac{1}{2}$; coll. alt. $2\frac{1}{2}$, lat. $2\frac{1}{2}\mu$. Lismore (350).

A very graceful elliptical form, acutely rounded behind and absolutely without any angularity. Clear pale yellow membrane.

TRACHELOMONAS CLAVATA var. SUBARMATA Playf. (Pl. vi., fig. 27).

Long. 58, lat. 22; coll. alt. 9, lat. $7\frac{1}{2}\mu$. Lismore (351).

A very rare and curious species, only known previously from the Botanic Gardens, Sydney, but now recorded from Lismore. The surface of the lorica was reticulate, however, not scrobiculate. I have seen but 3 specimens of this species and only 2 of var. *subarmata;* it is interesting to note that, however bizarre in appearance and rare in occurrence a form may be, it will keep its distinguishing characteristics wherever it is found.

TRACHELOMONAS EURYSTOMA var. PARVA, n.var. (Pl. vi., fig. 28).

Forma quam typicâ dimidio minor, magis rotunda, minime ovata, membrana glabra, striis nullis nec punctis.

Long. 13½, lat. 11; coll. lat. 4μ. Lismore (197).

A small rounded form, about half the size of the type, hardly ovate at all, obtained from weeds in the Richmond River. The membrane is smooth, not striate, and the ring-neck not fluted.

TRACHELOMONAS CORONATA, n.sp. (Pl. vi., figs. 29, 30).

Forma ovalis, vel ovata pone attenuata; superne collo latissimo divergente, margine cuspidato, coronata; inferne caudâ brevissimâ rectangulari bidentata praedita.

Long. 36—38, lat. 20—21; coll. alt. 2—4, lat. 12μ. Lismore (328).

The lorica is oval, or ovate narrowed posteriorly. Above, furnished with a wide outstanding collarette in form of a crown, with a cuspidate margin; below, a very short, square, bidentate tail. Membrane smooth or very slightly roughened.

TRACHELOMONAS SPLENDIDA, n.sp. (Pl. vii., fig. 1).

Lorica magna, elliptica; sursum collo quadrato, ore everso, inferne caudâ brevissimâ subrectangulari; membrana granulata.

Long. corp. 40, lat. 20; coll. alt. 6, lat. 5; caud. long. 6, lat. 1½μ. Lismore (365).

A large handsome species with a long-oval or elliptical body, square neck with everted rim, and short, subrectangular, stubby tail. Membrane dark yellow, granulate. The zooid was alive and active; the chlorophyll seemed to be diffused through the outer layer of the cytoplasm. The latter must have been very translucent, for in spite of the yellow colour and granules of the lorica, the internal organization of the zooid could easily be seen, which is rare in this genus.

This is one of my very latest finds; I thought I had exhausted the possibilities of the district, but the number and variety of types in *Trachelomonas* seem to be infinite.

TRACHELOMONAS HISPIDA (Perty) Stein.

Long. s.sp. 32—50, lat. s.sp. 23—33; spin. long. 4—6μ. Botany (92, 142); Lismore (333).

Of much larger dimensions than the type which is not over 30 × 20μ without spines; and spines only 2μ long.

TRACHELOMONAS BACILLIFERA Playf.

Long. s.sp. 35, lat. 32; spin. long. 2μ. Lismore (347).

Hitherto known only from Sydney; lorica almost spherical and very dark reddish-yellow in colour.

Var. MINIMA Playf. (Pl. vii., fig. 2).

Long. s.sp. 12½, lat. 10½; spin. long. 2μ. Lismore.

Only about half the size of the specimens previously recorded (Genus Trachelomonas, p. 22). It should be noted that in all the forms of *Tr. bacillifera* figured there, the spines are too fine, they should be much coarser, and not so many on the lorica, yet still quite close together.

Var. GLOBULOSA, n.var. (Pl. vii., fig. 3).

Forma sphaerica minuta. Diam. s. spin. 11μ. Brisbane.

A minute spherical form of a pale biscuit colour from the Brisbane water-supply. Such a tint is unusual in this species, all its forms being very dark coloured.

TRACHELOMONAS ARMATA var. GLABRA Playf. (Pl. vii., fig. 4).

Forma corpore ovato subgloboso nec oblongo.

Long. corp. 32, lat. 26$\mu$. Lismore (365).

This specimen is the shape of Ehrenberg's type—ovate subglobose, slightly narrower in front than behind,—quite smooth, however, except for the posterior ring of awns. The chloroplasts and cytoplasm were reticulate.

Var. LONGISPINA Playf.

Long. corp. 42, lat. 32; spin. poster. long. 17, lat. max. 42$\mu$. Lismore.

A fine specimen noted alive. The lorica was hispid with fine short spines (2$\mu$ long) and was armed behind with a ring of 10 long awns. Previously recorded only from Sydney and with no more than 4 posterior awns. For figure take that of var. *duplex* (Pl. vii., f. 5) without the subapical ring of awns. This is the first specimen of *Tr. armata* which agreed with Ehrenberg's type in being "hispid."

Var. DUPLEX Playf. (Pl. vii., fig. 5).

Forma spinis brevibus hispida (nec granulata); aculeis anterioribus acutis nec bacillaribus; aculeis posterioribus longissimis.

Long. corp. 45, lat. 35; acul. poster. long. 24$\mu$. Lismore (332, 347, 365).

Var. *duplex* is very rare, as yet only found at Lismore. In this form the lorica is hispid with fine short spines, and not granulate. The awns of the anterior series are acute, not bacillar.

TRACHELOMONAS LISMORENSIS var. MIRABILIS Playf.

Diam. corp. s. spin. 25—26; spin. long. 5—6$\mu$. Lismore (260, 261, 351).

My original description of this form gave only the end view. I can now state that the lorica is globose, differing in this from other forms of the species. Indeed it is doubtful if it should be placed under *Tr. lismorensis*, as the spines are characteristic, stout, conical, very closely set at equal distances apart and not in rows, 7—8 visible in a quadrant of the circumference, the outer half hyaline. (Pl. vii., f. 22).

Var. BISERIATA Playf.

