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THE BRITISH FRESHWATER RHIZOPODA AND HELIOZOA

BY

JAMES CASH

AND

GEORGE HERBERT WAILES, F.L.S.

ASSISTED BY

JOHN HOPKINSON, F.L.S., F.Z.S., V.P.R.M.S.

Secretary of the Ray Society

VOLUME III

RHIZOPODA, PART III

BY

G. H. WAILES

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PREFACE.

In the preparation of the third volume of this work on British Freshwater Rhizopoda, unfortunately left unfinished by the late James Cash, the descriptions in his MS., kindly placed at my disposal, have been utilized so far as possible; his note-books have been searched for records of localities, which are given with his name appended; and such of his drawings as were suitable have been reproduced. Several drawings kindly supplied by Prof. G. S. West are also given, and in a few instances the published figures of species by their authors are reproduced; the remaining drawings were made by myself from either living or mounted specimens.

In the time at my disposal it was not possible to obtain records from all parts of the British Isles, but owing to the kindness of friends much material was examined from districts which I was unable to visit. In some cases the gatherings of sphagnum and moss and the squeezings were numerous and representative of considerable areas, and my thanks for such are especially due to the following: the late William West, from whom were received about forty tubes of material from the north of Scotland, the Hebrides, the Orkneys, and the Shetland Islands, also about twenty tubes of material collected in the Scilly Islands, Cornwall, Devonshire, and the New Forest; James Saunders,

for nearly all the records for Bedfordshire, from material collected by him in the Luton district; W. S. Pring for material collected in the Isle of Wight; H. E. Forrest and the Rev. W. S. Ingrams for the Shropshire records, from material collected in the Shrewsbury district; John Hopkinson, James Saunders, H. E. Forrest, and H. Leigh for material from North Wales; N. Simpson, from Cambridgeshire; R. Wetherell, from Nottinghamshire and Rutlandshire; N. Chadwick, from the Isle of Man; H. Powell, from Dumfriesshire; and H. F. Wailes, the Rev. F. Johnson, and L. Bayley, for material from Ireland. In addition to these I am indebted to several friends for contributions of moss, etc., from other localities. The various published lists of Freshwater Rhizopoda found in the north of England and Scotland by J. M. Brown and G. S. West have also materially helped to increase the number of records.

Much more, however, still remains to be done before we can gain any correct idea of the distribution of the Freshwater Rhizopoda throughout the British Isles, and it is hoped that the objects for which the Ray Society was founded will be furthered by many microscopists making records of the Rhizopodal fauna of the districts in which they reside, and that these volumes will prove an aid and incentive to them in the task.

Since 1909 records of about forty species have been added to the genera described by Cash in Vols. I and II; these it is proposed to include in a fourth and final volume of this work.

Of the species described in those volumes the occurrence of *Amœba pilosa* in New York State and of *Nebela bipes* in the plankton of a small lake on Achill

Island, Mayo, are of interest; and in this connection it may be remarked that with the exception of Loch Ness not one of the British lakes has been investigated as to the Rhizopodal fauna of either the plankton or deposits, a large and unworked field awaiting investigation.

Our present records suffice, however, to show that the Rhizopodal fauna of the British Isles as a whole resembles that of Continental Europe with the exception of the occurrence of some species more or less characteristic of the North American fauna; they consist of the following: *Arcella mitrata*, *Nebela equicalceus*, *N. caudata*, *N. barbata*, *Euglypha cristata* var. *major*, *E. brachiata*, and *Sphenoderia macrolepis*. These do not occur abundantly, and their distribution appears to be confined to Ireland and the western portions of Great Britain; they are either common or not very rare in the United States, but, excepting the two first-named, are unrecorded from Continental Europe.

In conclusion I have to thank Dr. Eugène Penard for his invariable and ready assistance, and Mr. John Hopkinson for his bibliographical work, nearly all the synonymic references being his, and also for the final preparation of my MS. for the press, a labour which devolved upon him owing to my absence from England.

G. H. WAILES.

VANCOUVER, B.C.,
24th July, 1915.

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All the figures are photographic reproductions of drawings by Mr. Wailes except when otherwise specified. The coloured plates, Plates XXXV and XXXIX, and the text-figures, have been executed by Messrs. André & Sleigh, Ltd. All the other plates are collotype reproductions by Messrs. Griggs & Sons, Ltd.

FRONTISPIECE.

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JAMES CASH:

A SKETCH OF HIS LIFE.

James Cash, by whom the first two volumes of the present work were chiefly written, was born on 14th February, 1839, at Great Sankey, Warrington. He was of humble parentage, and is said to have walked when a child several miles each way daily to a school at Warrington. The cottage in which he was born was still standing in the summer of 1910, mostly surrounded by fields, by the side of the high road to Liverpool.

On leaving school he commenced business life in a lawyer's office, but soon joined the staff of the 'Warrington Guardian,' residing at Warrington. In 1867 he left there for Manchester, on becoming connected with the 'Manchester Guardian,' with which journal he continued to be associated until his death, for many years holding the position of Chief of the reporting staff, and residing in the neighbourhood of Sale, Cheshire. In the year 1873 he published a little book with the title: 'Where there's a Will there's a Way, or Science in the Cottage; an account of the labours of Naturalists in humble life.'

He married, in 1866, the eldest daughter of the Rev. J. B. Johnstone, pastor of the Warrington Presbyterian Church. He died on 20th February, 1909, leaving a widow, five sons, and two daughters. The illness which took him away was the first serious one

of his life ; indeed he had never known what it was to be really ill until then. On the previous Sunday, his seventieth birthday, he felt rather better, and turned his thoughts upon his work for the Ray Society, asking to see some proofs which had just arrived. They were the proofs of the plates for the second volume and seemed to give him much pleasure, but he was soon too wearied to attend to them and they were put aside for another day, which, however, never came to him.

