

On some British Freshwater Rhizopods and Heliozoa. By G. S. WEST, B.A., F.L.S. A.R.C.S., Hutchinson Student of St. John's College, Cambridge; Professor of Natural History at the Royal Agricultural College, Cirencester.

[Read 4th April, 1901.]

(PLATES 28-30.)

DURING the past few years I have been collecting and examining from every possible situation numerous small plants belonging to the Algæ, and amongst them I have found Rhizopods and Heliozoa in abundance. Most of the interesting forms of these groups I carefully sketched, in some instances making detailed and extended examinations of them, and I now possess an accumulation of notes and drawings, many of which may be deserving of notice.

Some of the observations in this paper relate to the habits and structure of certain of the Rhizopods and Heliozoa; others are descriptive of peculiar forms of the commoner and more abundant species; and others again are records of rarer and less-known species. I also give descriptions and figures of six animals which I believe have not previously been observed, one of which I have referred to a new genus (p. 325).

A point of considerable interest is the presence of a perforation at the apex of the shell of some forms of *Diffugia acuminata*, Ehrenb. The shell thus possesses two openings, one at each end, as in the case of those Rhizopods referred to the family *Amphistomina*.

As the remarkable animals belonging to the genus *Vampyrella* possess characters by which they are sharply demarcated from the other Rhizopods, I have placed them in a separate order—the *Vampyrellida*.

I have paid little attention to the species of *Amœba*, and it is very probable that I have overlooked several that are abundant and widely distributed.

Class RHIZOPODA.

Order AMŒBEA.

Fam. LOBOSA.

Gen. AMŒBA, *Ehrenb.*

1. AMŒBA PROTEUS, *Leidy*, in *Proc. Acad. Nat. Sci. Philad.* 1878, p. 99; *Freshw. Rhiz. N. Amer.* 1879, p. 31, t. i. ff. 1-8, t. ii. ff. 1-13.—*Volvox proteus*, *Pallas*, 1766. *Amœba princeps*, *Ehrenb. Abhandl. Akad. Wiss. Berlin*, 1831, pp. 28, 79; *Infus.* 1838, p. 126, t. viii. f. x.

Generally distributed; small forms most abundant. Some very large specimens were obtained from amongst *Utricularia minor* at Cocket Moss, near Giggleswick, W. Yorkshire. They possessed a very large elliptical nucleus, and were mostly gorged with Diatoms and Desmids.

2. AMŒBA VILLOSA, *Wallich*, in *Ann. Mag. Nat. Hist.* 1863, xi. p. 287, t. viii.; p. 366, t. ix.; p. 434, t. x. ff. 5-9.—*A. princeps*, *Carter*, in *Ann. Mag. Nat. Hist.* 1863, xii. pp. 30, 44, t. iii. ff. 1-3. *Trichamœba hirta*, *Fromontel.*

In a back-water of the R. Aire at "Seven Arches," near Bingley, W. Yorkshire, this species was in enormous abundance. The muddy bottom of the shallow water was covered with a thick black slime consisting entirely of *A. villosa*.

3. AMŒBA VERRUCOSA, *Ehrenb. Infus.* 1838, p. 126, t. viii. f. xi; *Carter*, in *Ann. Mag. Nat. Hist.* 1857, xx. p. 37, t. i. ff. 12, 13.—*A. natans*, *Perty*, 1852. *A. quadrilineata*, *Carter*, 1856. *Thecamœba quadripartita*, *Fromontel.*

A very abundant and widely distributed species. I obtained it in quantity amongst mosses at over 3000 ft. elevation on Snowdon, N. Wales.

Gen. PELOMYXA, *Greeff.*

4. PELOMYXA PALUSTRIS, *Greeff*, in *Archiv für mikr. Anat.* 1870, x. pp. 51-72, t. iii.-v.

Length of animals approximately 500 μ .

Amongst *Sphagnum* in very stagnant water in a bog above the lakes at Capel Curig, N. Wales.

5. *PELOMYXA VILLOSA*, *Leidy, Freshw. Rhiz. N. Amer.* 1879, p. 73, t. v., t. viii. ff. 31-33.—*Amœba sabulosa*, *Leidy*, 1874.

Terrington, N. Yorkshire, in ditches. Devil's Jumps, Frensham, Surrey, in bog-pools. Ashurst Bog, New Forest, Hants.

This is a smaller animal than *P. palustris*, Greeff, and possesses a terminal villous patch similar to that of *Amœba villosa*.

Gen. DACTYLOSPHÆRIUM, *Hertwig & Lesser*.

6. *DACTYLOSPHÆRIUM RADIOSUM*, *Blochmann, Die mikr. Thierwelt des Süßwass., I. Protozoa, Hamburg*, 1895, p. 14.—*Amœba radiosa*, *Ehrenb. Abh. Akad. Wiss. Berlin*, 1830, p. 80; *Infus.* 1838, p. 128, t. viii. f. xiii; *Carter, in Ann. Mag. Nat. Hist.* 1856, p. 243, t. v. ff. 10-18; *Leidy, Freshw. Rhiz. N. Amer.* 1879, p. 58, t. iv. ff. 1-18. *A. brachiata*, *Dujardin*, 1841. *A. ramosa*, *Duj.*, 1841.

General in pools on heaths, and in bogs and pools in hilly districts.

A peculiar form was very abundant in the pools on Esher West-end Common, Surrey, in Feb. 1894. It had a spherical body of 12-19 μ in diameter, and five (sometimes six) long, attenuated pseudopodia. Length of pseudopodia 25-54 μ . I could find no trace of this form in the same locality in either of the two following years. (Pl. 28. fig. 5.)

The usual mountain form of the animal possesses a subspherical or ellipsoidal body, 32-50 μ in diameter, and from twelve to twenty long and exceedingly narrow pseudopodia. Length of pseudopodia 25-70 μ .

An extraordinary form was met with from Llyn Idwal, N. Wales. The body was more or less polygonal, 27-34 μ in diameter, and the pseudopodia were six in number, very slender, and of extraordinary length (52-107 μ). (Pl. 28. fig. 4.)

7. *DACTYLOSPHÆRIUM VITREUM*, *Hertwig & Lesser, in Archiv für mikr. Anat.* 1874, x. Suppl. p. 54, t. ii. f. 1.

Shelf, West Yorkshire. Diameter of body 48-54 μ ; length of pseudopodia 29-48 μ .

All the animals possessed numerous radiating pseudopodia, seemingly entirely composed of the ectoplasm, the endoplasm extending a short way into their expanded bases. The ectoplasm

was homogeneous and very refractive. The endoplasm was dark-coloured and crowded with small granules; it also contained a well-marked nucleus and one contractile vacuole.

The genus *Dactylosphaerium* appears to be sufficiently well marked off from *Amœba*. The actual body of the animal is not strictly amœbiform, but always more or less spherical, sending out numbers of long, comparatively thin, attenuated pseudopodia. From what I have seen of these animals, I consider that *Dactylosphaeria* exhibit less active movements than *Amœba*. Some of the mountain forms of *D. radiosum* keep the same pseudopodia protruded to a variable extent for hours at a time.

FAM. RETICULOSA.

Gen. GYMNOPHRYS, Cienk.

8. GYMNOPHRYS COMETA, Cienkowski, in *Archiv für mikr. Anat.* 1876, xii. p. 31, f. 25; Blochmann, *Die mikroskop. Thierwelt des Süßwass.*, I. Protozoa, Hamburg, 1895, p. 14, t. i. f. 9.

Near Brigg, Lincolnshire. (Pl. 28. fig. 3.) From this locality several specimens of an animal were obtained which may, perhaps, be Cienkowski's *Gymnophrys cometa*. The body was somewhat small, being about 25 μ in length and 18 μ in breadth, and some of them were distinctly constricted in the middle as if undergoing division. The pseudopodia varied in number from three to five at either end of the body, and sometimes reached a length of 100 μ . They were delicate and hyaline, frequently much branched, and occasionally anastomosed with one another. The branches arose suddenly at a considerable angle from the main pseudopodial filament and exhibited a very rigid appearance. Small granules moved slowly along the pseudopodia, generally in groups.

Contractile vacuoles were entirely absent; this character and the peculiar nature of the rigidly-branched pseudopodia easily distinguishing it from *Biomyxa vagans*, Leidy, a Rhizopod with which it possesses much affinity.

No nucleus could be detected in any of the individuals.

Archer (in Qu. Jour. Micr. Sci. 1877, xvii. p. 349) states that Cienkowski's species reminds him of "a portion of the mass of a *Gromia* become isolated and detached by some readily conceivable force, having wandered too far from the head-

quarters." Curiously enough, the collection in which I observed what I take to be the animal described by Cienkowski contained large numbers of a *Gromia*.

Order TESTACEA.

Fam. ARCELLINA.

Gen. COCHLIOPODIUM, *Hertwig & Lesser*.

9. COCHLIOPODIUM BILIMBOSUM, *Leidy, Freshw. Rhiz. N. Amer.* 1879, p. 184, t. xxxii. ff. 1-25.—*Amœba bilimbosa, Auerbach*, 1856. *Cochliopodium pellucidum, Hertwig & Lesser, in Archiv für mikr. Anat.* 1874, x. Suppl. p. 66, t. ii. f. 7.

I find this animal to be somewhat scarce. I have only obtained really good examples of it from five localities, viz.:—near Brigg, Lincolnshire; near Lough Neagh, Ireland; near Gortahork, Co. Donegal, Ireland; Llyn Ogwen, and the lakes at Capel Curig, N. Wales.

Diameter of shell 32-44 μ .

10. COCHLIOPODIUM MINUTUM, sp. n. (Pl. 28. figs. 6-10.)

Very minute, with a cup-shaped delicate shell having an extremely wide mouth. Body-protoplasm granular; pseudopodia somewhat irregular, usually attenuated at the extremity. Nucleus absent. One or two vacuoles present in some individuals, but entirely absent in others.

Diameter of shell 12.4-13.5 μ .

Llyn-y-cwm-ffynon, N. Wales.

This small *Cochliopodium* was observed in abundance among numerous Desmids in washings of *Isoëtes*. The shell is very delicate, with a widely open mouth, and is structureless: it is also flexible, assuming various unsymmetrical shapes as it accommodates itself to the animal's movements. Seen from above the shell is usually circular, but it frequently exhibits an irregularly undulate margin.

The pseudopodia are commonly somewhat flattened extensions of colourless ectoplasm with distinctly attenuated ends. Sometimes they are flat, sheet-like expansions of irregular outline, which now and then fuse together, forming a bell-shaped ring of ectoplasm extending outwards from the edges of the mouth. In all cases they are colourless, hyaline projections showing no trace of any granulation. The animals, when active, extend

and retract these pseudopodia with considerable rapidity of movement.

The body-protoplasm within the shell is of a much darker hue than the pseudopodia, and, with the exception of a few instances in which it was homogeneous, exhibits a number of prominent granules. No nucleus was present in any of the individuals, but some possessed one or more vacuoles, which, however, were never observed to pulsate.

C. minutum is readily distinguished from *C. bilimbosum* by its minute size, its more delicate shell, and the absence of a nucleus. Moreover, it does not possess the punctate, expanded band of the shell in the region of the mouth.

11. *COCHLIOPODIUM VESTITUM*, *Archer, in Qu. Jour. Micr. Sci.* 1876, p. 299; 1877, p. 334; *Leidy, Freshw. Rhiz. N. Amer.* 1879, p. 188, t. xxxii. ff. 26-28.—*Amphizonella vestita*, *Archer, l. c.* 1871, xi. pp. 112, 135, t. vi. ff. 1-6. *Cochliopodium pilosum*, *Hertwig & Lesser, in Archiv für mikr. Anat.* 1874, x. Suppl. p. 78.