Diam. corp. s.sp. 15; sp. long 3$\mu$. Wyrallah (310); Byron Bay; Lismore (311, 328, 344, 347).

All the varieties of this species are remarkably regular in size and shape. This form is now confirmed from several localities in the district.

TRACHELOMONAS PAUCISPINOSA, n.sp. (Pl. vii., fig. 6).

Lorica subglobosa ubique rotundata; collo nullo; membrana glabra lutea, spinis brevibus validis acutis sparsis armata.

Long. s. spin. 17½, lat. 16; spin. long. c. 2½$\mu$. Lismore (261).

A smooth subglobose or very broadly oval form, armed with short, sharp, stout spines, very wide apart—only 5 or 6 are visible at each side. A very rare species.

TRACHELOMONAS SCABRA var. CORDATA Playf. Forma. (Pl. vii., fig. 7).

Forma magis ovata, inferne magis angustata, membrana fere glabra.

Long. 20, lat. 15$\mu$. Lismore (351).

A more ovate form than that described before and more narrowed below. Membrane only very slightly rough with low scattered thickenings here and there (*antea*, 1915, p. 29, Pl. iv., f. 11).

TRACHELOMONAS ACUMINATA var. AMPHORA Playf. (Pl. vii., fig. 8).

Long. 38, lat. 23; coll. alt. 8, lat. 6; caud. long. 10$\mu$. Lismore (347).

Described originally from Parramatta, now confirmed from Lismore. The zooid was alive and active, the chlorophyll seemed to be diffused.

TRACHELOMONAS URCEOLATA Stokes. (Pl. vii., fig. 9).

Long. 50—57, lat. 23—28; coll. alt. 4—6; caud. long. 10—17$\mu$. Lismore (347, 348, 352).

Merely a single specimen, not too like the type, was previously noted from Parramatta (Sydney), but I have now to record typical specimens alive in some quantity from this district. In most of the tailed forms the zooid is free within the lorica, but occasionally the body is adherent. Such are generally found in plankton gatherings and I would remark that it is not necessary to go for plankton to large bodies of water; the plankton of ponds is usually extremely varied and interesting.

TRACHELOMONAS GIRARDIANA mihi.

Syn. *Tr. urceolata* var. *Girardiana* Playf. (These Proceedings, 1915, p. 32, Pl. v., f. 7, 8). This form is really not in the least like *Tr. urceolata* and always retains its very characteristic appearance so that I think it should stand as a type.

Var. GLABRA, n.var. (Pl. vii., fig. 10).

Long. 36—40, lat. 20—22; coll. alt. 4—6, lat. 6; caud. long. 5—10$\mu$. Lismore (347).

Membrane smooth in these specimens, not scabrous as formerly. At present known only from Lismore.

TRACHELOMONAS ELEGANTISSIMA (G. S. West) Playf.

Arranged, but doubtfully, by G. S. West as (?) *Dinobryon elegantissimum* in Algae of the Yan Yean Reservoir, p. 81, fig. 10K; I placed this species under *Trachelomonas* on account of the resemblance of a similar form to *Tr. napiformis*. The zooid, however, which alone can decide the genus, has not yet been noted; and indeed it is not at all unlikely that it may turn out to be a species of *Salpingoeca* (*antea*, 1915, p. 32, f. 12).

TRACHELOMONAS HESPERIA, n.sp. (Pl. vii., fig. 11).

Forma ad *Tr. elegantissimam* var. *ovatam* valde accendens, sed stipite brevissima; corpore ovato, subgloboso, utrinque rotundato, inferne acuminato, in stipitem brevissimam producto, superne collo rectangulari, ore everso.

Long. corp. 14, lat. 8; coll. alt. 4, lat. 4; stip. long. 2$\mu$. Perth Water Supply, W. Australia.

A good many specimens of this form were found in a sample kindly sent me by the engineer of the Perth (W.A.) Water Supply. It is very like *Tr. elegantissima* var. *ovata* from the Sydney Water Supply, but with a very short stalk. The lorica is ovate, subglobose with rounded sides, narrowed below into a short stipes. Above there is a square neck with everted rim. Membrane smooth, that of the body stout, especially above, pale brown; but, in every case, that of the neck was hyaline and very delicate, evidently a later growth. One specimen noted was entirely hyaline, pellucid and thin-walled like a *Dinobryon*.

TRACHELOMONAS NAPIFORMIS var. BREVICOLLIS, n.var. (Pl. vii., figs. 12—14).

Forma paullo magis ovata, collo breviore, ore valde everso.

Long. 48—53 (corp. 36—38), lat. 24—25; coll. alt. 5—6, lat. 6—11; caud. 10—14$\mu$. Lismore (322, 333, 347).

A more perfectly ovate form of the type with shorter neck and accentuated rim. A new record for this species.

TRACHELOMONAS CUNEATA, n.sp. (Pl. vii., fig. 15).

Lorica trapezoidea, angulis lateralibus fere rectis; inferne cuneata, lateribus planis ad caudam convergentibus; sursum subtriangularis, lateribus convexis in collum sensim sensimque adscendentibus, ore everso; membrana hyalina scabra.

Long. 50, lat. 20; coll. lat. 6; caud. long. 14$\mu$. Lismore (258).

Lorica somewhat trapezoid with lateral angles almost square. Greatest breadth about 1-3rd from the mouth. From the lateral angles downward, cuneate, with flat sides converging to the tail. Above subtriangular, sides convex, gradually rising into the narrowed neck with everted rim; membrane irregularly roughened.

TRACHELOMONAS GIBBEROSA var. LONGICOLLIS, n.var. (Pl. vii., fig. 16).

Lorica corpore multo compresso; collo longissimo, lateribus parallelis.

Long. 54, lat. 26; coll. alt. c. 18, lat. 6; caud. long. c. 24$\mu$. Lismore (258).

An elegant form, with the body of the lorica much compressed antero-posteriorly, and with a very long neck. This form and the previous one are both uncommon; they were plentiful, however, alive in one gathering.

Var. TUMIDA, n.var. (Pl. vii., fig. 17).

Lorica corpore prae longitudinem multo majore; collo vix formato; cauda minutissima.