The Freshwater Rhizopoda were not the organisms to which Mr. Cash earliest devoted attention. He was an excellent bryologist, as the following contribution from Mr. W. H. Pearson of Manchester will show. "It was," he says, "at one of the meetings of the now defunct Lower Mosley Street Natural History Society that I made the valued and lifelong friendship of Mr. James Cash. Many of the members were working men interested in all branches of natural history, whilst a section devoted themselves exclusively to the study of cryptogamic botany. Arising out of this the Manchester Cryptogamic Society was formed in 1878, Mr. John Whitehead of Dukinfield being the first President and Mr. Cash one of the Vice-Presidents. To its meetings he contributed much of interest, including many specimens. He also read several papers, amongst these being one on the British Andreæas, at the same time showing specimens of the six species known to be indigenous to Great Britain, gathered by him upon Snowdon and the neighbouring mountains in August, 1879. These are *A. petrophila* Ehr., *A. alpestris* Schimp., *A. alpina* Turner, *A. rupestris* Turner, *A. crassinervia* Bruch,* and *A. falcata*

* [*A. rothii* Web. & Mohr.]

Schimp. On another occasion he exhibited *Campylostelium saxicola* Br. & Sch., and he also from time to time brought to the meetings some of the rarer mosses which he had collected in Scotland during his summer holidays, among the most interesting of these being *Encalypta streptocarpa* Hedw. in fruit. On another occasion he had the pleasure of announcing the rare find of *Tetradontium brownianum* Schwg.* near Stalybridge.

"In 1881 he visited the Wharfe Valley, and on his return he gave a brief sketch of his tour, describing the finding of such rare mosses as *Encalypta streptocarpa* Hedw., *Ornithodontium gracile* Schw., and *Tetraphis pellucida* Hedw., all in fruit. In the same year he announced the discovery, at Nant-y-Ffrith, near Wrexham, of *Ornithodontium gracile* Schw., a mass of which had fruited abundantly. This moss was not known to have been gathered before in Wales. In the same locality *Tetraphis pellucida* Hedw. was fruiting freely, and the rare *Weissia commutata* Mitt. was also found.

"In May, 1882, he read an interesting paper on some of the scarce mosses, with special reference to the history of the discovery of *Thuidium blandovii* Web. and Mohr and *Paludella squarrosa* Brid. on Knutsford Moor, Cheshire, and in October of the same year he exhibited and distributed specimens of a moss which he had gathered in Scotland, and had determined by microscopical examination to be the rare *Myurella apiculata* Hueben.†

"These few extracts from the minute books of the Manchester Cryptogamic Society show the keen

* [*Tetraphis browniana* Grev.]

† [This moss had before been gathered on rocks amongst the Breadalbane mountains by Mr. Gardner.]

interest Mr. Cash took in the British mosses, and doubtless, if he had not been drawn to confine his limited time to the study of the Rhizopoda, he would, with his general knowledge, his keen and critical observation, and his power as an artist—for his drawings of the mosses which he described were exceedingly beautiful—have attained a position in the forefront of British bryologists. His moss collection and MSS. relating to mosses have been presented by his widow to the Manchester Museum where they will form a valuable addition to the already rich collection of mosses.

"Although having to live a very busy life, with little opportunities for study and research, Mr. Cash was always most generous in helping others. He was a man of large heart and broad sympathies, and he proved his interest in the working-man naturalists of Lancashire by the publication of his book [previously mentioned]: 'Where there's a Will there's a Way,' a delightful little volume now very scarce, which certainly deserves to be reprinted.

"A French botanist has commemorated his name in a moss collected at Southport—*Amblystegium cashii*."

The study of mosses may seem to have but little connection with that of freshwater Rhizopoda, but it is not so. By "freshwater" we include Rhizopoda whose habitat is on such a moist surface as that of a damp moss or even damp earth, and doubtless the microscopical examination of mosses led Mr. Cash to take up the investigation of microscopic creatures living upon them. When he first turned his attention from the mosses to the rhizopods we do not know, but in 1891 he read a paper before the Manchester Microscopical Society giving the results of his investigation

of the Rhizopoda of the Manchester area in the same year. This paper added several species to the British list and seems to have revived in this country an interest in these creatures, which had greatly fallen off since the days of William Archer and J. H. Carter.

Much more recently he contributed a paper to the Linnean Society "On some new and little known British Freshwater Rhizopoda" in which he described two new genera, *Penardia* and *Difflugiella*, and four new species.*

James Cash was a very modest, retiring man, as may be gathered from an appreciation contributed by Mr. W. A. Shovelton, who was under him on the reporting staff of the 'Manchester Guardian' for a quarter of a century.

Mr. Shovelton indeed says that with a desire to say unreservedly what was in his heart of his old friend, he was yet checked by the thought that all through his life he disliked anything which sounded of panegyric, modesty indeed being a marked feature of his character. He had, Mr. Shovelton says, ability far above the average; he had a wide and thoroughly accurate knowledge of English literature, and was specially skilled in several branches of science; attainments which fitted him for a high position; but his natural timidity, his dislike of ostentation or of anything like self-advertisement, prevented him from winning that full recognition to which his merits entitled him.

His sons, who furnished the information for the first part of this sketch of his life, say: "His pleasures were always simple and homely. He loved to spend his leisure hours amongst his family at his own fire-

* 'Journ. Linn. Soc., Zool.' vol. xxix, pp. 217–225, pl. xxvi (1904).

side. His business duties were at all times exacting, thus perhaps enhancing the pleasure of his spare moments. He had an intense love for the country, and memory dwells upon rambles which we took together from our earliest years. Thus we became familiar, while still at a tender age, with most of the rural haunts around Manchester, and amongst the best-loved spots were the Bollin Valley near Bowdon—long famous in the annals of Lancashire naturalists—and Carrington Moss, which in those days was a wild, heather-clad waste harbouring a most interesting fauna and flora. The delight of those country walks together never diminished, and until the close of his life we were in the habit of uniting in frequent rambles through the Cheshire countryside. . . . We remember, too, the keen pleasure which the anticipation of a lengthy holiday had for him. Many of these holidays were spent in Wales, some in the English Lake country, others in Scotland; and at such times he quite forgot that he was getting old, climbing the mountains with the best of us. Only eight months before his death, in the blazing heat of a glorious June, we joined him in a long ramble from Tan-y-Bwlch over much rough and mountainous country to Aberglaslyn and Portmadoc, and he seemed the least tired of the party at the day's end."