Esher West-end Common, Surrey. It occurred in great abundance in ditches and ponds among various Algæ: June-Aug. 1894-5. Diameter without spines 25-45 μ ; length of spines 3.7-5 μ . The majority of the individuals were colourless, but a few possessed chlorophyll granules.

Sheep's Green, Cambridge, July 1896, somewhat scarce. None of the individuals possessed any colouring-matter.

I am inclined to agree with Schulze (in *Archiv für mikr. Anat.* xi. p. 337) that the chlorophyll granules frequently found in individuals of this Rhizopod have been originally taken into the body-protoplasm as food.

12. *COCHLIOPODIUM LONGISPINUM*, sp. n. (Pl. 28. fig. 1.)

Shell very thin and delicate, subspherical, with a broadly open, somewhat prominent mouth; exterior of shell covered with very long, extremely delicate, hair-like, radiating spines. Body-protoplasm granular, and with many highly-refractive globules. Nucleus large and round, situated towards the fundus. With one (or sometimes more) contractile vacuoles. Pseudopodia few broad and expansive, granular in the central part but hyaline and indistinct towards the edges.

Diameter of shell $42\ \mu$; diameter of mouth of shell $34\ \mu$; length of spines 23–29 μ .

Wicken Fen, Cambridgeshire: July 1899, amongst *Chara hispida*.

The thin shell and the extremely long, delicate spines readily distinguish this species from *C. vestitum*, Archer. The spines are also more numerous than in the latter species, and the mouth of the shell is comparatively broader than in any specimen of *C. vestitum* I have seen. The pseudopodia are also thicker and more expansive, and the refractive globules from the body of the animal often pass into them. No green colouring-matter was obtained in any of the examples.

Gen. ARCELLA, Ehrenb.

13. ARCELLA VULGARIS, Ehrenb. *Abhand. Akad. Wiss. Berlin*, 1830, pp. 40, 53, etc. t. i. f. vi; *Infus.* 1838, p. 133, t. ix. f. v; Carter, in *Ann. Mag. Nat. Hist.* xviii. 1856, p. 128, t. vii. f. 79; 1864, xiii. p. 30, t. ii. f. 14.—*A. hemisphærica*, Perty, 1852. *Arcellina vulgaris*, Carter, 1856.

Generally distributed throughout the British Islands.

Var. GIBBOSA.—*Arcella vulgaris*, Leidy, *Freshw. Rhiz. N. Amer.* 1879, t. xxvi. ff. 23–24.—*Arcella gibbosa*, Penard, in *Mém. Soc. de Phys. et d'Hist. Nat. de Genève*, 1890, tome xxxi. no. 2, p. 155, t. v. ff. 96–99, t. vi. f. 1.

The convex surface of the shell faceted, the facets being circular depressions which fade away towards the edges of the shell. Shell dark brown in colour, sometimes, nearly black.

In bogs, New Forest, Hants. In pools, Llangelynin, near Conway, N. Wales. Bog about two miles south of Clapham, W. Yorkshire.

From the last-named locality the specimens were very large, exceeding in dimensions any forms of the species I have yet come across. The diameter of the shell was in some cases as much as $240\ \mu$.

14. ARCELLA DISCOIDES, Ehrenb. *Monatsb. Akad. Wiss. Berlin*, 1843, p. 139; Leidy, *Freshw. Rhiz. N. Amer.* 1879, p. 173, t. xxviii. ff. 14–38.

Widely distributed, but not so abundant as *A. vulgaris*. At 2200 ft. on Glyder Fach, N. Wales.

15. *ARCELLA MITRATA*, *Leidy*, in *Proc. Acad. Nat. Sci. Philad.* 1876, p. 56; *Freshw. Rhiz. N. Amer.* 1879, p. 175, t. xxix.

A rare species which I have only obtained in abundance from the two following localities:—Cocket Moss, near Giggleswick, W. Yorkshire, amongst *Sphagnum* and *Utricularia minor*. Moel Siabod, N. Wales, in *Sphagnum*-pools.

Height of shell 100–145 μ ; diameter of shell 100–152 μ .

The mouth of the shell of this Rhizopod is inturned into the cavity of the shell, forming a short, broad, tube-like mouth. Leidy figures the pseudopodia as arising from the body-protoplasm at the inner end of this tube; but in all the living forms observed, a ventral column of protoplasm passed from the body-protoplasm into this tube, completely filling it up to the outer end. The pseudopodia then arose from the extreme ventral surface of this mass of protoplasm in the tube.

16. *ARCELLA ARTOCREA*, *Leidy*, in *Proc. Acad. Nat. Sci. Philad.* 1876, p. 57; *Freshw. Rhiz. N. Amer.* 1879, p. 178, t. xxx. ff. 1–9.

Bog above the lakes at Capel Curig, N. Wales.

Very large forms:—Diameter of shell (inclusive of rim) about 300 μ ; diameter of mouth 73 μ ; height of shell about 110 μ . Leidy gives 176 μ as his greatest breadth. (Pl. 28. fig. 2.)

Churchill, Co. Donegal, Ireland.

Diameter of shell about 85 μ .

I was unable to find any living specimens, all the shells being empty. The body of the shell was faceted, as in many of the more angular forms of *A. vulgaris*. It is apparently a very rare species, as I have never met with it from any other localities.

Gen. CENTROPYXIS, *Stein*.

17. *CENTROPYXIS ACULEATA*, *Stein*, *Sitz. böhm. Akad. Wiss.* 1857; *Leidy*, *Freshw. Rhiz. N. Amer.* 1879, p. 180, t. xxxi. ff. 1–32, t. xxxii. ff. 29–37.—*Arcella aculeata*, *Ehrenb. Abhand. Akad. Wiss. Berlin*, 1830, p. 40; 1841, p. 368, t. iii. f. 5. *Echinopyxis aculeata*, *Olap. & Lachm. Etudes Infus.* 1859, p. 447; *Carter*, in *Ann. Mag. Nat. Hist.* xiii. 1864, p. 29, t. i. f. 8.

This Rhizopod is very abundant and widely distributed, and the shell exhibits more variation than that of any other testaceous form. Some exceptionally large individuals were met with from near Athry Lough, W. Ireland, with a diameter of 450 μ

without the spines. It was observed in many varied localities up to 3000 ft. on Snowdon, N. Wales, and 3000 ft. in Scotland.

Although this animal was first described by Ehrenberg as a species of *Arcella*, and is yet regarded as such by some authors, I think there can be no doubt that it bears a closer resemblance to *Diffugia constricta* than to any other testaceous Rhizopod. Leidy points this out most clearly, and gives illustrations of numerous intermediate forms, and Blochmann also comments upon it.

From near Knaresborough and from near Giggleswick, W. Yorkshire, a large number of small examples were seen with the shells composed of sand-grains. The shells were very much oblique, and possessed three smooth, chitinous spines at the fundus, each spine being sharply apiculate. Diameter of shell $63\ \mu$; length of spines $25\ \mu$.

A peculiar form was met with from Widdale Beck, N. Yorkshire, with fourteen spines arranged in an arc, those at the fundus being very short, and those towards the mouth very long. Diameter of shell without spines $190\ \mu$.

Some striking forms were observed from Terrington, N. Yorkshire. The shells were thin, chitinous, and almost transparent. Diameter of shell $120\ \mu$. Three short, thick spines were present, each spine being perforated at the apex. Thus, in addition to the mouth of the shell, there were three open, tubular passages placing the interior of the shell in communication with external surroundings. Owing to the thinness and transparency of the shells, I was enabled to carefully examine the structure of the chitinous membrane of which they were composed. Leidy remarks (*loc. cit.* p. 183) that "while spineless specimens of *Centropyxis*, composed of chitinous membrane, approximate to *Arcella* in character, I never could satisfy myself that the shell of the former exhibited the cancellated structure of the latter. In some chitinous shells of *Centropyxis* I have observed a punctated appearance of some uniformity, but it did not display the clear cancellated arrangement so characteristic of the shell of *Arcella*."

The chitinous membrane composing the shells of the Terrington forms was of a pale yellow colour and minutely scrobiculate. The scrobiculations were irregularly disposed, being scattered more or less in groups, and between them were numerous much

smaller punctulations. The structure of the shell-membrane of the particular forms described was thus of a somewhat different nature from the cancellated structure exhibited by the shells of *Arcella*. (Cfr. Pl. 29. figs. 15, 16.)

Var. *ECORNIS*, *Leidy*, *l. c.* p. 180, t. xxx. ff. 20-34, t. xxxi. ff. 33, 34.—*Arcella ecornis*, *Ehrenb.* Abhand. Akad. Wiss. Berlin, 1841, p. 368, t. i. f. 9, t. iii. f. 46. *Centropyxis lævigata*, *Penard*, in *Mém. Soc. Phys. et d'Hist. Nat. Genève*, tom. xxxi. no. 2, 1890, p. 151. t. v. ff. 42-44, 49-55.

Not so abundant as the typical spined form. Obtained it very abundantly on damp moss on limestone rocks, Ingleton, N. Yorkshire. Also from near Bowness, Westmoreland.

Gen. DIFFLUGIA, *Leclerc*.

18. DIFFLUGIA CONSTRICTA, *Leidy*, *Freshw. Rhiz. N. Amer.* 1879, p. 120, t. xviii.—*Arcella constricta*, *Ehrenb.* Abhand. Akad. Wiss. Berlin, 1841, p. 410, t. iv. f. 35, t. v. f. 1. *Diffugia marsupiformis*, *Wallich*, in *Ann. Mag. Nat. Hist.* xiii. 1864, pp. 241, 244, t. xvi. ff. 3-5. *D. platystoma*, *Penard*, in *Mém. Soc. Phys. et d'Hist. Nat. Genève*, tom. xxxi. no. 2, 1890, p. 143, t. iv. ff. 35-37.

A very abundant species which exhibits much variation, many of the forms being practically indistinguishable from *Centropyxis aculeata* var. *ecornis*. The highest elevation at which I obtained it was 3000 ft. on Snowdon, N. Wales.

19. DIFFLUGIA PYRIFORMIS, *Perty*, 1848; *Kennt. kleinst. Lebensf.* 1852, p. 187, t. ix. f. 9; *Leidy*, *Freshw. Rhiz. N. Amer.* 1879, t. x., xi., xii. ff. 1-18, etc.—*D. compressa*, *Carter*, in *Ann. Mag. Nat. Hist.* xiii. 1864, p. 22, t. i. ff. 5, 6. *D. entochloris*, *Leidy*, in *Proc. Acad. Nat. Sci. Philad.* 1874, p. 79; 1875, p. 307. *D. saxicola*, *Penard*, in *Mém. Soc. Phys. et d'Hist. Nat. Genève*, tom. xxxi. no. 2, 1890, p. 138, t. iii. ff. 50-53. *D. avellana*, *Penard*, *l. c.* p. 144, t. iv. ff. 38-40. *D. fallax*, *Penard*, *l. c.* t. iv. ff. 41-51. *D. lucida*, *Penard*, *l. c.* p. 145, t. iv. ff. 52-58. *D. bacillifera*, *Penard*, et var. *inflata*, *Penard*, *l. c.* p. 46, t. iv. ff. 61-71. *D. lanceolata*, *Penard*, *l. c.* p. 145, t. iv. ff. 59, 60.

The most widely distributed species of the genus, especially in quiet waters. It is subject to very great variation, not only in outward form, but also in the nature of the materials composing

the shell. Only once have I obtained it from wet rocks, and that was at an elevation of 3000 ft. on Snowdon, N. Wales.

The three following are the most noteworthy forms I have met with:—

From a bog near Widdale Beck, N. Yorkshire, numerous large specimens were noticed with thin chitinous shells with which were incorporated very large Diatoms (*Navicula viridis* and *N. major*). Precisely similar forms were noticed in which the shells consisted almost entirely of Diatoms (*Vanheurckia rhomboides* and *Navicula divergens*) from near Clapham, W. Yorkshire, and from Mickel Fell, N. Yorkshire.