Long. 53, lat. 39; lat. oris 7; caud. long. 3$\mu$. Lismore.

A form in which the body of the lorica is very large compared with the total length. Above, it is gradually narrowed to the mouth without any distinct neck; tail quite minute. That polymorphism in these and similar organisms is largely a matter of the relative development of component parts, is well exemplified in this species. This form, var. *longicollis*, and the type (long. 53, 54, 56$\mu$ respectively) are all about the same size and the characteristic shapes are merely the result of the proportionate growth of the body, neck and tail of the lorica.

TRACHELOMONAS ROTUNDATA mihi. (Pl. vii., fig. 18).

*Tr. gibberosa* var. *rotundata* Playf., *antea*, 1915, p. 35, (var. *rotunda*, by a slip of the pen, in the explanation of the plates, p. 41).

Long. 40 (corp. 25); lat. 25; coll. alt. 6, lat. 6; caud. long. 9$\mu$. Lismore.

This form retains its shape well and is not at all like *Tr. gibberosa*. I erect it here as a separate type. Specimens a little larger than those from Parramatta; a new record for the species.

TRACHELOMONAS LANCEOLATA, n.sp. (Pl. vii., figs. 19, 20).

Lorica lanceolata, lateribus rotundatis; sursum collo quadrato; inferne sensim sensimque attenuata, acuminata; a latere interdum compressa. Membrana glabra.

Long. 30, lat. 12—13; coll. alt. 4, lat. 5—6$\mu$. Parramatta (136); Lismore (258).

Lanceolate with rounded sides, above converging to the wide square neck, below gradually running down to a point; membrane smooth. The Parramatta specimen was slightly compressed in side view.

TRACHELOMONAS SPIRALIS, n.sp. (Pl. vii., fig. 21).

Lorica elliptica, inferne acuminata, lateribus aequaliter arcuatis, sursum collo, lato, humili instructa. Membrana hyalina glabra, tenuissima, torta; costis spiralibus 3—4 ornatis.

Long. 36, lat. 21; coll. alt. 3, lat. 6$\mu$. Botany (151).

Lorica elliptic, pointed below, sides evenly arched, neck wide and low; membrane very thin, hyaline and with the delicate matt or frosted surface common in this class of *Trachelomonas*. It belongs to the stipitate group, though it has no tail. Three or four ridges run spirally from end to end, the lorica having probably been an adherent form which has got twisted in growth. The tail itself in these forms is due to twisting, as a close examination will often show.

## Fam. ASTASIACEAE.

### Genus MENOIDIUM Perty.

MENOIDIUM PELLUCIDUM Perty. (Pl. viii., fig. 1).

Long. 40—50, lat. 12—16, ap. 3$\mu$. Rookwood; Lismore (285, 350).

MENOIDIUM INFLATUM mihi. (Pl. viii., fig. 2).

Forma plana, levissime arcuata, fronte et postice acuta; rostro minuto angustissimo; cytoplasmate plerumque homogeneo, granulis amylaceis millis.

Long. 50—63, lat. 10—12$\mu$. Coogee; Botany (92); Guildford (60); Sydney Water Supply.

Syn. *M. pellucidum* var. *inflatum* Playf., Plankt. Sydney Water, p. 547. More common round Sydney than any other species, not noted yet at Lismore. It is flat like a piece of card, acutely pointed at each end, under side nearly flat, upper arched but not always as much as figured. Rostrum reduced to a mere spine, but from Stein's figures it seems likely that this is only the lower edge of the rostrum, the upper edge growing out of the body,. a little higher up, later on. Cytoplasm generally homogeneous, without granules.

MENOIDIUM ACUTISSIMUM, n.sp. (Pl. viii., fig. 3).

Forma longissima, angustissima; fronte truncata, haud rostrata; pone longe protracta, acutissima; latere inferiore fere recto, superiore quam levissime arcuato; pharynge distincto; stigmate minutissimo; bacillis amylaceis longis angustis in serie singula dispositis ornata.

Long. 200, lat. 8½, ap. 5μ. Lismore; Wyrallah.

A very rare *Menoidium*, but noted from two distinct localities. The body is straight and very long in proportion to the breadth. No distinct rostrum in front, where it is merely narrow and truncate, but the formation and flagellum are as in *Menoidium*. The under side is nearly flat, the upper very slightly arched, the sides diverging slightly from the snout to the anterior quarter, from there gradually converging to the extremely narrow and sharp-pointed hinder end. Cytoplasm hyaline, homogeneous, transparent, allowing a clear view of the bag-shaped pharynx with which are connected a minute c.v. and red stigma. A single series of long thin paramylum rods along the upper side, much more regular than is usual in this genus.

MENOIDIUM GRACILE, n.sp. (Pl. viii., figs. 4, 5).

Forma magna, corpore gracili, arcuato, postice acuminato, fronte rostrato; cytoplasmate plerumque granulato et bacillis amylaceis ornato.

Long. 72—100, lat. 6—8; marg. infer. alt. 6—12μ. Botanic Gardens, Sydney (150); Lismore (225, 260, 350).

Nearly twice as long as the type. Body well-arched, very slender, acuminate but not acute behind, rostrate in front. Cytoplasm generally granulate and with a few paramylum rods in front.

MENOIDIUM INCURVUM Fresenius. (Pl. viii., fig. 6).

Syn. *M. pellucidum* var. *incurvum*, Biol. Richmond River, p. 141. A very small form and rare, though there were plenty in gathering 188 out of weeds in the Richmond River. Broadest in front where it is abruptly truncate, without rostrum, and very active in its movements, darting and twisting about incessantly; there is very little in its appearance to connect it with this genus.

*Cf.* Klebs, Organ. einig. Flag.; and Daugeard, Recherch. s. l. Euglen., p. 151, f. 46; the latter gives 25 × 7μ as the size.

Long. 16, lat. 5μ. Lismore (188, 358).

MENOIDIUM TORTUOSUM (Stokes) Senn. (Pl. viii., fig. 7).