How the Ray Society came to publish his unfinished work on the 'British Freshwater Rhizopoda' was told by the present writer in the history of the work at the commencement of the second volume. It is intended to complete it with a fourth volume containing newly-found species of Rhizopoda and the Heliozoa.

J. H.

SYNONYMA.

In the synonymic references the same method of indicating the divisions of a work has been adopted as in the 'Bibliography of the Tunicata,' the principal division being given in Roman capitals unaccompanied by vol., tome, or Band, etc.; separately paged parts or memoirs in small Roman capitals; and parts not separately paged (seldom indicated) in Arabic type. A series is indicated in parentheses preceding the number of the volume. To economise space some of the titles are more abbreviated than in the former volumes of this work and smaller type is used.

All measurements are expressed in micromillimetres (μ). $1\,\mu = 0{\cdot}001$ mm. or $0{\cdot}00003937$ in. ($\frac{1}{25400}$).

BRITISH FRESHWATER RHIZOPODA.

In the first volume of this monograph forty-four genera of Freshwater Rhizopoda were enumerated as represented in the British Isles, and in the second volume, owing to the discovery in Britain of species referable to *Cryptodifflugia*, *Amphizonella*, and *Zonomyxa*, the number was increased to forty-seven. It is now, by the addition to the British list of *Paulinella* and *Clypeolina*, and the representation of *Gromia* by *Allogromia* and *Rhynchogromia*, increased to fifty, whilst *Lecythium* is substituted for the pre-occupied name *Pamphagus*.

The arrangement of the genera is as follows:—

Order II. CONCHULINA (*continued*).

Family 2. Euglyphina.

Genera: (32) *Euglypha*, (33) *Placocista*, (34) *Assulina*, (35) *Sphenoderia*, (36) *Paulinella*, (37) *Cyphoderia*, (38) *Campascus*, (39) *Trinema*, (40) *Corythion*.

Family 3. Gromiina.

Genera: (41) *Lecythium*, (42) *Pseudodifflugia*, (43) *Diaphoropodon*, (44) *Clypeolina*, (45) *Microgromia*, (46) *Lieberkuehnia*, (47) *Allogromia*, (48) *Rhynchogromia*.

Family 4. Amphistomina.

Genera: (49) *Diplophrys*, (50) *Amphitrema*.

Order II. CONCHULINA.

Family 2. Euglyphina.

Test rigid, more or less ovoid; circular, oval, or trigonal in transverse section; composed of chitinous or silicious discs and scales, often arranged in geometrical pattern; aperture single, usually terminal, but sometimes oblique; plasma granular, grey or colourless; nucleus single; contractile vesicles one or more; pseudopodia filose, of variable length, sharply pointed, simple or branched but not anastomosing.

The following genera belonging to this family have not yet been recorded from the British Isles:—

Nadinella Penard, 1899, containing a single species only, *N. tenella*, similar to a *Campascus*, but having the aperture of the test terminal instead of oblique.

Pareuglypha Penard, 1902, also containing a single species, *P. reticulata*, which is similar in the form of the test to *Euglypha mucronata*, but both the test and its prolongation consist of small plates similar to those forming the tests of the *Cyphoderiæ*.

Synopsis of the British Genera.

Test hyaline, ovoid, composed of silicious imbricated scales arranged in alternating longitudinal rows; glabrous or furnished with spines; aperture terminal, circular or oval, bordered by regularly-arranged denticulated scales. 32. *Euglypha*.

Test hyaline, ovoid, compressed, composed of imbricated silicious scales, glabrous or furnished with spines, aperture lanceolate with undulate border. 33. *Placocista*.

Test brown or colourless, sub-circular or ovoid, compressed, composed of imbricated oval scales, glabrous; aperture elongate-oval, bordered by an irregularly-dentated membrane. 34. *Assulina*.

Test hyaline, globular or oviform, glabrous, composed of imbricated scales or plates; aperture terminal, linear or circular. 35. *Sphenoderia.*

Test small, transparent, oviform, formed of plates arranged in alternating transverse rows; aperture small, terminal, oval; plasma containing a crescent-shaped chromatophore. 36. *Paulinella.*

Test brown or yellow, retort-shaped, glabrous, formed of imbricated circular scales or small discs on a chitinous membrane; circular or trigonal in transverse section; aperture circular, oblique. 37. *Cyphoderia.*

Test brown, chitinous, retort-shaped, glabrous, covered with amorphous plates or discs, with or without horn-like prolongations on the fundus; aperture circular, oblique, furnished with a thin membranous disc-shaped collar. 38. *Campascus.*

Test hyaline, ovoid, unsymmetrical, formed of circular, imbricated, silicious scales; aperture circular, oblique, invaginated. 39. *Trinema.*

Test hyaline, ovoid or subcircular, unsymmetrically compressed, formed of non-imbricated oval plates; aperture sub-circular or oval, oblique. 40. *Corythion.*

Genus 32. **EUGLYPHA** Dujardin, 1841.

Difflugia Ehrenberg (pars) Infusionsth. (1838), p. 131. (Non Leclerc, 1815.)

Euglypha Dujardin Zooph., Infus. (1841), p. 251.

Test hyaline, ovoid or elongated, circular or elliptical in transverse section, formed of circular, oval, or scutiform silicious scales arranged in alternating longitudinal rows regularly imbricated; glabrous or furnished with silicious spines or cils; aperture terminal, circular or elliptic, bordered by serrated or denticulated scales; the plasma colourless, only partially filling the test, the central portion generally occupied by a stratum of dark granules; nucleus large, placed centrally towards the fundus; one or two pulsating vesicles

usually visible; the pseudopodia filose and dichotomously branched.