From Lough Shannacloontippen and Ballynahinch, W. Ireland, numbers of minute forms of this Rhizopod were observed. The shell was chitinous, of a pale yellow colour, and a few sand-grains were attached irregularly at the fundus. The same form was noticed from Capel Curig, N. Wales, except that the chitinous shell was colourless. Length of shell 29–30 μ ; breadth 18–24 μ . (Pl. 28. figs. 13, 14.)

From Llyn Idwal, N. Wales, the forms possessed long slender necks, and the shell was composed of exceptionally large sand-grains. The same form was also obtained from Cockett Moss, near Giggleswick, W. Yorkshire. Length of shell about 250 μ ; breadth 46 μ .

Var. *vas*, *Leidy*, Freshw. Rhiz. N. Amer. 1879, p. 99, t. xii. ff. 2–9.—*D. vas*, *Leidy*, in Proc. Acad. Nat. Sci. Philad. 1874, p. 155; 1875, p. 307.

Not uncommon, but rarely so abundant as more typical forms of *D. pyriformis*. The peculiar neck of this variety is very characteristic.

The largest forms seen were from the New Forest, Hants. Length of shell 470 μ ; breadth 380 μ ; breadth of neck 100 μ .

Some peculiar forms were seen from Llyn Idwal, N. Wales, in which the sand-grains composing the neck were quite transparent and colourless, whereas those composing the body of the shell were yellow and opaque. Length 460 μ ; breadth 300 μ .

20. *DIFFLUGIA URCEOLATA*, *Carter*, in *Ann. Mag. Nat. Hist.* xiii. 1864, pp. 27, 37, t. i. f. 7; *Leidy*, l. c. p. 106, t. xiv.—*D. lageniformis*, *Wallich*, in *Ann. Mag. Nat. Hist.* xiii. 1864, p. 240, t. xiv. ff. 15, 16.

A rare species, which I have only obtained copiously from Bowness, Westmoreland.

21. *DIFFLUGIA ACUMINATA*, *Ehrenb. Infus.* 1838, p. 131, t. ix. f. 3; *Leidy, l. c.* p. 109, t. xiii.—*D. bacillarium*, *Perty*.

An abundant and widely distributed species, which I have observed up to 2200 ft. on Glyder Fach, N. Wales.

Var. *AMPHORA*.—*D. amphora*, Penard, in *Mém. Soc. Phys. et d'Hist. Nat. Genève*, tom. xxxi. no. 2, 1890, p. 139, t. iii. ff. 55–65. Not *D. amphora*, Leidy (which is a variety of *D. urceolata*).

Differs from typical *D. acuminata* in the upper portion of the shell being acutely conical but not acuminate.

This variety frequently possesses a shell consisting of a thin chitinous membrane incorporated with Diatoms. *Cfr.* Leidy, *l. c.* t. xiii. ff. 23–26. Such forms were very abundant from Cocket Moss, near Giggleswick, W. Yorkshire, and in all cases the Diatom was *Vanheurckia rhomboides* var. *saxonica*.

Var. *ELEGANS*.—*D. elegans*, Penard, *l. c.* p. 140, t. iv. ff. 4–11.

A small variety with the acuminate apex of the shell tube-like and perforated. Length of shell 94–100 μ ; breadth of shell 52–58 μ ; breadth of mouth 27–31 μ . (Pl. 28. figs. 11–12.)

Wicken Fen, Cambridgeshire. Llyn-y-cwm-ffynon, N. Wales.

The shells of this variety are generally chitinous, pale yellow or brown in colour, and they may or may not be encrusted with a variable amount of sand-grains. The body of the animal is quite normal, and is supported towards the apex of the shell by the usual, protoplasmic, stay-like projections. The actual apex of the shell is drawn out into a long tube, which is frequently bent at a considerable angle to one side, and the end of this tube is open. I have never observed any exudation of protoplasm into this tube, the body of the animal being somewhat removed from its base. As the shell possesses two openings, one at each end, it is quite comparable to shells like *Ditrema* and *Amphitrema*, which are placed in the family *Amphistomina*, although in the *Diffugia* only one aperture is utilized for the protrusion of pseudopodia.

Occasionally a few Diatoms are incorporated into the shell, and one instance was noticed in which a number of living Diatoms were attached to it.

22. *DIFFLUGIA CORONA*, Wallich, in *Ann. Mag. Nat. Hist.* 1864, xiii. t. xv. ff. 19, 20; *Leidy, Freshw. Rhiz. N. Amer.* 1879, p. 117, t. xvii.

A rare species which I have only observed from Llyn Llydaw, Snowdon, and in pools, Y Foel Fras, N. Wales. In all the specimens observed the spines were very robust. Length of shell 150–160 μ ; breadth (including spines) 165–182 μ ; breadth of mouth 75 μ .

23. *DIFFLUGIA GLOBULOSA*, Dujardin, in *Ann. Sci. Nat.* 1837, viii. p. 311, t. ix. f. 1 a, b; *Leidy, l. c.* p. 96, t. xv. ff. 25–31; t. xvi. ff. 1–24. *D. globularis*, Wallich, in *Ann. Mag. Nat. Hist.* xiii. 1864, p. 241, t. xvi. ff. 1, 2, 17, 27. *D. acropodia*, Hertwig & Lesser, in *Archiv für mikr. Anat.* 1874, x. Suppl. p. 107, t. ii. f. 6.

A general and widely distributed species, exhibiting considerable variation in size and form. I have obtained it at 2700 ft. on Glyder Fawr, and at 3000 ft. on Snowdon, N. Wales.

The smallest forms observed were from Roundhay Park, W. Yorkshire. The shells were straw-coloured and slightly asperulate; diam. 13·5–17 μ ; diam. of mouth 5·7 μ . (Pl. 29. figs. 17, 18.)

Another small form, which was abundant from Lough Guitane and Torc Mt., S.W. Ireland, possessed a yellow, chitinous shell with an exceptionally wide mouth. Diam. 38 μ ; diam. of mouth 29–33 μ .

Two specimens were observed conjugating from Cocket Moss, near Giggleswick, W. Yorkshire. From this locality the animals possessed a perfectly globose, colourless chitinous shell, attached to which were a few sand-grains and numerous large Diatoms. The mouth was relatively very small. Diam. 190 μ ; diam. of mouth 52 μ .

24. *DIFFLUGIA LOBOSTOMA*, Leidy, in *Proc. Acad. Nat. Sci. Philad.* 1874, p. 79; 1877, p. 307; *Freshw. Rhiz. N. Amer.* 1879, p. 112, t. xv. ff. 1–24, t. xvi. ff. 25–29.—*D. crenulata*, Leidy, 1874.

Somewhat scarce. Diameter of shell 49–285 μ .

Form with a three-lobed mouth observed from Carlton Bank, N. Yorkshire; Llyn Cwlyd and Capel Curig, N. Wales.

Form with a five-lobed mouth observed from near Sedbergh, W. Yorkshire. These specimens were very much larger than any previously recorded.

Gen. LECQUEREUSIA, *Schlumberger*.

25. LECQUEREUSIA SPIRALIS, *Blochmann, Die mikr. Thierwelt des Süßwass., I. Protozoa, Hamburg, 1895, p. 17.*—*Diffugia spiralis, Ehrenb. 1840; Abhand. Akad. Wiss. Berlin, 1871, p. 274, t. iii. ff. 25–27; Pritch. Infus. 1861, p. 553. Lecquereusia jurassica, Schlumb. in Ann. Sci. Nat. 1845, p. 255. Diffugia Helix, Cohn, in Zeitschr. f. wissenschaft. Zool. 1853, p. 261.*

Generally distributed and abundant. The amount of coiling of the shell and the nature of the materials composing it vary considerably. The forms possessing a shell composed entirely of sand-grains are somewhat rare.

Gen. NEBELA, *Leidy*.

26. NEBELA COLLARIS, *Leidy, Freshw. Rhiz. N. Amer. 1879, p. 145, t. xxii.; t. xxiii. ff. 1–7; t. xxiv. ff. 11, 12.*—*Diffugia collaris, Ehrenb. Monatsb. Akad. Wiss. Berlin, 1848, p. 218. D. peltigeracea, Carter, in Ann. Mag. Nat. Hist. xiii. 1864, t. i. f. 12. D. symmetrica, Wallich, in Ann. Mag. Nat. Hist. xiii. 1864, t. xvi. ff. 27–33. Nebela militaris, Penard, in Mém. Soc. Phys. et d'Hist. Nat. Genève, tom. xxxi. no. 2, 1890, p. 164, t. vii. ff. 16–22.*

Widely distributed, especially in *Sphagnum*-bogs. Up to 2000 ft. on Glyder Fach, and 2700 ft. on Glyder Fawr, N. Wales. In *Sphagnum*-pools, Orkney Is.

Var. LAGENIFORMIS.—*N. lageniformis, Penard, l. c. p. 158, t. vi. ff. 50–61. N. ambigua, Cash, in Trans. Manchester Micr. Soc. 1891, p. 50, t. ii. f. 17.*

This variety is distinguished by its more elegant outline and prominent neck. In habit, structure of shell, etc. it is precisely similar to typical *N. collaris*. Length of shell 115–123 μ ; breadth of shell 63–70 μ ; breadth of mouth 25–27 μ .

A less frequent form than the type, and one which I have only obtained in quantity from pools on Penyghent, W. Yorkshire, and from Capel Curig, N. Wales.

27. *NEBELA FLABELLULUM*, *Leidy*, in *Proc. Acad. Nat. Sci. Philad.* 1876, p. 118, ff. 6, 7; 1877, p. 264; *Freshw. Rhiz. N. Amer.* 1879, p. 152, t. xxiii. ff. 8-19.

Not so abundant as the preceding species; often found amongst mosses on dripping rocks. Up to 2700 ft. on Glyder Fawr N. Wales.

28. *NEBELA DENTISTOMA*, *Penard*, in *Mém. Soc. Phys. et d'Hist. Nat. Genève*, tom. xxxi. no. 2, 1890, p. 162, t. vi. ff. 98-100; t. vii. ff. 1-5.—*N. crenulata*, *Cash*, in *Trans. Manchester Micr. Soc.* 1891, p. 50, t. ii. f. 18.

Length of shell 108-113 μ ; max. breadth of shell 82-88 μ ; breadth of mouth 36-38 μ ; thickness 42 μ .

Amongst *Philontis fontana* in springs at 2700 ft. on Glyder Fawr, N. Wales.

This species, which is either rare or overlooked, is completely different in outward form from *N. collaris*, the only species with which it could be confounded. Except for the mouth, it is a perfect oval in shape, and that orifice appears as a chord cutting off the narrower end. There is not even the faintest suspicion of a neck, and the mouth is considerably wider than in any form of *N. collaris*. The specific name refers to the nature of the mouth, and therein lies the character which at once distinguishes *N. dentistoma* from *N. collaris*. The mouth of the shell of the former species always presents a crenulate appearance, owing to the irregular disposition of the small plates composing the shell, whereas the mouth of the latter species is perfectly smooth and sometimes slightly thickened. The ratio of the breadth of the mouth to the breadth of the shell in *N. dentistoma* averages 1 : 2·3, whereas in *N. collaris* it averages 1 : 2·8.

29. *NEBELA CARINATA*, *Leidy*, in *Proc. Acad. Nat. Sci. Philad.* 1876, p. 118, ff. 10, 11; *Freshw. Rhiz. N. Amer.* 1879, p. 154, t. xxiv. ff. 1-10.—*Diffugia carinata*, *Archer*, 1866; in *Qu. Jour. Micr. Sci.* 1869, ix. t. xx. f. 12.

Although widely distributed this species is not abundant. It is usually found amongst *Sphagnum*. I obtained numerous examples from some deep *Sphagnum*-pools at 2200 ft. on Glyder Fach, N. Wales.