Syn. *Atractonema tortuosum* Stokes, Infus. U.S. p. 92, Pl. i., f. 31. A narrow spiral form, rostrate in front, acutely pointed behind; cytoplasm homogeneous, with a few paramylum granules or short rods. It moves in a spiral manner, unlike other members of the genus, which either revolve slowly round the long axis or *bore* their way through the water, rocking from side to side in a manner peculiarly their own.

Long. c. 22, lat. 5μ. Stokes gives long. 20—40μ. Lismore (350, 365).

Genus DISTIGMA Ehr.

DISTIGMA PROTEUS var. CLAVATUM mihi. (Pl. viii., fig. 8).

Syn. *Menoidium pellucidum* var. *clavatum* Playf., Biol. Richmond River, p. 142. *Cf.* Senn, Flagellata, pp. 177, 178, f. 128B.

Long. 40—84, lat. 6—12μ. Lismore (187, 188, 365).

Formae. (Pl. ix., figs. 10—13).

These forms have all the appearance of being a distinct species of *Peranema*, but I believe them to be young forms of the preceding.

Long. 18—44, lat. max. 8—12μ. Auburn (139); Pott's Hill (121); Lismore (258).

### Genus ASTASIA Dujardin.

ASTASIA MARGARITIFERA Schmarda. (Pl. viii., fig. 9).

I am doubtful about the identification of this infusorian, having never observed it in the free-swimming form figured by Senn, *l.c.*, p. 177, f. 128A. Only when travelling with its characteristic metabolic movement does it draw one's attention, and so I represent it here. The flagellum is very often (generally?) wanting; cytoplasm granulate. On one occasion half a dozen individuals were found living parasitically within the tissues of a living specimen of the *Turbellaria;* they were devoid of a flagellum and worked themselves to and fro with their usual metabolic progression.

Long. c. 20—50$\mu$. Auburn (139); Pott's Hill (121); Lismore (312).

### Genus SPHENOMONAS Stein.

SPHENOMONAS QUADRANGULARIS var. CRUCIFORMIS, n.var. (Pl. viii., fig. 10).

Ovate, pointed in front; with four, more or less elevated, longitudinal ridges each containing at the summit a series of granular markings. The European form (type) is rhomboidal in outline, with rounded lateral angles; in end view almost square, with slightly cuspidate sides and sharp angles. Ours are cruciform with deeply excavated sides and rounded tips to the arms. Rare. For the type *see* Stein, T. xxiii., f. 49—53; Kent, T. xxiv., f. 21—23.

Long. 24—27, lat. 10—13$\mu$. Rookwood (107); Lismore (297, 345, 347).

SPHENOMONAS AUSTRALIS, n.sp. (Pl. viii., fig. 11).

Cellulae pyriformes, sursum attenuatae, subacutae; inferne rotundatae; lateribus arcuatis; rugis 6 (visis 4) granulatis per longitudinem dispositis ornata. Vertice visae hexagonae lateribus emarginatis.

Long. 25—26, lat. 10—12$\mu$. Rookwood; Botanic Gardens, Sydney (156); Lismore (312).

This species is more frequently met with here than any other of the genus. It is drop-shaped, narrowed and subacute in front, rounded behind. End view hexagonal, as the body is ornate with 6 longitudinal granulate ridges. The hinder part of the body is generally a solid ball of some perfectly transparent highly refringent substance (leucosin ? or paramylum ?). So homogeneous and pellucid is it that the granules on the under side can be seen, magnified, through it.

Var. ELLIPTICA, n.var. (Pl. viii., fig. 12).

Cellulae longe-ovatae, paene ellipticae, fronte acuminatae, postice rotundatae, lateribus levissime arcuatis. Dimensiones ut in f. typica. Rookwood (107).

A much less common elliptic form of similar size and characteristics to the type.

Var. RHOMBOIDEA, n.var. (Pl. viii., fig. 13).

Cellulae rhomboideae, lateribus angulatis, utroque polo acuminatae.

Long. ad. 30, lat. 16$\mu$. Guildford (45).

The cells are rhomboidal, sides angled, ends subacutely rounded.

SPHENOMONAS TERES (Stein) Klebs. (Pl. viii., figs. 14, 15).

Syn. *Atractonema teres* Stein, *op. cit.*, T. xxiii., f. 35—41; *Clostenema socialis* Stokes, *op. cit.*, p. 112, Pl. ii., f. 15. Almost, if not quite, as common as the foregoing species. Senn, *l.c.*, p. 177, f. 128D, figures it with only an incipient trailer (the secondary flagellum), but I find specimens with a trailer twice the length of the body, and young forms have no second flagellum at all. The fact is that the trailer develops later than the true flagellum. The latter is of the *Peranema*-type, stout at the base and tailing off to the tip. It is held motionless for the most part, straight out in front; only the tip is in movement. Sometimes the extreme end of the cell is constricted into a little stubby tail.

Long. 20—25, lat. 6—12$\mu$. Auburn (139); Lismore (298, 312, 345).

Var. PYRIFORMIS, n.var. (Pl. viii., figs. 16, 17).

Cellulae ut in f. typica rugis nullis, sed pyriformibus, interdum caudâ brevi subtriangulari instructae.

Long. 16—26, lat. 9—20$\mu$. Auburn (140); Botany (91); Lismore (188, 298, 312).

Smooth and without ridges as in the typical form, but in shape pyriform, with or without a short broad tail.

It is probable that *Sph. teres* is a young form or at least a polymorphic form of *Sph. australis*. I have noted faint longitudinal lines down the body, which seemed to indicate the formation of ridges. In Pl. viii., fig. 18, is shown an intermediate form in which the ridges are plainly visible, but the characteristic marginal granulation was not present and the cell therefore inclined to *Sph. teres*.

SPHENOMONAS TRIQUETRA, n.sp. (Pl. viii., fig. 20).

Cellulae inaequaliter ovatae, utroque polo acuminatae; a vertice visae inaequaliter triquetrae.

Long. 30, lat. 20$\mu$. Rookwood; Botanic Gardens (156).

Irregularly ovate in shape, pointed at each end, with a ridge running spirally down the face; end view irregularly triangular with hollow sides and rounded angles.

Var. CUNEATA, n.var. (Pl. viii., fig. 19).