Owing to the transparency of the tests in all species of this genus, the processes of division, encystment, etc., can be readily followed; reserve scales are frequently observed within the tests of all the species except *E. cristata* which accumulates them around the exterior of the aperture.

The process of encystment and of the development of the cyst in *Euglypha acanthophora* (*alveolata*) has recently been described and illustrated in detail by Popoff* up to the liberation of the "swarm spores" or gametes; these are isogametes, and from the conjugation of two of them a small amœboid form results, the further development of which has not been followed.

Large tests of about double the average linear dimensions are occasionally seen; these according to Penard are maturation or "double encystment" tests, and result from the plastogomy of two individuals.

The processes of conjugation and fission have been alluded to in Vol. I, pp. 22–25. During division, the nucleus may divide by a process of nearly normal mitosis or occasionally by the more simple method of fission; perhaps it is after the latter process that a moiety of the nucleus and the reserve scales are sometimes discarded as described in Vol. I, p. 23.

With reference to the spherical bodies (diameter 8–10 μ) so often found in *Euglypha* and other tests, having the appearance of spores, and the presence of so-called reproductive bodies often seen in the plasma, it should be borne in mind that many kinds of parasites infest the Rhizopoda, and that until the life-histories of these various bodies have been worked out it would be premature to hazard any definite pronouncement on the subject. Some of the so-called "reproductive bodies" no doubt represent granules of excretion.

The plasma of the *Euglyphæ* can be readily examined

* 'Archiv für Protist.,' vol. xxv, pt. 1, 1912.

and is seen to be divided into three nearly equal zones; that nearest the aperture is alveolar in structure, the central zone is granular and contains the greater portion of the food particles and granules of excretion, etc., whilst the third zone, which occupies the fundus, consists of the clear peri-nuclear plasma.

The spines with which the tests of most of the species are furnished are very various in shape, but are fundamentally of two kinds only, viz. (1) modified scales, (2) extraneous in character and attached to the test at the imbrications of the scales. As might be expected the scale-spines are fairly constant in their presence and shapes, but species bearing attached spines are frequently glabrous, and the spines when present may vary greatly, not only in number, but also in length and form; they may also occur in pairs or threes, while scale-spines only occur singly.

The development of the scale-spines may be traced through a series of species beginning with *E. tuberculata*, which is glabrous, except var. *cirrata* Wailes, found in America, through *E. scutigera* in which they are rudimentary, and *E. aspera* in which they are short and thorn-like, to *E. acanthophora* in which they are fully developed. In *E. brachiata* they are highly specialised and in *E. cristata* and *E. bryophila* they are confined to apical tufts. For purposes of classification the spines may be differentiated as follows:—

(1) Modified scales.

(2) Attached to the test at the imbrications of the scales, and may—

(*a*) Arise direct as fine cils (*E. ciliata* and *E. strigosa*);

(*b*) Be attached by small hemispherical nodules at their bases and be acicular (*E. filifera*) or dagger-shaped (*E. compressa*).

The shape of the body-scales in this genus varies from elliptical to circular except in three species, which possess scutiform scales, viz.—*E. scutigera* Penard, *E. aspera* Penard, and *E. crenulata* Wailes.

The two last-named species have not been recorded from the British Isles.

The aperture-scales are either pointed, denticulated, or serrated; they are distinctive of and usually constant in each species and are typical of the genus *Euglypha*.

Both scales and spines consist principally, if not entirely, of silica and are secreted within the body of the animal; they are insoluble in boiling sulphuric acid and readily dissolved by caustic potash. The material with which they are cemented together is dissolved by boiling, but not by cold, sulphuric acid.

The nuclei have some specific value, but the plasma and pseudopodia are very similar in most species of the genus.

The *Euglyphæ* are vegetable feeders and are among the most widely distributed of the Rhizopoda; they are generally abundant in most kinds of mosses, in sphagnum, and in submerged vegetation.

Synopsis of the British Species.

DIVISION I.—Spines when present always modified scales. Transverse section circular (except in *E. bryophila*). Aperture circular and may have two rows of aperture-scales.

Test glabrous; body-scales scutiform; length 75–90 μ. (1) *E. scutigera*.

Test bearing a few stout spines on the fundus; body-scales elliptical; length 55–80 μ. (2) *E. acanthophora*.

Test glabrous; body-scales circular or oval; length 45–100 μ. (3) *E. tuberculata*.

Test elongate, with a tuft of spines on the apex; length 33–70 μ. (4) *E. cristata*.

Test elongate, fundus conical, apex with one or two terminal spines; length 100–140 μ. (5) *E. mucronata*.

Test elongate, with a few long spines near the aperture; length 92–128 μ. (6) *E. brachiata*.

Test oviform, slightly compressed, apex with a tuft of spines; length 35–52 μ. (7) *E. bryophila*.

DIVISION II.—Spines when present not modified scales. Transverse section of test elliptical.

SECTION A.—Aperture circular.

Test bearing a few long marginal spines; length 55–70 μ. (8) *E. filifera.*

Test usually ciliated; aperture-scales thickened; length 45–100 μ. (9) *E. strigosa.*

Test glabrous; aperture-scales not thickened; length 22–52 μ. (10) *E. rotunda.*

SECTION B.—Aperture oval.

Test glabrous; aperture-scales pointed; length 22–25 μ. (11) *E. lævis.*

Test usually ciliated; aperture-scales not thickened; length 40–90 μ. (12) *E. ciliata.*

Test lenticular in transverse section; spines confined to the margins; length 70–132 μ. (13) *E. compressa.*

Test glabrous; ovoid in broad view, occasionally unsymmetrical; aperture small, unevenly denticulated; length 23–49 μ. (14) *E. denticulata.*

1. **Euglypha scutigera** Penard.

(Plate XXXIII, figs. 1 and 2, and fig. 111 in text.)

Euglypha scutigera.