30. NEBELA HIPPOCREPIS, *Leidy, Rhiz. N. Amer.* 1879, p. 156, t. xxv. ff. 9-14.

Length of shell $183\ \mu$; breadth $133\ \mu$; breadth of mouth $29\ \mu$.

Amongst wet *Sphagnum* below the outlet of Llyn Idwal, N. Wales.

Only one specimen of this rare species was observed, and it was an old, empty shell. The digitate processes of the carina which pass down into the cavity of the shell are unique and unmistakable. It has only previously been found in New Jersey.

Blochmann suggests that it is the same species as *N. bigibbosa*, Penard, but on careful comparison the two shells are seen to be of quite a different nature, *N. bigibbosa* being entirely devoid of a keel. A species which may, however, ultimately prove to be *N. hippocrepsis* is *N. galeata*, Penard, but Penard's figures are too indistinct for one to form any definite opinion.

31. NEBELA BARBATA, *Leidy, in Proc. Acad. Nat. Sci. Philad.* 1876, p. 119, f. 8; *Freshw. Rhiz. N. Amer.* 1879, p. 159, t. xxiv. ff. 14-17.

Llyn Llydaw, Snowdon, N. Wales. A number of minute sand-grains were attached to the shell. Length $198\ \mu$; breadth $50\ \mu$; length of spines about $15\ \mu$.

Gen. HELEOPERA, *Leidy*.

32. HELEOPERA PICTA, *Leidy, Freshw. Rhiz. N. Amer.* 1879, p. 162, t. xxxi. ff. 1-11.—*Diffugia sphagni*, *Leidy*, 1874. *Nebela sphagni*, *Leidy*, 1876.

Not uncommon in *Sphagnum*-pools and bogs. Frequently met with in the encysted condition.

33. HELEOPERA PETRICOLA, *Leidy, l. c.* p. 165, t. xxvi. ff. 12-20.

A much scarcer species than *H. picta*. Bog near Widdale Beck, N. Yorkshire. Hawkshead, Lancashire. Capel Curig, N. Wales. Near Glenties, Co. Donegal, Ireland. Orkney Is.

Gen. QUADRULA, *F. E. Schulze*.

34. QUADRULA SYMMETRICA, *F. E. Schulze, in Archiv für mikr. Anat.* 1875, p. 329, t. xviii. ff. 1-6; *Archer, in Qu. Jour. Micr. Sci.* 1877, p. 122.—*Diffugia symmetrica*, *Wallich, in Ann. Mag. Nat. Hist.* xiii. 1864, p. 245. *D. assulata*, *Ehrenb* 1871.

Widely distributed, but rarely abundant. Not uncommon amongst *Sphagnum* in peaty pools and bogs; also amongst mosses on wet rocks.

I have noticed a small form of this animal in which the oral end of the shell is produced into a neck of considerable length. The chitinous plates composing the shell are also polygonal in form and more numerous. Length of shell $63-68\mu$; breadth of shell $28-33\mu$; breadth of neck $10-14\mu$. Bowness, Westmoreland, and Moel Siabod, N. Wales.

35. *QUADRULA IRREGULARIS*, Archer, in *Qu. Jour. Micr. Sci.* xvii. 1877, p. 113.—*Q. monensis*, Cash, in *Trans. Manchester Micr. Soc.* 1891, p. 50, t. ii. ff. 14-16.

Among mosses in a mountain-stream, Penyghent, W. Yorkshire. Length of shell 35μ ; breadth of shell 36μ ; breadth of mouth 13μ ; thickness 23μ . (Pl. 29. figs. 19, 20.)

Not more than two or three specimens of this interesting species were observed, but the shell is so characteristic and its aspect so different from that of *Q. symmetrica*, that it is impossible to confuse them. The plates composing the shell (or test) were comparatively regular in outline and arrangement, being approximately square and more or less arranged in oblique series. It agrees very well with Archer's description in being "smaller than *Q. symmetrica*, quite without any neck, the 'mouth' being where a small chord seems, as it were, cut off the globular, or perhaps somewhat compressed test, nor are there any 'lips' nor even any evident thickened margin." Archer states that the plates composing the test are arranged in longitudinal rows, but in the few specimens observed the rows of plates were slightly oblique. He also says: "mouth subcircular in outline," whereas the mouth of the Yorkshire specimens was almost narrowly elliptical. This fact is immaterial, however, if the usual allowance be made for the variation which is so striking a feature of the testaceous Rhizopods. The specimens observed were undoubtedly identical with *Q. monensis*, and, moreover, they also agreed with Cash's description in possessing an elliptical mouth and obliquely disposed plates. But as I am firmly convinced that *Q. monensis* is the same species of Rhizopod as that named *Q. irregularis* by Archer nineteen years previously, the latter name takes precedence.

Gen. HYALOSPHENIA, *Stein*.

36. HYALOSPHENIA CUNEATA, *Stein, Sitzungsab. böhm. Akad. Wiss.* 1857; *Leidy, Freshw. Rhiz. N. Amer.* 1879, p. 129, t. xx. ff. 1-10.—*H. lata, Schulze, in Archiv für mikr. Anat.* 1875, xi. p. 335, t. xviii. ff. 15-18; *Archer, in Qu. Jour. Micr. Sci.* 1877, p. 110.

Cocket Moss, near Giggleswick, W. Yorkshire. Large specimens with a relatively broad mouth to the shell. Length of shell $75\ \mu$; breadth of shell $60\ \mu$; breadth of mouth $31\ \mu$.

River Ballanderry near its entrance into Lough Neagh, Ireland. Small specimens with a faint indication of a neck to the shell, the mouth of which is relatively small. Numbers of specimens were examined in a very active state, and each possessed two contractile vacuoles. The nucleus in these Irish specimens was comparatively small. Length of shell $56-62\ \mu$; breadth $40-44\ \mu$; breadth of mouth $13-14\ \mu$; thickness $16\ \mu$. (Pl. 29. figs. 21, 22.)

37. HYALOSPHENIA ELEGANS, *Leidy, Freshw. Rhiz. N. Amer.* 1879, p. 140, t. xx. ff. 19-29.—*Diffugia (Catharia) elegans, Leidy, in Proc. Acad. Nat. Sci. Philad.* 1874, p. 156.

This species I have only observed among *Sphagnum* at Cocket Moss, near Giggleswick, W. Yorkshire.

LEPTOCHLAMYS, gen. n.

Shell ovoid, slightly oblique, consisting of a thin, transparent, structureless, chitinous membrane; narrower or ventral end of shell slightly produced and minutely expanded, terminating in a mouth which is often placed a little obliquely; vertical view of shell circular; mouth circular. Protoplasmic body completely filling the shell; nucleus very large and situated dorsally. With a single, short pseudopodium, broadly expanded and sometimes cordate. Vacuoles entirely absent.

38. LEPTOCHLAMYS AMPULLACEA, sp. unica. (Pl. 29. figs. 23-26.)

Small; body composed of finely granular protoplasm, containing a large punctate nucleus at the pole away from the mouth; both green and brown food-particles present in the body-protoplasm. With a single pseudopodium (sometimes a faint indication of two), well differentiated into a lobe of dull

grey endoplasm enveloped in a larger mass of clear transparent ectoplasm.

Length of shell 48–55 μ ; diameter of shell 36–40 μ ; diameter of mouth 15–17 μ .

This interesting Rhizopod was abundant among various Algæ and *Isoëtes*, in the shallow water at the margins of Llyn-y-cwm-flynnon, Glyder Fawr, N. Wales.

The structureless shell at first reminds one of *Hyalosphenia*, but, apart from the entirely different nature of the animal, the shell is at once distinguished from shells of that genus by its circular cross-section and circular mouth. It is a thin, transparent, chitinoid shell, generally somewhat obliquely ovoidal (or ellipsoidal), and possesses a slightly expanded, minutely bell-shaped mouth at the narrower or ventral pole. The shell is quite firm and rigid, and the body-protoplasm of the animal completely fills it, fitting closely to the inner surface.

The nucleus, which, as compared with that of other lobose Rhizopods, is exceedingly large, is situated towards the extreme dorsal pole of the shell, and exhibits a finely punctate appearance. The body-protoplasm is of a dull grey colour, and is filled with granules of variable magnitude, more especially in the region immediately ventral to the nucleus. Various food-particles in different stages of digestion are noticeable in almost every individual, the animals feeding largely on unicellular Palmellaceæ. The method of feeding is quite normal.

One of the most remarkable features of *Leptochlamys* is the extraordinary pseudopodium. On the protrusion of the pseudopodium the animal first exudes from the mouth of the shell a more or less globular mass of ectoplasm, which is transparent and very hyaline in appearance. This is followed by an exudation of slightly darker-coloured, homogeneous endoplasm. The pseudopodium is quite a large mass, ever changing its shape, but never at any time becoming divided into two pseudopodia. At most, it becomes retuse at the broad, distal end, and at all times there is a well-marked separation into ectoplasm and endoplasm.

No vacuoles (contractile or otherwise) were observed in any of the animals, and so far as I could ascertain they were absent.

The genus is undoubtedly nearest to *Cryptodiffugia*, Penard (in Mém. Soc. Phys. et d'Hist. Nat. Genève, tom. xxxi. no. 2, 1890, p. 168, t. vii. ff. 95–107), but is readily distinguished by

the different mouth of the shell, and the nature of the animal and its pseudopodia.

Fam. EUGLYPHINA.

Gen. EUGLYPHA, *Dujardin*.

39. EUGLYPHA ALVEOLATA, *Dujardin*, *Infusoires*, 1841, p. 252, t. ii. ff. 9, 10; *Hertwig & Lesser*, in *Archiv für mikr. Anat.* 1874, x. Suppl. p. 124, t. iii. f. 5; *Leidy*, *Freshw. Rhiz. N. Amer.* 1879, p. 207, t. xxxv. ff. 1-18.—*Diffugia areolata*, *Ehrenb.* *D. acanthophora*, *Ehrenb.* *Euglypha tuberculata*, *Duj.* *E. lævis*, *Perty.* *E. minima*, *Perty.*

Generally distributed and often abundant. Very variable in the form of the shell and in the plates composing it. The young forms were described by Perty as *E. lævis* and *E. minima*.

Some very large forms were noticed from Puttenham Common, Surrey; there were four strong spines in the dorsal region of the shell. Length of shell 154μ ; breadth 80μ .

It was obtained abundantly at 2700 ft. on Glyder Fawr, N. Wales.

40. EUGLYPHA CILIATA, *Leidy*, *Freshw. Rhiz. N. Amer.* 1879, p. 214, t. xxxv. ff. 19, 20; t. xxxvi.; t. xxxvii. ff. 30, 31.—*Diffugia ciliata*, *Ehrenb.* *Monatsb. Akad. Wiss. Berlin*, 1848, p. 379. *Euglypha compressa*, *Carter*, in *Ann. Mag. Nat. Hist.* 1864, xiii. p. 32, t. i. f. 13; *Schulze*, in *Archiv für mikr. Anat.* 1875, xi. p. 101, t. v. ff. 3, 4.

Generally distributed, but not so abundant as the preceding species. The forms noticed with the largest spines were from the New Forest, Hants. It was obtained at 2700 ft. on Glyder Fawr, N. Wales, and conjugating examples were observed from Moel Siabod, N. Wales.

Var. STRIGOSA.—*Diffugia strigosa*, *Ehrenb.* *Euglypha strigosa*, *Leidy*, in *Proc. Acad. Nat. Sci. Philad.* 1878, p. 172; *Penard*, in *Mém. Soc. Phys. et d'Hist. Nat. Genève*, tom. xxxi. no. 2, 1890, p. 179, t. ix. ff. 58-68.