Cellulae inaequaliter cuneata, fronte rotundatae, postice attenuatae, acuminatae; a vertice visae inaequaliter triquetrae.

Long. 30, lat. 15$\mu$. Guildford.

Somewhat cuneate in shape, broadest in front, where it is rounded off, gradually narrowed to a subacute point behind. A longitudinal ridge down the face; end view irregularly triangular with hollow sides and rounded angles.

SPHENOMONAS EXCAVATA, n.sp. (Pl. ix., fig. 1).

Cellulae oblongae, subrectangulares; extremitatibus lateribusque arcuatis; utroque polo bullâ conicâ praeditae; rugis 3, mediano spirale, per longitudinem dispositis instructae; flagello recto. A vertice visae subrectangulares, utrinque rugis altis 3. A latere late-fusiformes.

Long. 32, lat. 21, crass. c. 16$\mu$. Lismore (358).

Subrectangular, ends and sides arched; at each pole a conical boss, from the anterior part of which the straight thick *Peranema* flagellum springs. No

trailer noted. Three deeply excavated longitudinal ridges run down both the upper and under face, the central one somewhat spiral. End view subrectangular, with 3 strongly marked ridges front and back, the other two sides slightly hollowed. Side view broadly fusiform or lenticular. Membrane smooth; cytoplasm hyaline, transparent, homogeneous. No paramylum, no granulation of the ridges.

SPHENOMONAS SPIRALIS, n.sp. (Pl. ix., fig. 2).

Cellulae ambitu late-fusiformes, superne acutae, inferne obtusae; rugis spiralibus 5—6 paene transverse dispositis alte excavatae; membrana glabra; cytoplasmate retracto, granulato, hyalino; flagello recto, crasso, interdum secundo retrorsum directo.

Long. 40, lat. 34$\mu$. Botanic Gardens, Sydney (156).

Broadly lenticular in general outline, pointed above, obtuse below, deeply scored by 5 or 6 spiral ridges laid almost horizontally and from left to right. Membrane smooth; cytoplasm retracted, hyaline, granular; a stout flagellum directed straight forward, sometimes also a trailer.

Var. ANGUSTA, n.var. (Pl. ix., fig. 3).

Cellulae ambitu longe-ovales; utroque polo obtusae infra marginem spinâ praeditae; rugis spiralibus 3—4 oblique dispositis alte excavatae; cytoplasmate haud retracto; ceteris ut in forma typica.

Long. 40, lat. 21$\mu$. Lismore.

General outline long oval; obtuse at each end, with a sharp point within the margin; only 3—4 ridges spirally and obliquely wound; cytoplasm not retracted; a flagellum and a trailer observed.

SPHENOMONAS MIRABILIS, n.sp. (Pl. ix., figs. 4, 5).

Cellulae oblongae, utroque polo rotundatae; costis spiralibus 6 oblique vel per longitudinem dispositis ornatae; membrana glabra, costis haud granulatis; cytoplasmate retracto, hyalino, granulato; flagello valido recto.

Long. 34—36, lat. 18—23$\mu$. Lismore (328, 345, 365).

Cell oblong, rounded at each end; membrane smooth, ridged by 6 sharp-edged spiral costae longitudinally and more or less obliquely wound and from right to left (the opposite way to *Sph. spiralis*). Cytoplasm retracted, hyaline, granulate, flagellum stout, straight, no trailer noted. End view circular.

## Fam. PERANEMACEAE.

### Genus PERANEMA (Ehr.) Stein.

PERANEMA TRICOPHORUM (Ehr.) forma. (Pl. ix., fig. 6).

Forma angusta arcuata. Long. 50, lat. 10$\mu$.

I doubt if I have ever seen the type of this species. The European form is fusiform. The specimen figured is narrower and arched. Botanic Gardens, Sydney (156). *Cf.* Senn., p. 180, f. 130A.

PERANEMA CUNEATUM, n.sp. (Pl. ix., figs. 7—9).

Long. 25—70, lat. 5—15$\mu$. Auburn (139, 140); Botanic Gardens (156); Parramatta (132); Lismore (187).

This is the common *Peranema* of our waters. It is, when free-swimming, cuneate, sharp-pointed in front and abruptly truncate behind; one corner is sometimes produced as a pointed tail directed backwards, or a blunt wart-like prominence often bifid and placed to one side. A minute stigma may occasionally be observed. Cytoplasm homogeneous and transparent. Neither Stein nor Dujardin describe or figure anything even remotely resembling this form. The body is metabolic.

PERANEMA ASPERUM, n.sp. (Pl. ix., fig. 14).

Forma corpore globoso; granulis amylaceis ubique asperrima.

Long. 15—16, lat. 11—12$\mu$. Rookwood; Lismore (286).

A small, irregular, globose or subglobose form with the surface rugged all over with large irregular amylaceous granules.

Var. RECTANGULARE, n.var. (Pl. ix., fig. 15).

Forma cylindracea. Dimensiones ut in forma typica.

Genus URCEOLUS Mereschowski.

URCEOLUS SABULOSUS (Stokes) Senn. (Pl. ix., fig. 16).

Syn. *Urceolopsis sabulosus* Stokes, *op. cit.*

Long. 42, lat. 19; lat. oris 13$\mu$. Lismore.

Hyaline, granular, surface slightly rough, mouth and neck smooth. It glides along applying the huge mouth (which seems to be a kind of open pharynx) to the floccose and sucking in anything edible.

Genus HETERONEMA (Duj.) Stein.

HETERONEMA ACUS Ehr. (Pl. ix., fig. 17).

Long. 30—90, lat. 3—6$\mu$. Auburn (159); Botany; Pott's Hill (121).

Flagellum and trailer noted.

Genus TROPIDOCYPHUS Stein.

TROPIDOCYPHUS OCTOCOSTATUS Stein. (Pl. viii., fig. 21).

I give a side view of an animalcule that may be this species. Stein, T. xxiv., f. 1—5; Senn, p. 183.

Genus NOTOSOLENUS Stokes.

NOTOSOLENUS PENTAGONUS, n.sp. (Pl. ix., figs. 2, 3).