WAILES & PENARD in Proc. R. Irish Acad., XXXI, LXV (1911), pp. 41–42, pl. iv, f. 20.

WAILES in Naturalist, 1913, p. 147.

Test of medium size, glabrous, oviform, not compressed; aperture circular, bordered by two rows of finely-serrated scales, ten to twelve in each row; body-scales scutiform; plasma and pseudopodia normal.

Length 75–90 μ; diameter 45–55 μ; aperture 14–20 μ in diameter; scales 11–12 μ in length, 8–10 μ in breadth.

Habitat.—Sphagnum and submerged vegetation.

ENGLAND.—Pilmoor, N. Yorkshire; Wicken Fen, Cambridgeshire (*West*).

This species was first described in 1911 from specimens found in Switzerland; in Britain it appears to be very rare.

Encystment tests which measure 110–125 μ in length occur; they are the result, according to the observations of Penard, of the plastogomy of two individuals, and contain an oviform cyst the test of which is composed of oval scales and is about the size of a normal test.

Fig. 111.—Body-scales of *Euglypha scutigera*. × 900. *a*, normal form; *b*, intermediate form; *c*, rudimentary form.

2. **Euglypha acanthophora** (Ehrenberg) Perty.

(Plate XXXIII, figs. 3–5, and Pl. XXXV, fig. 2.)

Euglypha alveolata

Dujardin (pars) Zooph., Infus. (1841), p. 252, Atlas, p. 2, pl. ii, f. 9.
Griffith & Henfrey Microg. Dict. (1855), p. 247, pl. xxiii, f. 54 ed. 4 (1883), p. 306, pl. xxx, f. 54.
Lachmann in Verh. Ver. Rheinl. XVI, Sitzber. (1859), p. 93.
Pritchard Hist. Infus., ed. 4 (1861), p. 556, pl. xxi, f. 11.
Leidy in Proc. Acad. Philad. 1874 (1875), p. 225; *op. cit.* 1877, pp. 262–264; (pars) 1878, pp. 171–172; (pars) Freshw. Rhiz. N. Amer. (1879), pp. 207–214, pl. xxxv, ff. 7, 8, 15–17.
Schulze in Arch. mikr. Anat. XI (1875), pp. 97–101, pl. v, ff. 1, 2.
Gabriel in Morph. Jahrb. I (1876), p. 539.
Strasburger in Jena. Zeitschr. X (1876), p. 413.
Buetschli (pars) in Bronn's Thierreichs, I, 1 (1880), pl. iii, f. 12 a.
Gruber in Zool. Anzeig. III (1880), pp. 582–584.
Hitchcock (pars) Synops. Freshw. Rhiz. (1881), pp. 35–36.
Taránek (pars) in Sitzber. böhm. Ges. Wiss. 1881, pp. 224, 233.
Blochmann Mikr. Thierw. Süsswass. (1886), p. 14, pl. i, f. 29; ed. 2, p. 18, pl. i, f. 22.
Ludwig in Leunis' Synops. Thierkunde, ed. 3 (1886), p. 1170, f. 1156.
Lord (pars) in Sci. Gossip, XXVII (1891), p. 276, f. 216.
Frenzel (pars) in Bibl. Zool. IV, xii (1897), 1, pp. 137–140, pl. ix, f. 17.
Stenroos in Acta Soc. Fauna Fenn. XVII (1898), i, pp. 36, 85, 233.
Penard (pars) in Rev. Suisse Zool. VII (1899), pp. 13, 105–121 *passim*; (pars) in Arch. Sci. nat. (4) VII (1899), pp. 253, 264, 265, 267; (pars) in Brit. Antarct. Exped. I, 6 (1911), pp. 220, 233.
Eyferth Einfach. Lebensf. ed. 3 (1900), p. 266, pl. ix, f. 14.
Calkins (pars) Protozoa (1901), pp. 40, 47, 90, ff. 13 d, 17 d; Protozoology (1910), p. 23, f. 5 a.
Issel in Atti Soc. Torino, XXXVI (1901), pp. 64, 68.
West (pars) in Jrn. Linn. Soc., Zool. XXVIII (1901), p. 327.
Cushman & Henderson (pars) in Amer. Natur. XXXIX (1905), p. 154.
Cockerell (pars) in Univ. Colorado Stud. IV (1907), p. 262.
Brown (pars) in Naturalist, 1909, p. 107; (pars) in Brit. Assoc. Handb. Sheffield (1910), pp. 500, 501.
Popoff in Arch. Protist. XXV (1912), pp. 8–26, pls. i, ii, text-ff. a–h.

Difflugia acanthophora
EHRENBERG in Abh. Acad. Berlin, 1841 (1842), pp. 413, 444, pl. iv, I, f. 36; *op. cit.* 1871 (1872), pp. 145, 235.
Euglypha acanthophora
PERTY in Mitth. nat. Ges. Bern, 1849, p. 45.
HOPKINSON in Zool. Anzeig. XLIV (1914), p. 528.
Euglypha setigera
PERTY (pars) in Mitth. nat. Ges. Bern, 1849, pp. 162, 168; Kennt. kleinst. Lebensf. (1852), p. 187, pl. viii, fig. 19 *b*.
MAGGI (pars) in Atti Soc. Ital. XXI (1879), p. 319.
Difflugia setigera
EHRENBERG in Abh. Akad. Berlin, 1871 (1872), p. 146.
Difflugia Setigerella acanthophora
EHRENBERG in Abh. Acad. Berlin, 1871 (1872), p. 245.
Euglypha alveolata var. *gracilis*
TARÁNEK (pars) in Sitzb. böhm. Ges. Wiss. 1881, p. 233.
Euglypha
DELAGE & HÉROUARD Zool. concrète, I (1896), f. 138.
Euglypha brachiata
PENARD Faune Rhiz. Léman (1902), pp. 504–507, 10 figs. (Non Leidy, 1878.)
Euglypha armata
WAILES & PENARD in Proc. R. Irish Acad. XXXI, LXV (1911), pp. 36, 37–38, 62, pl. iii, f. 16.
WAILES in Scott. Natur. 1912, p. 60; in Jrn. Linn. Soc., Zool. XXXII (1912), pp. 125, 144, 159; *loc. cit.* (1913), p. 213; in Naturalist, 1913, p. 147.