I have only occasionally met with the forms with more or less diffuse, hair-like spines, which are included in this variety. Bowness, Westmoreland. Bog near Widdale Beck, N. Yorkshire. Richmond Park, Surrey. Llyn Ogwen, N. Wales. Orkney Is.

41. *EUGLYPHA MUCRONATA*, *Leidy*, in *Proc. Acad. Nat. Sci. Philad.* 1878, p. 172; *Freshw. Rhiz. N. Amer.* 1879, p. 219, t. xxxvii. ff. 11-14.

A rare species, which I have only met with amongst *Sphagnum* at Hawkshead, Lancashire.

One specimen was noticed in which there were two spines, one at the extreme apex, and the other some little distance below it. Length of shell (without spine) $123\ \mu$; breadth $60\ \mu$.

42. *EUGLYPHA BRACHIATA*, *Leidy*, in *Proc. Acad. Nat. Sci. Philad.* 1878, p. 172; *Freshw. Rhiz. N. Amer.* 1879, p. 200, t. xxxvii. ff. 5-10.

Capel Curig, N. Wales. Small lakes E. of Recess, W. Ireland. Length of shell about $120\ \mu$; breadth about $32\ \mu$.

This is another rare species of the genus, which I have only obtained twice, and in both instances from submerged *Sphagnum*. It was described by Leidy from New Jersey.

Gen. PLACOCYSTA, *Leidy*.

43. *PLACOCYSTA SPINOSA*, *Leidy*, *Freshw. Rhiz. N. Amer.* 1879, p. 221, t. xxxviii.—*Euglypha spinosa*, *Carter*, in *Ann. Mag. Nat. Hist.* 1865, xv. p. 290, t. xii. f. 13; *Archer*, in *Qu. Jour. Micr. Sci.* 1872, xii. p. 90.

Somewhat rare. Length of shell $120-127\ \mu$; breadth $96-100\ \mu$; breadth of mouth $50-54\ \mu$; thickness about $38\ \mu$.

Scarce in a bog near Bowness, Westmoreland. Hawkshead, Lancashire. Llyn Llydaw, Snowdon, N. Wales: dead shells not uncommon, but no living animals seen. It is recorded as occurring in N. Wales in *Qu. Jour. Micr. Sci.* 1876, xvi. p. 237, but described as "very rare indeed."

The form of the shell and the wide mouth with perfectly smooth edges are characters sufficient to distinguish this genus from *Euglypha*.

Gen. SPHENODERIA, *Schlumberger*.

44. *SPHENODERIA LENTA*, *Schlumberger*, in *Ann. Sci. Nat.* 1845, p. 256; *Leidy*, *Freshw. Rhiz. N. Amer.* 1879, p. 229, t. xxxiv. ff. 25-41.—*Euglypha globosa*, *Carter*, in *Ann. Mag. Nat. Hist.* 1865, xv. p. 290, t. xii. f. 14; *Hertwig & Lesser*, in *Archiv für mikr. Anat.* 1874, x. Suppl. p. 129, t. iii. f. 7.

Generally distributed throughout the British Islands. The

largest forms observed were from Wrynose, Lancashire. Length of shell $65\ \mu$; diameter of shell $54\ \mu$.

Var. *FISSIROSTRA*.—*Sphenoderia fissirostris*, Penard, in Mém. Soc. Phys. et d'Hist. Nat. Genève, tom. xxxi. no. 2, 1890, p. 184, t. x. ff. 30–40.

Body of shell elliptic-ovoid; plates near the fundus round, but larger and elliptical towards the mouth. Length of shell $46\ \mu$; breadth $23\ \mu$; diameter of mouth $13.5\ \mu$. Llyn Bochlywd, N. Wales. Orkney Is.

The only difference between this form and typical *Sphenoderia lenta* is the presence of the larger, elliptical plates near the mouth, and this is insufficient as a specific distinction.

The genus *Sphenoderia* is not recognized by Blochmann (Die mikr. Thierwelt des Süßwass., I. Protozoa, Hamburg, 1895, p. 18), who merges it with the genus *Euglypha*. Personally, I think the narrow chitinous mouth, which is quite devoid of the plates of which the remainder of the shell is composed, is a very good generic character, and one which at once distinguishes *Sphenoderia* from *Euglypha*.

Gen. ASSULINA, Ehrenb.

45. *ASSULINA SEMINULUM*, Ehrenb. 1871; *Leidy, Freshw. Rhiz. N. Amer.* 1879, p. 225, t. xxxvii. ff. 15–27.—*Diffugia seminulum*, Ehrenb. *Monatsb. Akad. Wiss.* 1848, p. 379. *Euglypha brunnea*, Leidy, 1874. *E. tineta*, Archer, 1875.

General amongst *Sphagnum* and on wet rocks. Up to 3500 ft. on Lochnagar, Scotland. Orkney Is.

Gen. TRINEMA, Dujardin.

46. *TRINEMA ENCHELYS*, Leidy, in *Proc. Acad. Nat. Sci. Philad.* 1878, p. 172; *Freshw. Rhiz. N. Amer.* 1879, p. 227, t. xxxix.—*Diffugia enchelys*, Ehrenb. *Infus.* 1838, p. 132, t. ix. f. 4. *Arcella hyalina*, Ehrenb. *Trinema acinus*, Dujardin, *Infusoires*, 1841, p. 249, t. iv. f. 1. *Trinema complanatum*, Penard. *T. lineare*, Penard.

Probably the commonest and most widely distributed of testaceous Rhizopods, occurring abundantly in all kinds of damp and wet situations. The largest forms noticed were from Mickle Fell, N. Yorkshire, and it was observed up to 2700 ft. on Glyder Fawr, N. Wales.

Gen. CYPHODERIA, *Schlumberger*.

47. CYPHODERIA AMPULLA, *Leidy*, in *Proc. Acad. Nat. Sci. Philad.* 1878, p. 173; *Freshw. Rhiz. N. Amer.* 1879, p. 202, t. xxxiv. ff. 1-16.—*Diffugia ampulla*, *Ehrenb.* 1840; *Abhandl. Akad. Wiss.* 1871, t. iii. f. 11. *Cyphoderia margaritacea*, *Schlumberger*, in *Ann. Sci. Nat.* 1845, iii. p. 255; *Hertwig & Lesser*, in *Archiv für mikr. Anat.* 1874, x. Suppl. p. 132. *Euglypha curvata*, *Perty*. *E. margaritacea*, *Wallich*. *Cyphoderia margaritacea*, var. *major*, *Penard*.

General and abundant. The largest specimens observed were equal in size to those described by Penard as var. *major*, and were obtained from Stavely Dam, near Knaresborough, W. Yorkshire. Length up to 165μ ; breadth 66μ . It was obtained at over 3000 ft. elevation on Snowdon, N. Wales.

The form with the prominent manillate process at the fundus was noticed from Wicken Fen, Cambs., and from Lough Neagh, Ireland.

From Llyn Idwal, N. Wales, many active animals were noticed in which the body-protoplasm had retreated from the thick end of the shell, leaving a large space, but no strands of protoplasm stretched across this space from the body-protoplasm to the shell as in *Arcellas* and *Hyalosphenias*.

From Bowness, Westmoreland, numerous small specimens were observed with an apparently homogeneous, deep-brown shell, which was asperulate on its outer surface. The neck was also more pronounced and bent than in any other specimens I have seen. Length of shell $81-87\mu$; breadth $28-31\mu$.

Fam. GROMIINA.

Gen. PSEUDODIFFLUGIA, *Schlumberger*.

48. PSEUDODIFFLUGIA GRACILIS, *Schlumberger*, in *Ann. Sci. Nat.* 1845, iii. p. 254; *Leidy*, *Freshw. Rhiz. N. Amer.* 1879, p. 198, t. xxxiii. ff. 18-28.—*Pleurophrys sphaerica*, *Clap. et Lachm.* 1859. *Pleurophrys? amphitrematoides*, *Archer*.

Somewhat scarce and liable to be overlooked.

Capel Curig, N. Wales, amongst *Sphagnum*. Also near the outlet of Llyn Bochlwyd, N. Wales.

Gen. PAMPHAGUS, *Bailey*.

49. PAMPHAGUS HYALINUS, *Leidy*, *Freshw. Rhiz. N. Amer.* 1879, p. 194, t. xxxiii. ff. 13-17.—*Arcella? hyalina*, *Ehrenb.*

1838. *Gromia hyalina*, *Schlumberger*, 1845. *Lecythium hyalinum*, *Hertwig & Lesser*, in *Archiv für mikr. Anat.* 1874, x. Suppl. p. 177, t. iii. f. 8.

Not uncommon in ponds and lakes. Observed most abundantly from ponds, Cirencester, Gloucestershire, among *Potamogetons*. Also abundant among *Isoëtes*, Llyn Idwal, N. Wales. Diam. 32–38 μ .

50. *PAMPHAGUS CURVUS*, *Leidy*, l. c. p. 196, t. xxxiii. ff. 11, 12.

The specimens were obtained from amongst mosses on wet rocks at over 3000 ft. elevation on Snowdon, N. Wales. They agreed very well with the animals described by Leidy, but were somewhat larger. Length 59–76 μ ; greatest breadth 32–36 μ . (Pl. 29. fig. 27.)

The vertical aspect of the animal was circular, and the pseudopodia, which were much branched, exhibited somewhat active movements. The animals were all feeding upon a small species of *Nitzschia*, individuals being observed in which the whole body, inside the thin, hyaline shell, was packed with the valves of this Diatom.

Gen. GROMIA, *Dujardin*.

51. *GROMIA STAGNALIS*, sp. n. (Pl. 29. fig. 28.)

Body small, perfectly spherical, usually green in colour. Shell chitinous, spherical, colourless or straw-coloured, very thin and transparent, smooth on its external surface. Mouth small, not readily visible. A large amount of protoplasm is exuded from the mouth, flowing all over the exterior of the shell, and giving rise to numerous, divergent and anastomosing pseudopodia. Nucleus small, often not visible, situated in the region away from the mouth.

Diameter of body 28–32 μ .

Among *Lemna minor* in stagnant ditches, near Brigg, Lincolnshire.

This beautiful Rhizopod occurred in abundance in the sediment collected by washing and squeezing *Lemna minor* and a few species of filamentous algæ. The only other freshwater species of *Gromia* are *G. fluviatilis*, *Dujardin* (in *Ann. Sci. Nat. sér. 2*, tom. viii., Zool. pp. 310–313), and *G. terricola*, *Leidy* (in *Proc. Acad. Nat. Sci. Philad.* 1874, p. 88; *Freshw. Rhiz. N. Amer.* 1879, p. 277, t. xlvii. ff. 1–4). From both of these species *G. stagnalis* is readily distinguished by its small size, green

colour, and habit. *G. fluviatilis*, Duj., was found among *Potamogeton* in the R. Seine, and has an oval shell of much larger size. *G. terricola*, Leidy, occurs on the ground amongst moist mosses, and is also a much larger animal.

A species found amongst *Ceratophyllum* and other water-plants, and described as *G. granulata* by Schulze (in *Archiv für mikr. Anat.* 1875, xi. p. 117, t. vi. ff. 5, 6), appears to me to be hardly distinguishable from *G. fluviatilis*, Duj.

The green colour of *G. stagnalis* is due to the presence of more or less diffuse chlorophyll in the protoplasm of the body. This has most likely been acquired by the animal whilst feeding on the numerous small green algæ with which it was associated. The protoplasm, which is poured out from the mouth of the shell in quantity, has a dull and somewhat translucent appearance, and exhibits no visible granulation. Nor is a continuous streaming movement to be observed in the pseudopodia, the general movements of which are very slow.

Fam. AMPHISTOMINA.

Gen. DIPLOPHRYS, *Barker*.