Forma corpore pentagono; fronte acute-rotundata, pone truncata; lateribus emarginatis; angulis rotundatis; vertice visa compressa.

Long. 21, lat. 17$\mu$. Lismore (358).

There are three other species described and figured by Stokes, *op. cit.*, p. 108, Pl. ii., f. 10—14; *cf.* Senn, p. 183. All forms of the genus are compressed arcuate in end view. This species forms a fairly regular pentagon with the anterior angle somewhat produced; body truncate behind, widest in the middle; sides emarginate, angles rounded. Cytoplasm hyaline, finely granular in the centre of the cell, with a pharynx-like mark below the flagellum. Stokes also remarks on this. Flagellum thick, straight, a long trailer sometimes present.

## Genus ANISONEMA Dujardin.

### ANISONEMA ACINUS Duj. (Pl. ix., fig. 18).

Syn. *Anisonema ovatum* Maskell, Trans. N.Z. Inst., N.S., vol. 20, 1887, T. i., f. 8; Maskell gives long 20$\mu$. Our specimens agree entirely with Dujardin's figure and description (*op. cit.*, p. 345, Pl. iv., f. 27; not Pl. v. as in the text). Senn's figure (*Flagellata*, p. 183, f. 134A) is quite different, being elliptical and attenuate slightly to each end. Dujardin's dimensions, long. 20 to 31$\mu$, just cover Maskell's and ours. The trailer is very long, quite three times the length of the body sometimes.

Long. 30, lat. 18$\mu$. Rookwood; Lismore (260).

### ANISONEMA HEXAGONUM, n.sp. (Pl. ix., fig. 19).

Cellulae inaequaliter hexagonae; in medio subquadratae; sursum et inferne triangulari-conicae; utroque polo acutae; lateribus rectis; uno latere transverse striata.

Long. c. 30, lat. 18$\mu$. Duck Creek, Clyde; Guildford.

Irregularly hexagonal, central part subquadrate; above and below triangular-conical, ends pointed, sides straight, transversely striate, apparently on one side only; flagellum and long trailer observed.

Var. ELEGANS, n.var. (Pl. ix., fig. 20).

Quam forma typica longior et angustior.

Long. c. 40, lat. 10$\mu$. Duck Creek, Clyde; Guildford.

The same general shape as the type, but longer and more slender. Both very rare, sizes only estimated.

### ANISONEMA GRANDE (Ehr.) Stein. (Pl. ix., fig. 21).

Long. c. 38, lat. 21, crass. c. 10½$\mu$. Lismore (328).

Syn. *Bodo grandis* Ehr.; *cf.* Stein, T. xxiv., f. 6—11, but his figures are not convincing and look too much like *Anisonema acinus* Duj. which he gives as a synonym. That is, however, a much smaller species, only about half the size of this. Kent's figures are copies of Stein's, except f. 30 (after Butschli). The latter seems to represent our form. The subapical groove, in which the trailer is inserted, is not conspicuous as in *A. acinus*. The hinder part of the body often contains coloured masses of ingested food-stuffs and even whole organisms such as *Trachelomonas*. There is the usual stout straight flagellum and very long thick trailer, often three times the length of the body. The latter is compressed in side view.

## Genus ENTOSIPHON Stein.

### ENTOSIPHON SULCATUM (Duj.) Stein. (Pl. ix., fig. 22).

Long. 22, lat. 14$\mu$. Lismore. Rare.

Syn. *Anisonema sulcata* Duj., p. 345, Pl. iv., f. 28. Senn gives long. 15—25, lat. 7—15$\mu$.

## EXPLANATION OF PLATES I.—IX.

### Plate i.

Fig. 1.—*Poteriodendron petiolatum* Stein (x 800).
Fig. 2.— ,, ,, var. *Abbotti* (Stokes) mihi (x 800).
Figs. 3, 4.—*Salpingoeca ampullacea* (A. Br.) Stein (x 1600).
Fig. 5.— ,, ,, var. *cordata*, n. var. (x 1600).
Fig. 6.— ,, *amphoridium* var. *australica* mihi (x 1600).
Fig. 7.— ,, *Steinii* Kent (x 1600).
Figs. 8, 9.— ,, *oblonga* Stein (x 2400).
Fig. 10.—*Bodo edax* Klebs (x 2400).
Fig. 11.— ,, *saltans* Ehr. (x 2400).
Fig. 12.—*Trepomonas agilis* Duj. (*a*) front, (*b*) side (x 2400).
Fig. 13.—*Hexamita inflata* Duj. (?) (x 2400).
Figs. 14, 15.—*Ochromonas aspera*, n.sp., (*a*) side (x 2400).
Fig. 16.— ,, *cylindracea*, n.sp., (*a*) side (x 2400).
Figs.17-21.—*Dinobyron sertularia* Ehr. (17, 19) two forms of lorica; (18) zooid; (20, 21) cysts; (all x 1200).
Figs. 22, 23.—*Dinobyron sertularia* var. *angulatum* Seligo, two forms, (x 1200).
Figs. 24, 25.— ,, *cylindricum* var. *divergens* (Imhof) Lemm. (x 1200).
Figs. 26, 27.— ,, *utriculus* (Ehr.) Klebs, two forms, (x 1600).
Figs. 28, 29.— ,, ,, var. *Tabellariae* Lemm., (28) five individuals joined by the discs of their pedicels (x 1600); (29) cyst (x 1200).