Test of medium size, oviform or slightly elongated towards the aperture, not compressed; the fundus bearing 3 to 7 of its scales produced into spines; aperture circular, bordered by one or two rows of serrated scales; body-scales elliptical. Plasma and pseudopodia normal.

Length 55–80 μ; diameter about half the length; aperture about half the diameter; spines 20–35 μ in length.

Habitat.—Sphagnum and submerged vegetation.

ENGLAND.—Rossendale, Lancashire (*Lord*); Pilmoor and Bilsdale, N. Yorkshire; Sheffield district, W. Yorkshire (*Brown*); Cheshire (*Cash*); Puttenham Common, Surrey (*West*); Chillingston, Kent.

WALES.—Dolgoth and Towyn, Merionethshire (*Cash*).

SCOTLAND.—Lerwick and Scalloway, Shetland Islands; Harris, Outer Hebrides.

IRELAND.—Achill, Clare, and Caher Islands, Mayo; Inisbofin, Galway; Glendalough, Wicklow.

In the early part of the year 1841 Ehrenberg read a paper before the Kgl. Akademie der Wissenschaften of Berlin in the course of which he described amongst other species two filose Conchulina under the names of *Difflugia areolata* and *D. acanthophora*, the former having "postica parte nuda" and the latter "postica parte tribus quatuorve aculeis armata."

Later in the same year Dujardin, in his 'Histoire naturelle des Zoophytes: Infusoires,' established the genus *Euglypha* and described as two species *E. tuberculata* and *E. alveolata*, his brief diagnosis of the former being "têt orné de tubercules arrondis," and of the latter "têt orné d'impressions polygonales, régulières." He had found them in vessels (or tanks) of fresh water with aquatic plants taken from marshes. *E. tuberculata* is a well-defined and figured species, and there can be no doubt of its identity, although he mentions that he has seen an empty test with many spines "en arrière" (*i. e.* on the fundus) irregularly placed as in the next species described (*alveolata*), for we may dismiss this observation as pertaining to another species, most probably *Euglypha ciliata*. *E. alveolata* is not so clearly described, indeed Dujardin says that he has only seen the tests and mentions its analogy with the preceding species (*E. tuberculata*), of which he says one might be tempted to consider it as only a variety, especially as they were together in the same vessel. He describes and figures one form with five scales on the fundus modified into long, slender spines, and another without any spines, and mentions differences between them in the disposition of their scales.

Ehrenberg's memoir was not published until after Dujardin's work had appeared, and in his description of the plates on which *Difflugia acanthophora* and *D. areolata* are figured he refers Dujardin's *Euglypha alveolata* to them, saying that it therefore falls; and he also says that "*Euglpha tuberculosa*" (using the name applied to this species by Dujardin in his

description of the figures) is not distinct from *E. alveolata*, which is a combination of two species, one of which (fig. 9) he refers to *Difflugia acanthophora*, and the other (fig. 10) to *D. areolata*.

In his determination of the identity of these two species, Ehrenberg, who did not admit *Euglypha* to be a genus distinct from *Difflugia*, was right, but not in ignoring *both* the specific names given to them by Dujardin and adopting his own names for them.

Perty, in 1849, recognized this distinction, adopting Ehrenberg's name *acanthophora* for the spined *Euglypha*, but nearly all subsequent writers have overlooked the determination of Ehrenberg and Perty, using the name *alveolata* for both the species embraced under it by Dujardin, as well as for his *tuberculata* which is one of them, so that it is impossible, in the absence of description or figure, or a reference to either, to determine which species is implied. Several authors have, however, used the name *tuberculata*, and a very few *tuberculosa*, the spineless species being implied under either name.

In 1902 Eugène Penard recognized, as Ehrenberg and Perty had done, that *alveolata* comprized two species, and he referred the spined form to *Euglypha brachiata* Leidy, from which it is undoubtedly distinct. This error was pointed out and corrected in 1911,* when a new name, *armata*, was given to the species, but there was not any necessity for this, the name *acanthophora* having been given to it by Ehrenberg, as stated above, so long ago as 1841, although it was not published until the following year. His figure clearly shows that the spines are modified scales, and that he only shows four whilst Dujardin shows five is of no moment, the number being variable.

The question arising is whether *acanthophora* or *alveolata* is the name under which the spined species should be known, and in view of the facts that there is no indication as to which of the two forms would

* Wailes in 'Proc. R. Irish Acad.,' vol. xxxi, pt. lxv, p. 37.

have been considered by Dujardin as the type of the species, and that he had already described one of them as *E. tuberculata*, and also taking into consideration the confusion which has arisen from the indiscriminate use of the name *alveolata* and would be perpetuated if it were continued in use, it appears to be better, and not an infringement of the laws of zoological nomenclature, which allow a name of uncertain application to be discarded, to revert to Ehrenberg's name of *acanthophora*. With this view Dr. Penard agrees.

In North America this species attains a length of 100 μ; a second circle of spines around the median portion of the test is sometimes present.

Under the name of *E. alveolata*, Popoff (1912) describes and illustrates the process of encystment and the liberation of the isogametes, which, as stated on p. 4, conjugate and form small amœba-like bodies, whose development into the mature animal has not been followed.

Penard distinguishes two varieties of this species, but intermediate forms exist.

Var. **flexuosa** Penard. (Pl. XXXIII, fig. 4.)

Euglypha brachiata var. *flexuosa*
PENARD Faune Rhiz. Léman (1902), p. 505, ff. 1–5.
THIÉBAUD in Zool. Anzeig. XXIX (1906), p. 796.
Euglypha armata var. *flexuosa*
WAILES & PENARD, Proc. R. Irish Acad. XXXI, LXV (1911), p. 38.
WAILES in Jrn. Linn. Soc., Zool. XXXII (1912), p. 125.