52. DIPLOPHRYS ARCHERII, *Barker*, in *Qu. Jour. Micr. Sci.* 1868, p. 123; *Hertwig & Lesser*, in *Archiv für mikr. Anat.* 1874, x. Suppl. p. 139, t. iii. f. 9.

In stagnant ditches, near Brigg, Lincolnshire. In bog-pools, Thursley Common, Surrey. Lough Gatny, Co. Donegal, Ireland.

All the specimens observed were small in size, and without exception were solitary individuals. The average diameter of the body was 14 μ .

Gen. AMPHITREMA, *Archer*.

53. AMPHITREMA WRIGHTIANUM, *Archer*, in *Qu. Jour. Micr. Sci.* 1867, vii. p. 4; 1870, x. p. 122, t. xx. ff. 4, 5.

This is evidently a rare species of Rhizopod. I have only obtained it once, from Llyn Llydaw, Snowdon, N. Wales. Length of shell 60 μ ; diameter of shell 36 μ .

Some shells of an amphotomous Rhizopod were observed from near Recess, W. Ireland, which probably pertained to this genus. The shells were chitinous, yellow in colour, and each aperture was situated on a slight protuberance. No living animals of this form were observed.

Order **VAMPYRELLIDA.**Gen. **VAMPYRELLA**, *Cienkowski*.

54. **VAMPYRELLA LATERITIA**, *Leidy, Freshw. Rhiz. N. Amer.* 1879, p. 253, t. xlv. ff. 10-16.—*Amœba lateritia*, *Fresenius*, 1856-8. *Vampyrella Spirogyræ*, *Cienk. in Archiv für mikr. Anat.* i. 1865, p. 218, tt. xii-xiii. ff. 44-56; *Hertwig & Lesser, in Archiv für mikr. Anat.* 1874, x. Suppl. p. 61, t. ii. f. 2.

Near Brigg, Lincolnshire. Diameter of animal without pseudopodia $23-32\ \mu$; diameter inclusive of long pseudopodia $67-77\ \mu$. (Pl. 29. figs. 29-31.)

The Heliozoön-like form was abundant in a ditch amongst *Lemna minor*. The body of the animal was rarely globular, generally being ellipsoidal or even oblong. Outside the bright red, pigmented mass was a zone of clear protoplasm from which radiated a number of delicate pseudopodia of considerable length. Between the bases of these delicate pseudopodia the clear zone also gave origin to a number of much shorter, thicker pseudopodia, which, although only capable of comparatively slow movements, were extended or retracted more quickly than the elongate, delicate, protoplasmic filaments.

I was sufficiently fortunate to observe several of these animals feeding on the cell-contents of a species of *Mougeotia*. They have frequently been described as feeding on *Spirogyra*, but I know of no recorded instance of a species of this genus attacking a filament of *Mougeotia*. The animal attached itself firmly to the lateral margin of one of the cells of the filament, and in a very short time the long, delicate pseudopodia were retracted. At the same time the clear, outer, protoplasmic zone was continually putting forth and retracting shorter and stouter pseudopodia. That portion of the animal which originally attached itself to the cell *very soon had perforated it*, a portion of the animal protoplasm passing into the cell and causing a violent, dancing movement of the granules of the vegetable protoplasm. Whilst this was happening the chromatophore of the *Mougeotia*-cell was observed to be disintegrating at a point immediately opposite the place of attachment of the animal. I watched this destruction go on for about two hours; it was accompanied by much violent movement on the part of the small granules of the protoplasm, but during that time only a portion of the

chromatophore and surrounding protoplasm of the vegetable cell had been absorbed by the *Vampyrella*.

It has been stated by some authors that *Vampyrella* does not perforate the cells of *Spirogyra* and other filamentous algæ on which it feeds, but attacks them and devours their contents by breaking the filaments at the joints. It is possible that it does so sometimes, but Cienkowski's original observation of the perforation of the cells of *Spirogyra* by this animal is, however, amply confirmed by the attacks I observed *V. lateritia* to make on the cells of *Mougeotia*, a plant which breaks at the junction of the cells much more readily than *Spirogyra*.

55. *VAMPYRELLA PEDATA*, Klein; Blochmann, *Die mikros. Thierwelt des Süßwass.*, I. Protozoa, Hamburg, 1895, p. 22.—*Hyalodiscus rubicundus*, Hertwig & Lesser, in *Archiv für mikr. Anat.* 1874, x. Suppl. p. 49, t. ii. f. 5. *Plakopus ruber*, F. E. Schulze, in *Archiv für mikr. Anat.* 1875, xi. p. 348, t. xix. ff. 9-16.

In the lakes at Capel Curig, and in Llyn-y-cwm-ffynon, N. Wales. Diameter of encysted stage 53-67 μ .

The animals observed were subspherical or ovoidal in form, with the endoplasm filled with small granules of a bright red colour. They had previously been gorging themselves with food, as they were filled with large numbers of small Desmids, the contents of which had also become of the same red colour. I was at first inclined to regard them as forms of *Hyalodiscus rubicundus*, but I think there is no doubt that the form described and figured by Hertwig & Lesser is merely a stage of *Vampyrella pedata*. The red colour of the Welsh examples was identical with the red colour observed in *Vampyrella lateritia*.

Class HELIOZOA.

Order APHROTHORACA.

Gen. ACTINOPHRYS, Ehrenb.

56. *ACTINOPHRYS SOL*, Ehrenb. in *Abhand. Akad. Wiss. Berlin*, 1830, pp. 42 etc. t. ii. f. 4; *Infus.* 1838, p. 303, t. xxxi. f. vi; Wallich, in *Ann. Mag. Nat. Hist.* 1863, xi. p. 446, t. x. f. 4; Leidy, *Freshw. Rhiz. N. Amer.* 1879, p. 235, t. xl.—*Trichoda Sol*, Müller. *Actinophrys difformis*, Ehrenb.

General and abundant in still waters.

From Llyn Teyrn, N. Wales, several forms were noticed of a deep reddish-brown colour and which possessed rather fewer pseudopodia. It is quite possible they belonged to some other species of Rhizopod, but they were associated with normal forms of *A. Sol*. Diameter 26–27 μ .

Forma *PICTA*.—*Actinophrys picta*, Leidy, *l. c.* 1879, p. 241, t. xlv. f. 4.

Near Brigg, Lincolnshire. Variable in size, the smallest forms having a diameter of only 31 μ . Leidy's species *A. picta* seems to me to be merely a form of *A. Sol* containing a considerable amount of more or less diffused chlorophyll granules. The general structure of the body, especially in the foamy appearance of the protoplasm and the nature of the pseudopodia, is in both cases identical.

57. *ACTINOPHRYS SUBALPINA*, sp. n. (Pl. 30. fig. 36.)

Body subspherical, colourless, consisting of semitransparent, finely granulated protoplasm from which foamy vesicles are entirely absent. Nucleus single, large, finely granulated, generally prominent. Contractile vacuole single, prominently situated at one edge. Pseudopodia very long, straight, rigid, with a delicate central axis, twice or three times longer than the diameter of the body, very robust and gradually attenuated to a fine apex; containing numerous granules, but with perfectly smooth edges.

Diameter of body 42–61 μ ; length of pseudopodia 60–125 μ .

Associated with *Pamphagus curvus* amongst wet moss on dripping rocks, Snowdon, N. Wales, at 3000 ft. elevation.

This fine Heliozoön appears to be quite distinct from any form of *Actinophrys Sol* I have yet come across. The *body*, which is relatively small, has a totally different structure from that of *A. Sol*, the finely granular protoplasm being absolutely devoid of the foam-like vesicles which are characteristic of the latter species. The *pseudopodia* are also of a different type, being relatively longer and stouter, and distinctly though gradually attenuated to a very fine point; they possess smooth edges, but contain numerous scattered groups of minute granules. Running up the middle of each pseudopodium is a delicate thread-like axis which can frequently be traced down into the body of the animal. The *nucleus*, which in *A. Sol* is usually difficult of observation, is

in *A. subalpina* quite a prominent feature. It is subspherical, situated more or less in the centre of the body, and exhibits a delicately dotted appearance, probably due to numerous fine granules.

The *contractile vacuole* is relatively large and is situated at one side of the body. It commonly projects somewhat from the outer surface of the body, and but for this protuberance the animal presents an even edge all round.

The habitat of *A. subalpina* is somewhat remarkable, the animals occurring amongst mosses on the vertical face of dripping rocks, and also at a considerable elevation above sea-level. I have never yet found *A. Sol* except in still water.

The dumbbell-like form of the animal (which I figure to illustrate the species—Pl. 30. fig. 36) might be considered merely as a case of fission, or as one stage in the conjugation of a pair of individuals. When found it was in the stage figured. It was watched for some hours, and it ultimately separated into two individuals; but, as these individuals were normal and did not undergo any further changes so long as they were under observation, I am inclined to regard it merely as ordinary fission.

Gen. ACTINOSPHERIUM, Stein.

58. ACTINOSPHERIUM EICHHORNII, Stein, *Sitzungsb. böhm. Akad. Wiss.* 1857, p. 41; Hertwig & Lesser, in *Archiv für mikr. Anat.* 1874, x. Suppl. p. 176, t. v. f. 1; Leidy, *Freshw. Rhiz. N. Amer.* 1879, p. 259, t. xli.—Actinophrys Eichhornii, Ehrenb. 1840.

Widely distributed in still water, but not so abundant as *Actinophrys Sol*.

Order CHLAMYDOPHORA.

Gen. HELIOPHRYS, Greeff.

59. HELIOPHRYS VARIANS, nob.—*Heterophrys varians*, Schulze, in *Archiv für mikr. Anat.* 1874, x. p. 386, t. xxvi. ff. 2–5. *Heliophrys variabilis*, Greeff, *ibid.* 1875, xi. p. 28, ff. 20–23.

In ditches, near Brigg, Lincolnshire. Diameter of body 25 μ .

There can be little doubt that *Heterophrys varians*, Schulze, and *Heliophrys variabilis* are forms of the same animal. The general body of the animal has in each case the same structure,

and in each it is enveloped in a thick coat of apparently mucous material. This external envelope is very delicate, and in the specimens I observed was only rendered visible by small bacteria which adhered to its outer surface. The pseudopodia in the animals described by Schulze and Greeff are of the same type, and, moreover, this type is somewhat peculiar. Some, but not all, of the pseudopodia are branched, and to my mind this not only indicates a close affinity between the above-mentioned Heliozoa, but is quite sufficient to separate Greeff's *Heliophrys* from Archer's *Heterophrys*.

The specimens observed from Lincolnshire possessed one nucleus, and this was in a somewhat excentric position. No contractile vacuoles were observed, but I have no reason to believe that they were absent.

Gen. HETEROPHRYS, *Archer*.

60. HETEROPHRYS MYRIAPODA, *Archer*, in *Qu. Jour. Micr. Sci.* 1869, n. s. ix. p. 267, t. xvii. f. 4.

Llyn-y-cwm-ffynon, N. Wales. Diameter of body about 27 μ . The forms observed were somewhat small, but agreed in all respects with Archer's description and figure.

61. HETEROPHRYS RADIATA, sp. n. (Pl. 30. fig. 34.)

Body small, spherical, dark grey in colour, protoplasm densely filled with granules of variable size. Nucleus single, situated in an excentric position. No vacuoles observed. Outer coat of gelatinous material quite colourless, almost as thick as the diameter of the body, with a finely fimbriated outer surface. Pseudopodia numerous, long and delicate, with numerous scattered granules along their length.

Diameter of body 21 μ , with outer coat 53 μ ; length of pseudopodia about 43 μ .

Epping Forest, Essex, in ponds.

This species of *Heterophrys* is nearest the one described by Hertwig and Lesser (in *Archiv für mikr. Anat.* 1874, x. Suppl. p. 215, t. v. f. 3) as *H. spinifera*; but it is distinguished from the latter by the larger body and the much less fimbriated outer covering. The pseudopodia are also much more numerous, and in proportion to the size of the body are considerably shorter.