### Plate ii.

Figs. 1, 2.—*Mallomonas acaroides* Perty; (1) young form, type (x 800); (2) mature form (x 1200).
Fig. 3.—*Mallomonas splendens* (G. S. West) Playf. (x 1200).
Fig. 4.— ,, ,, var. *pusilla*, n. var. (x 1200).
Fig. 5.— ,, *australica*, n.sp. (x 1600).
Fig. 6.— ,, ,, v. *gracillima*, n. var. (x 1600).
Figs. 7, 8.— ,, ,, v. *subglobosa*, n. var. two stages of growth, (x 1200).
Fig. 9.— ,, *litomesa* Stokes (x 1600).
Fig. 10.— ,, ,, var. *curta*, n. var. (x 1600).
Fig. 11.—*Phaeococcus planktonicus* W. & G. S. West (x 320) (*a*) simple zooid (x 960).
Figs. 12-14.—*Scintilla chlorina*, n.sp.; (12) x 2400, (13, 14) x 1600.
Fig. 15.— ,, *splendida*, n.sp. (x 800).
Figs. 16-18.—*Synura virescens* (Bory), three forms; (all x 1600).
Figs. 19-22.—*Chilomonas paramecium* Ehr., four forms; (all x 1600).
Fig. 23.—*Cryptomonas ovata* Ehr. (x 800).
Fig. 24.— ,, *ampulla*, n.sp. (x 800).
Fig. 25.— ,, *maxima*, n.sp. (x 800).
Fig. 26.— ,, *Nordstedtii* (Hausg.) Senn. (x 1600).
Fig. 27.— ,, *gemma*, n.sp. (x 1600).
Fig. 28.— ,, *oblonga*, n.sp. (x 1600).

### Plate iii.

Fig. 1.—*Eutreptia viridis* Perty (x 560).
Fig. 2.—*Colacium vesiculosum* (Ehr.) Stein (x 1200).
Fig. 3.— ,, ,, forma, *cf.* Stein, T. xxi., f.31,32 (x 1200).
Figs. 4-6.— ,, *elongatum*, n.sp. (4) x 1200, (5,6) x 2400.
Fig. 7.—*Euglena viridis* Ehr., large cylindrical form (x 1200).
Figs. 8, 9.— ,, *sociabilis* Daugeard (x 800).
Figs. 10, 11.—,, *amblyophis* (Ehr.) mihi (x 400).
Figs. 12, 13.—,, *deses* Ehr. (13) another form of head (x 960).
Fig. 14.— ,, ,, developing out of the vegetative cell (x 800).

Fig. 15.—*Euglena deses* var. *minuta*, n. var. (x 1200).
Fig. 16.— ,, ,, var. *intermedia* Klebs (x 1200).
Fig. 17.— ,, *oxyurus* Schmarda (x 300).
Fig. 18.— ,, ,, var. *helicoidea* (Bernard) mihi (x 300).
Fig. 19.— ,, ,, var. *gracillima*, n. var. (x 400).

Plate iv.

Fig. 1.—*Euglena tripteris* (Duj.) Klebs. (x 480).
Fig. 2.— ,, *spirogyra* (Ehr.) (x 800).
Fig. 3.— ,, ,, with granules forming here and there (x 400).
Fig. 4.— ,, ,, var. *elegans*, n. var. (x 800).
Fig. 5.— ,, *acus* Ehr.; our nearest form (x 600).
Fig. 6.— ,, *acutissima* Lemm. (x 600).
Figs. 7, 8.— ,, ,, var. *parva*, n. var. (7) x 1200, (8) x 800.
Figs. 9-11.— ,, *pisciformis* Klebs. (x 1200).
Fig. 12.— ,, *texta* (Duj.) Senn, showing striae (x 800).
Fig. 13.— ,, ,, var. *ovata*, n. var. (x 960).
Fig. 14.— ,, ,, var. *obesa*, n. var. (x 525).
Figs. 15, 16.—,, ,, var. *bullata*, n. var. (15) x 525, (16) x 1200.
Fig. 17.— ,, *guttula*, n.sp. (x 1200).
Fig. 18.— ,, ,, var. *elongata*, n. var. (x 1200).
Fig. 19.— ,, *vivida*, n.sp. (x 1800).
Figs. 20, 21—,, *pusilla*, n.sp. (20) x 1600, (21) x 1800.
Fig. 22.— ,, ,, var. *longa*, n. var. (x1200)
Fig. 23.— ,, sp. ? (x 1200).

Plate v.

Fig. 1.—*Phacus pleuronectes* (Müller) Duj. (x 800).
Fig. 2.— ,, ,, var. *minutus*, n. var. (x 800).
Fig. 3.— ,, ,, var. *australis*, n. var. (x 480).
Fig. 4.— ,, *hispidulus* (Eichwald) (x 1200).
Fig. 5.— ,, *monilata* var. *suecica* Lemm. (x 1200).
Fig. 6.— ,, *longicauda* (Ehr.) Duj. (x 400).
Fig. 7.— ,, ,, var. ——— Lemm. (x 800).
Figs. 8-11.— ,, *triqueter* (Ehr.) Duj. (x 960).
Figs. 12, 13.—,, *inflatus*, n.sp. (x 1600)
Fig. 14.— ,, *lismorensis*, n.sp. (x 960).
Fig. 15.— ,, *pyrum* var. *ovatus*, n. var. (x 1600).
Fig. 16.— ,, ,, var. *australicus* mihi. (x 960).
Fig· 17.— ,, ,, var. *rudicula*, n. var. (x 1200).
Fig. 18.—*Cryptoglena australis*, n.sp. (*a*) side; (x 1600).
Fig. 19.— ,, *phacoidea*, n.sp. (x 1800).

Plate vi.

Fig. 1.—*Lepocinclis Steinii* var. *suecica* Lemm. (x 1200).
Fig. 2.— ,, *sphagnicola* Lemm. (?); (x 1200).
Figs. 3, 4.— ,, *cymbiformis*, n.sp. (x 1200).
Figs. 5, 6.— ,, *capitata*, n.sp. (5) x 1200, (6) x 800.
Figs. 7, 8.— ,, *costata*, n.sp. (x 1600).
Fig. 9.— ,, ,, v. *obesa*, n. var. (x 1600).
Figs. 10, 11.— ,, *paxilliformis*, n.sp. (x 800).
Fig. 12.—*Trachelomonas volvocina* var. *planktonica*, n. var. (x 1200).
Fig. 13.— ,, ,, var. *scabra*, n. var. (x 1200).
Fig. 14.— ,, ,, var. *coronetta*, n. var. (*a*) another collarette; (x 1600).
Fig. 15.— ,, ,, var. *pustulosa*, n.var (x 1200).