Test usually more elongated than in the type, but otherwise similar; the upper portion bearing a variable number of flexuous spines arising at various distances from the apex. Plasma and pseudopodia as in the type.

Dimensions similar to those of the type.

ENGLAND.—Pilmoor, N. Yorkshire.
SCOTLAND.—Loch Ness, Inverness-shire (*Penard*).
IRELAND.—Inishbofin, Galway.

Var. **brevispina** Penard.

Euglypha alveolata
LEIDY (pars) Freshw. Rhiz. N. Amer. (1879), p. 209, pl. xxxv, ff. 1, 10.
Euglypha brachiata var. *brevispina*
PENARD Faune Rhiz. Léman (1902), p. 505, ff. 6–10.
Euglypha armata var. *brevispina*
WAILES & PENARD, Proc. R. Irish Acad. XXXI, LXV (1911), p. 38.
WAILES in Jrn. Linn. Soc., Zool. XXXII (1912), p. 125; in Naturalist, 1913, p. 147.

Test similar to that of the type or sometimes more elongated; the fundus bearing 4, rarely 3 or 5, short stout spines, often truncate, arising at equal distances from the apex. Plasma and pseudopodia as in the type.

Dimensions similar to those of the type.

ENGLAND.—N. Yorkshire; Cheshire (*Cash*).

IRELAND.—Clare Island and Caher Island, Mayo; Pond near Lough Nahanagan, Wicklow.

3. **Euglypha tuberculata** Dujardin.

(Plate XXXIII, figs. 6 and 7; Pl. XXXV, figs. 3–5; and figs. 112–114 in text.)

Euglypha tuberculata
DUJARDIN Zooph., Infus. (1841), pp. 251–252.
PERTY Kennt. kleinst. Lebensf. (1852), p. 187.
PRITCHARD Hist. Infus., ed. 3 (1852), p. 213; ed. 4 (1861), p. 556.
GRIFFITH & HENFREY Microg. Dict. (1855), p. 247, pl. xxiii, f. 53; ed. 4 (1883), p. 306, pl. xxx, f. 53.
PURKYNĚ in Živa, III (1855), p. 212, f. 2 (5).
CLAPARÈDE & LACHMANN Infus. et Rhiz. I (1859), pp. 456–457.
LACHMANN in Verh. Ver. Rheinl. XVI, Sitzb. (1859), p. 93.
MAGGI in Rend. R. Ist. Lomb. (2) IX (1876), p. 543; *op. cit.* (2) XXI (1888), p. 310.
BUCK in Zeits. wiss. Zool. XXX (1877), p. 36.
HOPKINSON in Zool. Anzeig. XLIV (1914), p. 528.
Euglypha tuberculosa
DUJARDIN Zooph., Infus. (1841), Atlas, p. 2, pl. ii, ff. 7, 8.
MAGGI in Atti Soc. Ital. XXI (1878), p. 319.
PARONA in Boll. Scient. II (1880), p. 211.
Euglypha alveolata
DUJARDIN (pars) Zooph., Infus. (1841), p. 252, Atlas, p. 2, pl. ii, f. 10.
PERTY in Mitth. nat. Ges. Bern, 1849, p. 45; Kenntn. kleinst. Lebensf. (1852), p. 187.
CARTER in Ann. Nat. Hist. (2) XVIII (1856), pp. 226–227, pl. v, ff. 25–36; *op. cit.* (5) III (1879), p. 409.
CARPENTER Foram. (*Ray. Soc.* 1862), pp. 21, 36, pl. i, f. 5.
WALLICH (pars) in Ann. Nat. Hist. (3) XIII (1864), p. 240, pl. xvi, f. 45.