From *H. myriapoda*, Archer, it is distinguished by its smaller

size, its more copious outer coat, and by its longer and more slender pseudopodia.

This pretty little animal was obtained in washings of *Myriophyllum* from some large ponds in Epping Forest. None of the individuals observed possessed any green colour, and I was unable to detect the presence of any vacuoles. The outer zone which envelops the body is very wide, perfectly colourless, and its outer surface exhibits an exceedingly delicate fimbriation, much more delicate than the fringing of the corresponding structure in *H. spinifera* or *H. myriapoda*. The pseudopodia are delicate strands of protoplasm, with numbers of relatively large granules scattered at intervals along their length.

The extraordinary fimbriated (or 'spinous') outer coat of *H. Pavesii*, Garbini (in Zoolog. Anzeig. xxi. no. 575, 1898, p. 668, cum fig. 2), is alone a sufficient distinction between it and *H. radiata*.

Gen. SPHÆRASTRUM, Greeff.

62. SPHÆRASTRUM FOCKEI, *Archer*, in *Qu. Jour. Micr. Sci.* xvi. 1876, p. 858.—Heterophrys Fockei, *Archer*, *l. c.* ix. 1869, p. 267. Sphærastrum conglobatum, *Greeff*, in *Archiv für mikr. Anat.* 1875, xi. p. 29, t. ii. ff. 24-26.

Llyn Teyrn, N. Wales, among *Sphagnum cuspidatum*.

All the animals observed were solitary and some of them of small size, but otherwise they were exactly like Archer's description and figure.

Gen. LITHOCOLLA, F. E. Schulze.

63. LITHOCOLLA GLOBOSA, F. E. Schulze, in *Archiv für mikr. Anat.* 1874, x. p. 389, t. xxvi. ff. 6-10; *Schaudinn*, 'Heliozoa' in *Das Tierreich, Berlin*, 1896, p. 14.

Diameter of body $23\ \mu$; length of pseudopodia about $31\ \mu$.

Capel Curig, N. Wales.

The pseudopodia were granulated, and the investing sand-grains of the body-protoplasm were small and compact. I can see no difference between this animal and *Elæorhanis cincla*, Greeff (1873), except in the granulation of the pseudopodia. Perhaps the two are identical, and, if so, Greeff's name will take precedence. This Heliozoön was described originally from the Baltic Sea, and has also been recorded from freshwaters in Germany.

Order **CHALAROTHORACA.**Gen. POMPHOLYXOPHRYS, *Archer*.

64. POMPHOLYXOPHRYS PUNICEA, *Archer*, in *Qu. Jour. Micr. Sci.* ix. 1869, p. 386, t. xvi. f. 45; x. 1870, p. 105, t. xvi. f. 4.—*Hyalolampe fenestrata*, *Greeff*, in *Archiv für mikr. Anat.* 1869, v. p. 501, t. xxvi. f. 37; *Hertwig & Lesser*, l. c. 1874, x. Suppl. p. 221.

Wicken Fen, Cambridge; abundant among *Chara hispida* and *Utricularia vulgaris*, in peaty pools and ditches. Diameter of body about $44\ \mu$. Pseudopodia few, radiating, and without granules. All the animals exhibited a rather quick gliding motion through the water. The body-protoplasm contained a peculiar red pigment and sometimes a small amount of chlorophyll, the latter perhaps obtained in the food. The globules of the enveloping skeleton were from $2\text{--}3.8\ \mu$ in diameter.

Hampsfell, Lancashire; scarce among *Myriophyllum* in pools. The examples were inactive and possessed few pseudopodia. Several large vacuoles were observed in one individual. The siliceous globules were $3.2\text{--}4\ \mu$ in diameter.

N. Wales:—Among *Sphagnum* in a pool near Llyn Teyrn, Snowdon; Moel Siabod; Capel Curig; Glyder Fach, abundant in pools at 2200 ft.

Gen. RHAPHIDIOPHRYS, *Archer*.

65. RHAPHIDIOPHRYS PALLIDA, *F. E. Schulze*, in *Archiv für mikr. Anat.* 1874, x. p. 377, t. xxvi. f. 1.

Small forms with zoochlorellids; diameter of body about $42\ \mu$.

Llyn Idwal, N. Wales, among *Isoëtes*. (Pl. 30. fig. 35.)

Although the forms noticed from N. Wales possess chlorophyll-bodies, I think they should be referred rather to *R. pallida*, Schulze, than to *R. viridis*, Archer. All the examples seen were solitary, and they possessed several contractile vacuoles, two characters which distinguish the former species from the latter. Moreover, the outer coat was colourless and the pseudopodia were ornamented with granules as in *R. pallida*. Schulze, in his description of *R. pallida*, mentions some larger, pale, shining corpuscles in the body-protoplasm, corresponding in size and

position to the chlorophyll-bodies of *R. viridis*. The chlorophyll-bodies which I observed (zoochlorellids?) were numerous, but confined towards the periphery of the body. I think that the Welsh examples are best described as forms of *R. pallida*, Schulze, containing chlorophyll-bodies.

Gen. ACANTHOCYSTIS, Carter.

66. ACANTHOCYSTIS CHÆTOPHORA, Leidy, *Freshw. Rhiz. N. Amer.* 1879, p. 264, t. xliii. ff. 1-6.—*Trichoda chætophora*, Schrank, 1803. *Actinophrys viridis*, Ehrenb. 1833; *Infus.* 1838, p. 304, t. xxxi. f. vii. *Acanthocystis turfacea*, Carter, in *Ann. Mag. Nat. Hist.* 1864, xiii. p. 36, t. ii. f. 25; Hertwig & Lesser, in *Archiv für mikr. Anat.* 1874, x. Suppl. p. 204. *A. viridis*, Greeff, in *Archiv für mikr. Anat.* 1869, v. p. 481, t. xxvi. ff. 8-17. *A. pallida*, Greeff, *l. c.* p. 489, t. xxvii. f. 19.

A somewhat uncommon species, of which the two most interesting forms observed were the following:—

From Terrington, N. Yorkshire. A colourless form, with the smaller spines rather more numerous than the larger ones. Diameter of body $74\ \mu$; length of large spines $40-44\ \mu$; length of small spines $16-19\ \mu$.

From Barnes Common, Surrey. A specimen containing numerous oval chlorophyll-bodies and with the outer protoplasmic envelope of a brown colour. Only the delicate spines were observed and these were much longer than usual. Diameter of body $67-76\ \mu$; length of spines $38-54\ \mu$.

67. ACANTHOCYSTIS PALUDOSA, sp. n. (Pl. 30. figs. 32, 33.)

Body spherical, consisting of finely granular protoplasm, often colourless, but sometimes bright green from the presence of numerous chlorophyll corpuscles of variable size. Nucleus central or subcentral, rarely visible in the living animal. Outer surface of the body firm, sometimes of a pale yellow colour, beset with very numerous short siliceous spines. Spines delicate, simple, irregularly radiating, and with pin-head-like bases. Pseudopodia comparatively scanty, long and extremely delicate, beset along their length with numerous fine granules.

Diameter of body without spines $43-49\ \mu$; length of spines $5.3-8\ \mu$.

In ponds and ditches, Sheep's Green and Wicken Fen, Cambridgeshire. Near Shelf and near Ilkley, W. Yorkshire.

This animal is undoubtedly the same species as the

"*Acanthocystis*?" mentioned and figured by Leidy in his *Rhizopods of N. Amer.* p. 270, t. xliii. ff. 14-16. It is of the same size, the delicate spines are exactly similar, and the individuals were colourless or filled with bright green chlorophyll corpuscles. I have obtained it from four separate localities, and on two occasions it was in quantity; and as it has also been observed from the United States, and the specimens I observed showed no appreciable variation, I think it quite worthy to be named as a distinct animal. The same Heliozoön is mentioned by Scourfield (*P. Z. S.* 1897, pp. 786-789) as occurring from Spitsbergen.

To a certain extent it resembles the four following species:—*Acanthocystis flava*, Greeff, *A. aculeata*, Hertwig & Lesser, *A. Pertyana*, Archer, and *A. spinifera*, Greeff. *A. paludosa* is sufficiently distinct to need no differentiation from the first two species. From *A. Pertyana* and *A. spinifera* it differs wholly in the nature of the spines, which are much more numerous and delicate. The pseudopodia are few in number and granular in appearance as in *A. spinifera*, but the outer surface of the body to which the spines are attached seems to be very much firmer. *A. paludosa* also resembles *A. erinaceus*, Penard, 1889 (*cf.* Schaudinn, 'Heliozoa' in *Das Tierreich*, 1896, p. 19), but is a larger species with relatively shorter and more numerous spines.

In old and dead individuals the spines readily become disengaged from the firm outer coat, and then each spine is seen to be pin-shaped, with a capitate base or point of attachment.

The living animal protrudes a few long delicate pseudopodia which can withstand considerable irritation before being retracted. When the pseudopodia are fully out, the animal glides slowly through the water.

Order DESMOTHORACA.

Gen. CLATHRULINA, Cienkowski.

68. CLATHRULINA ELEGANS, Cienk. in *Archiv für mikr. Anat.* 1867, iii. p. 310, t. xviii.; *Leidy, Freshw. Rhiz. N. Amer.* 1879, p. 273, t. xlv.

Rare: among *Isoëtes* and numerous algæ, Llyn Ogwen, N. Wales. Pool near Windermere, Westmoreland. Also from the vicinity of Lough Neagh, Co. Armagh, Ireland; many of these specimens were attached in the encysted condition and had brown siliceous capsules.

EXPLANATION OF THE PLATES.

c.v. = contractile vacuole.

n. = nucleus.

v. = vacuole.

PLATE 28.