Fig. 16.—*Trachelomonas botanica* var. *borealis*, n. var. (x 800).
Figs. 17, 18.— ,, *ovalis* Playf. (17) with discoid chloroplasts, (18) chlorophyll irregularly reticulated (x 1200).
Fig. 19.— ,, *teres* Maskell, forma. *(a.b.c)* three other forms of collar (x 1200).
Fig. 20.— ,, *bulla* var. *australis* Playf. (x 800).
Fig. 21.— ,, *oblonga* Lemm. (x 1600).
Fig. 22.— ,, *pulcherrima* var. *minor* Playf. (x 1200).
Fig. 23.— ,, *Volzii* var. *sulcata*, n. var. (x 1200).
Fig. 24.— ,, *ampullula* var. *major* Playf.; a scrobiculate form with zooid. (x 1200).
Fig. 25.— ,, ,, var. *gracilis*, n. var. (x 1200).
Fig. 26.— ,, ,, var. *elliptica*, n. var. (x 1200).
Fig. 27.— ,, *clavata* var. *subarmata* Playf., a lorica with reticulate surface, and zooid. (x 1200).
Fig. 28.— ,, *eurystoma* var. *parva*, n. var. (x 1800).
Figs. 29, 30.— ,, *coronata*, n.sp. (x 1200).

Plate vii.

Fig. 1.—*Trachelomonas splendida*, n.sp. with zooid showing internal structure and diffused chlorophyll. (x 1050).
Fig. 2.— ,, *bacillifera* var. *minima* Playf. (x 1600).
Fig. 3.— ,, ,, var. *globulosa*, n. var. (x 1200).
Fig. 4.— ,, *armata* var. *glabra* Playf., showing zooid with reticulate chlorophyll. (x 960).
Fig. 5.— ,, ,, var. *duplex* Playf., form with pointed, not bacillar, anterior awns. (x 800).
Fig. 6.— ,, *paucispinosa*, n. sp. (x 1600).
Fig. 7.— ,, *scabra* var. *cordata* Playf. forma. (x 1600).
Fig. 8.— ,, *acuminata* var. *amphora* Playf. zooid with diffused chlorophyll. (x 960).
Fig. 9.— ,, *urceolata* Stokes with zooid. (x 800).
Fig. 10.— ,, *Girardiana* var. *glabra*, n. var. with zooid. (x 1200).
Fig. 11.— ,, *hesperia*, n.sp. (x 1600).
Figs. 12–14.— ,, *napiformis* var. *brevicollis*, n. var. (12) showing zooid, x 800. (13, 14) other forms of neck, x 1200.
Fig. 15.— ,, *cuneata*, n.sp. (x 1200).
Fig. 16.— ,, *gibberosa* var. *longicollis*, n. var. (x 1200).
Fig. 17.— ,, ,, var. *tumida*, n. var. (x 960).
Fig. 18.— ,, *rotundata* mihi. (x 960).
Figs. 19, 20.— ,, *lanceolata*, n.sp. (19) from Parramatta; (20) from Lismore (x 1200).
Fig. 21.— ,, *spiralis*, n.sp. (x 1200).
Fig. 22.— ,, *lismorensis* var. *mirabilis* Playf., characteristic spine.

Plate viii.

Fig. 1.—*Menoidium pellucidum* Perty, type. (x 1200).
Fig. 2.— ,, *inflatum* mihi. (x 800).
Fig. 3.— ,, *acutissimum*, n.sp. (x 600).
Figs. 4, 5.— ,, *gracile*, n.sp. (x 800).
Fig. 6.— ,, *incurvum* Fresenius (x 1800).
Fig. 7.— ,, *tortuosum* (Stokes) Senn, three specimens (x 800).
Fig. 8.—*Distigma proteus* var. *clavatum* mihi. (x 800).
Fig. 9.—*Astasia margaritifera* Schmarda. (x 1800).
Fig. 10.—*Sphenomonas quadrangularis* var. *cruciformis*, n. var. (*a*) end view. (x 1600).
Fig. 11.— ,, *australis*, n.sp.; (*a*) end view. (x 1600).
Fig. 12.— ,, ,, var. *elliptica*, n. var. (x 1600).
Fig. 13.— ,, ,, var. *rhomboidea*, n. var. (x 1600).

Figs. 14, 15.— ,, *teres* Stein (14) type x 2400; (15) form x 1900.
Figs. 16, 17.— ,, ,, var. *pyriformis*, n. var. (16) x 2400; (17) x 1600.
Fig. 18.— ,, ,, form, with incipient ridges. (x 1600).
Figs. 19, 20.— ,, *triquetra*, n.sp. (20) type x 1200; (19) var. *cuneata* n. var. x 1200. (*a*, *a*) end views.
Fig. 21.—*Tropidocyphus octocostatus* Stein (?) side view (x 1600).

Plate ix.

Fig. 1.—*Sphenomonas excavata*, n.sp. (*a*) side, (*b*) end (x 1200).
Fig. 2.— ,, *spiralis*, n.sp. (x 960).
Fig. 3.— ,, ,, var. *angusta*, n. var. (x 960).
Figs. 4, 5.— ,, *mirabilis*, n.sp. (x 1200).
Fig. 6.—*Peranema tricophorum* (Ehr.), forma. (x 800).
Fig. 7–9.— ,, *cuneatum*, n.sp. (x 800).
Figs. 10–13.—*Distigma proteus* var. *clavatum* mihi, supposed young forms. (x 800).
Fig. 14.—*Peranema asperum*, n.sp. (x 1200).
Fig. 15.— ,, ,, var. *rectangulare*, n.var. (x 1200).
Fig. 16.—*Urceolus sabulosus* (Stokes) Senn. (x 800).
Fig. 17.—*Heteronema acus* Ehr. (x 800).
Fig. 18.—*Anisonema acinus* Duj. (x 1600).
Fig. 19.— ,, *hexagonum*, n.sp. (x 1600).
Fig. 20.— ,, ,, var. *elegans*, n. var. (x 1600).
Fig. 21.— ,, *grande* (Ehr.) Stein (*a*) side. (x 1200).
Fig. 22.—*Entosiphon sulcatum* (Duj.) Stein (x 1600).
Fig. 23.—*Notosolenus pentagonus*, n.sp. (x 1600).