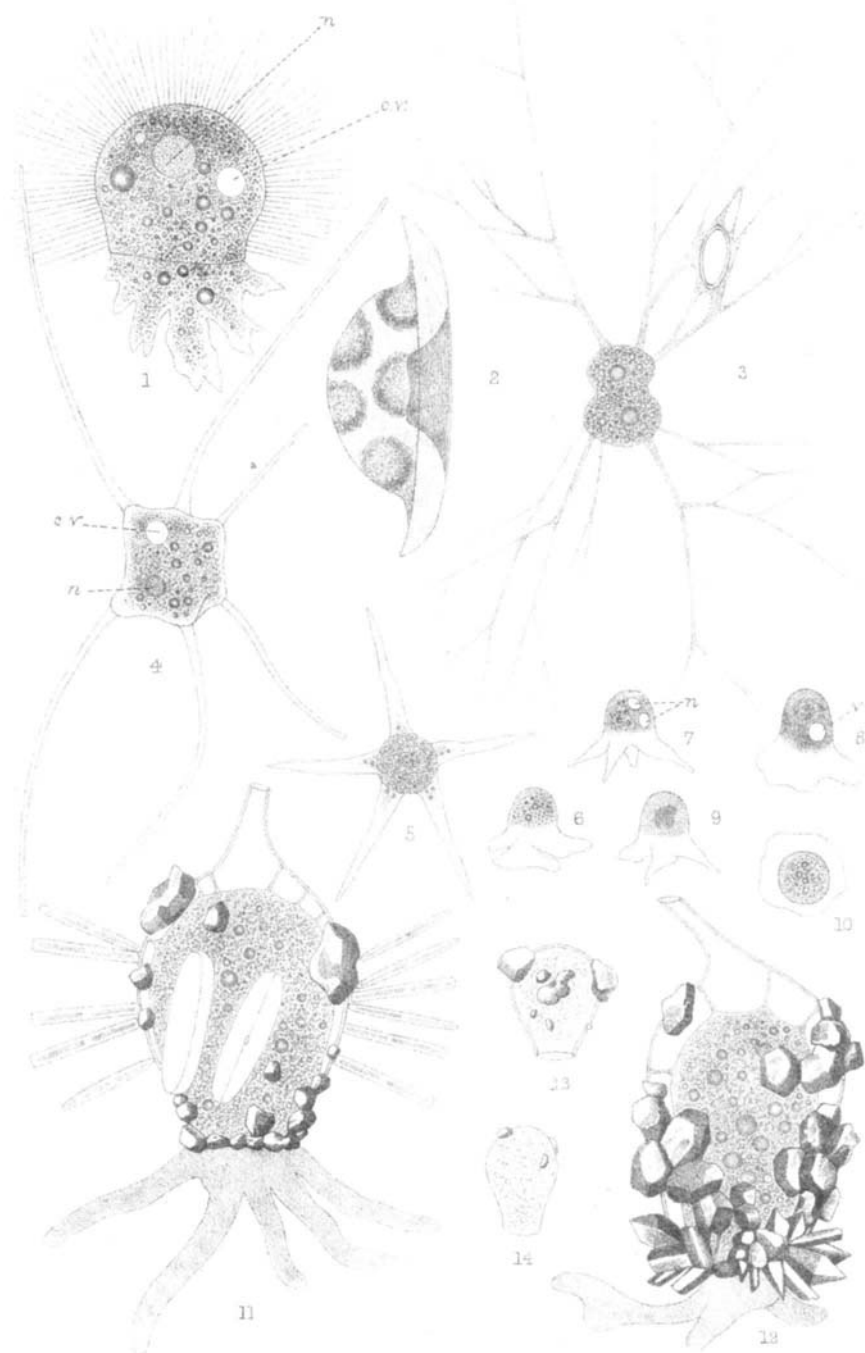
- Fig. 1. *Cochliopodium longispinum*, sp. n. $\times 520$. Active individual.
 2. *Arcella artocrea*, Leidy. $\times 150$. Empty shell.
 3. *Gymnophrys cometa*, Cienkowski. $\times 520$.
 Figs. 4, 5. *Dactylosphaerium radiosum*, Blochmann. $\times 520$.
 6-10. *Cochliopodium minutum*, sp. n. $\times 520$. Active individuals.
 11, 12. *Diffugia acuminata*, Ehrenb., var. *elegans*, nob. Fig. 11 is a specimen from Wicken Fen, Cambs., with living Diatoms attached to the outside of the shell; $\times 400$. Fig. 12 is from Llyn-y-cwm-ffynon, N. Wales; $\times 520$.
 13, 14. *Diffugia pyriformis*, Perty. Very small forms. $\times 520$.

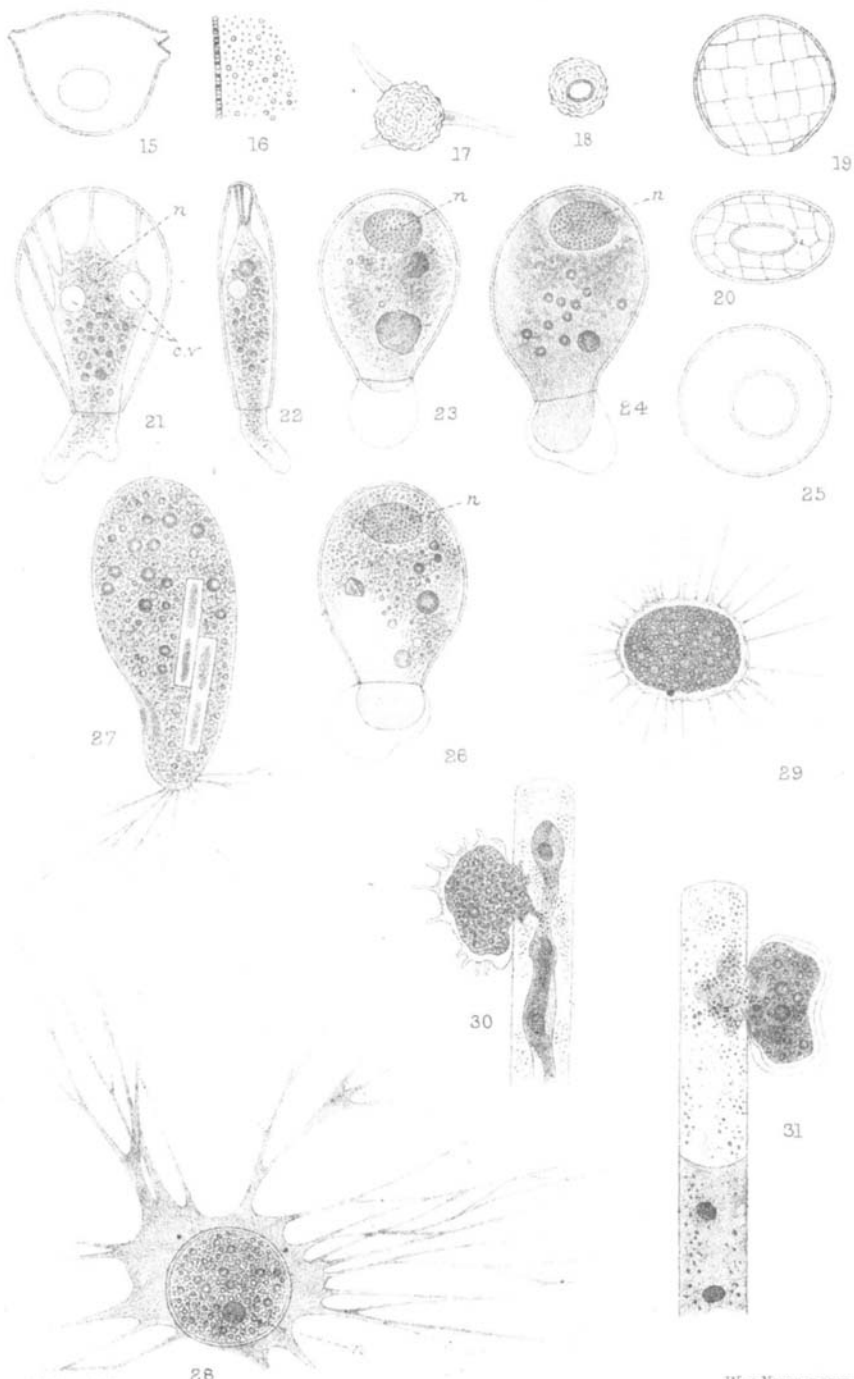
PLATE 29.

- Figs. 15, 16. *Centropyxis aculeata*, Stein. A form from Terrington, N. Yorks.; $\times 170$. Fig. 16 is a portion of the shell-membrane; $\times 830$.
 17, 18. *Diffugia globulosa*, Dujardin. Very small forms. $\times 520$.
 19, 20. *Quadrula irregularis*, Archer. $\times 520$.
 21, 22. *Hyalosphenia cuneata*, Stein. $\times 520$.
 23-26. *Leptochlamys ampullacea*, gen. et sp. n. $\times 520$.
 Fig. 27. *Pamphagus curvus*, Leidy. $\times 520$.
 28. *Gromia stagnalis*, sp. n. $\times 520$.
 Figs. 29-31. *Vampyrella lateritia*, Leidy. $\times 520$. Fig. 29, individual with pseudopodia fully extended. Fig. 30, an example just attacking a filament of *Mougeotia*. Fig. 31, a third example which has perforated a cell of *Mougeotia* and partially absorbed the cell-contents.

PLATE 30.

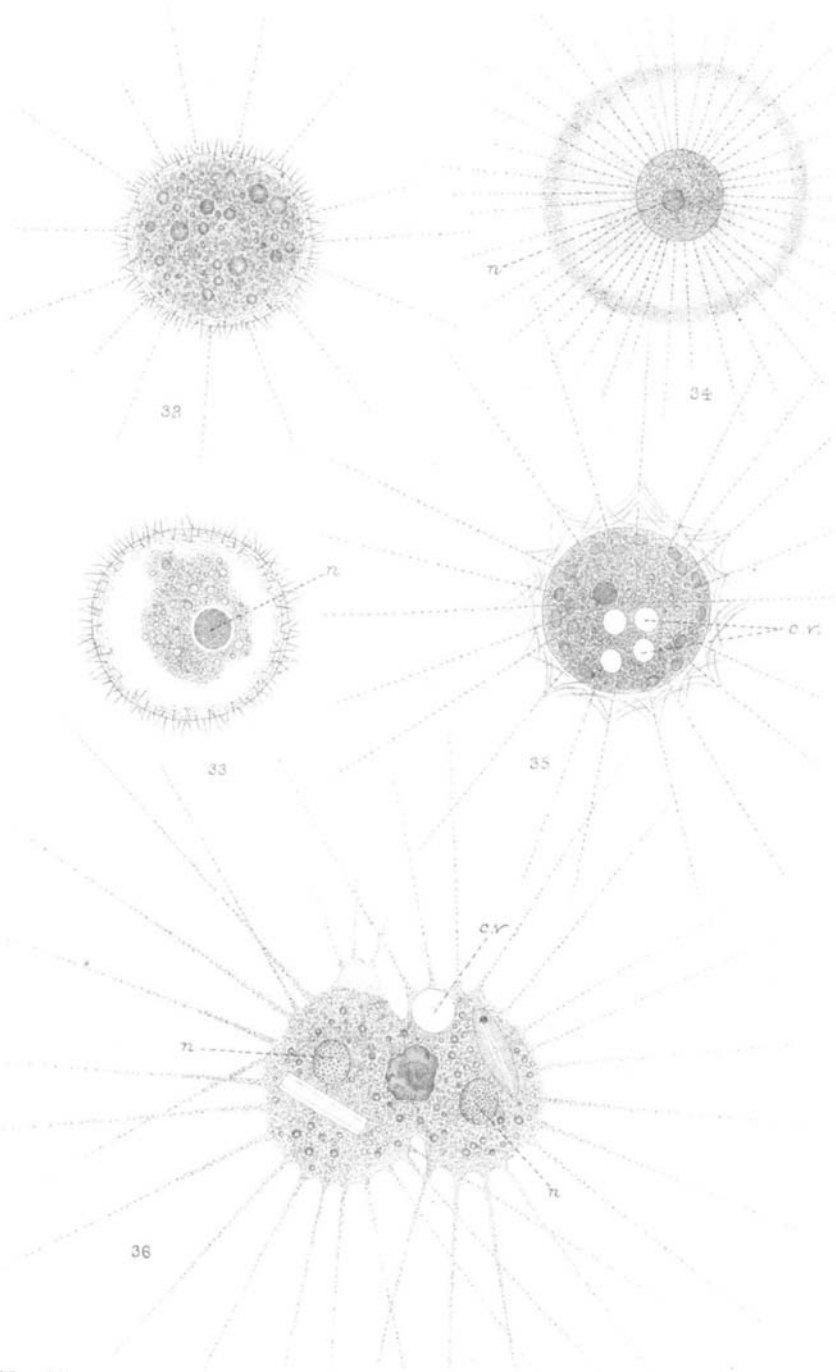
- Figs. 32, 33. *Acanthocystis paludosa*, sp. n. $\times 520$. Fig. 32, active individual of a bright green colour. Fig. 33 is a colourless individual with little protoplasm and a well-marked nucleus.
 Fig. 34. *Heterophrys radiata*, sp. n. $\times 520$.
 35. *Rhaphidiophrys pallida*, F. E. Schulze. $\times 520$. Individual containing chlorophyll-bodies.
 36. *Actinophrys subalpina*, sp. n. $\times 520$. Individual undergoing division, the nucleus having completely divided.
-





West, Newman imp.
Enslinmond lith.

West, Newman imp.



GSWest del.
ARHammond lith.

West, Newman imp.

BRITISH FRESHWATER RHIZOPODA.

EXPLANATION OF THE PLATES.

c.v.=contractile vacuole.

n.=nucleus.

v.=vacuole.

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