Gegenbaur Grundz. vergl. Anat., ed. 2 (1870), p. iii; Anat. compar. (1874), p. 107.
Ehrenberg in Abh. Akad. Berlin, 1871 (1872), pp. 239, 243, 263.
Hertwig & Lesser in Arch. mikr. Anat. X, Suppl. (1874), pp. 124–129, 132, pl. iii, f. 5.
Eyferth Einfach Lebensf. (1878), p. 34, pl. ii, f. 13; ed. 2 (1885), p. 52, pl. iii, f. 37.
Leidy (pars) in Proc. Acad. Philad. 1877 (1878), p. 321; *op. cit.* 1878, pp. 171–172; (pars) Freshw. Rhiz. N. Amer. (1879), pp. 207–214, pl. xxxv, f. 14.
Buetschli (pars) in Bronn's Thierreichs, I, 1 (1880), pl. iii, f. 12 b.
Gruber in Zeits. wiss. Zool. XXXV (1881), pp. 431–439, pl. xxiii; *op. cit.* XXXVI (1881), pp. 104–106, pl. v, f. 42; XXXVIII (1883), p. 384; XL (1884), p. 129, pl. viii, f. 8; in Arch. Sci. nat. (3) VI (1881), pp. 624–627; in Biol. Centralbl. I (1881), pp. 79–80, 456; in Jrn. R. Micr. Soc. 1881, p. 69; *op. cit.* 1888, p. 969; in Ann. Nat. Hist. (5) IX (1882), pp. 135–137; in Ber. nat. Ges. Freiburg, II (1888), pp. 149–152, pl. vi, ff. 1, 2; (pars) in Zacharias' Tier. Süsswass. I (1891), pp. 140–158, ff. 16 (9), 17–32.
Hitchcock (pars) Synops. Freshw. Rhiz. (1881), pp. 35–36.
Taránek (pars) in Sitzber. böhm. Ges. Wiss. 1881, pp. 224, 233.
Blochmann in Morphol. Jahrb. XIII (1887), pp. 173–175, pl. v; in Biol. Centralbl. XIV (1893), p. 195; in Ann. Nat. Hist. (6) I (1888), pp. 27–36, pl. iv.
Schewiakoff in Morphol. Jahrb. XIII (1887), pp. 193–258; in Biol. Centralbl. VIII (1888), pp. 272–274; in Jrn. R. Micr. Soc. 1888, pp. 66–68; in Mém. Acad. St. Pétersb. (7) XLI (1893), viii, pp. 6, 73, 76, 98, 111, 113.
Maggi in Rend. R. Ist. Lomb. (2) XXI (1888), pp. 301, 310, pl., f. 6.
Penard (pars) in Mém. Soc. Genève, XXXI, 1, ii (1890), pp. 177–178, pl. ix, ff. 26–29, 32–40; (pars) in Rev. Suisse Zool. VII (1899), pp. 13, 105–121 *passim*; *op. cit.* XVI (1908), p. 462; (pars) in Arch. Sci. nat. (4) VII (1899), pp. 253, 264, 265, 267; Faune Rhiz. Léman (1902), pp. 494–497, 7 figs.; in Arch. Protist. II (1903), pp. 268–269; Sarcodinés grands lacs (1905), p. 115; Sarcodinés in Cat. Invert. Suisse (1905), pp. 100–101; in Proc. Roy. Soc. Edinb. XXV, 2 (1905), pp. 594, 596, 603; (pars) in Brit. Antarct. Exped. I, 6 (1911), pp. 220, 233; in Jrn. Quekett Micr. Club, (2) XI (1911), p. 299.
Entz Stud. Protist. (1888) i, pp. 139, 372–373; in Math. Termész értes. XV (1897), pp. 171–173, 178; in Math. Nat. Ber. Ungarn, XV (1899), pp. 182–188 *passim*.
Dreyer in Jena. Zeits. Naturw. XXVI (1891), pp. 390, 468, pl. xxvii, f. 230 *a–c*.
Jaworowski in Kosmos, XVI (1891), p. 286.
Lord (pars) in Sci. Gossip, XXVII (1891), pp. 267–268, ff. 214, 215.
Hertwig in Ver. deutsch. zool. Ges. II (1892), p. 96; in Festschr. C. von Kuppfer (1899), pp. 370–371, pl. xxxviii, f. 11.
Moore in Ann. Nat. Hist. (6) XI (1893), p. 151.
Levander in Acta Soc. Fauna Fenn. XII (1894), ii, pp. 6, 21; *op. cit.* XX (1901), viii, pp. 8, 11, 12; in Festschr. Palmén, I (1905), ii, pp. 19, 47.
Labbé in Arch. Zool. expér. (3) III (1895), p. xi.
Frenzel (pars) in Bibl. Zool. IV, xii (1897), 1, pp. 137–140, 150, pl. ix, ff. 18–20.
Scourfield in Proc. Zool. Soc. 1897, p. 788.

Calkins in Biol. Lect. Woods Holl, 1899 (1900), p. 215; (pars) Protozoa (1901), pp. 55–56, f. 22 a–d.
Dangeard in Le Botanist, VII (1900), pp. 147, 153.
Prowazek in Arb. zool. Inst. Wien, XII (1900), pp. 243–252 *passim*, pl. i, f. 1 a–c; in Zeits. angew. Mikr. V (1900), p. 271.
West (pars) in Jrn. Linn. Soc., Zool. XXVIII (1901), p. 327.
Goette Lehrb. Zool. (1902), pp. 38–39, f. 11 (1–7).
Lister in Lankester's Zoology, I, II (1903), pp. 52–53, f. 3.
Averintzeff in Trudui S.-Peterb. Obshch. XXXVI, II (1906), pp. 83, 93, 94, 291–292, pl. i, f. 20, pl. ii, f. 26; in Arch. Protist. VIII (1906), p. 114; in Zool. Anzeig. XXXI (1907), pp. 245, 310.
Schouteden in Ann. Biol. lacustre, I (1906), pp. 367, 368, f. 38.
Ziegler Zool. Wörterbuch, 1 (1907), p. 204, f. 191.
Hoogenraad in Tijds. Nederh. Dierk. Ver. (2) X (1908), pp. 412-413, 424.
Landacre in Proc. Ohio Acad. IV (1908), p. 429.
Brown (pars) in Naturalist, 1909, p. 107; (pars) in Brit. Assoc. Handb. Sheffield (1910), pp. 500, 501; in Jrn. Linn. Soc., Zool. XXX (1910), pp. 360, 362; in Ann. Scott. Nat. Hist. 1911, pp. 229, 230; in Naturalist, 1912, p. 181; in Scott. Natur. 1913, p. 208.
Doflein Lehrb. Protozoenk., ed. 3 (1911), pp. 24, 30, 141, 154, 623, 626, ff. 23, 31, 139, 158, 355.
Hartog in Encycl. Brit., ed. 11, XXIII (1911), pp. 246–247, ff. 4 (*a–d*), 6 A (1–7).
Wailes & Penard in Proc. R. Irish Acad. XXXI, LV (1911), pp. 16, 36, 38.
Raukauf in Zool. Anzeig. XXXIX (1912), pp. 372–375, 4 figs.
Wailes in Scott. Natur. 1912, p. 60; in Jrn. Linn. Soc., Zool. XXXII (1912), pp. 125, 144, 145; in Naturalist, 1913, p. 147.

Difflugia areolata

Ehrenberg in Abh. Akad. Berlin, 1841 (1842), pp. 304–372 *passim*, 413, pl. i (iv), f. 8 c; pl. ii (i), f. 45; pl. iii (i), f. 49; pl. iv (v), f. 2; in Ber. Akad. Berlin, 1845, p. 319; in Abh. Akad. Berlin, 1847 (1849), p. 460, pl. vi, III, f. 61; in Ber. Akad. Berlin, 1848, p. 215; *op. cit.* 1849, pp. 89, 98, 191, 228, 231; 1853, p. 266, tables 1–3 opp. p. 182; Mikrogeol. (1854), pl. xxxiii (iv), f. 2; pl. xxxiv (i) B, f. 2, (iii) B, f. 1; pl. xxxviii (xxi), A, f. 2; pl. xxxix (iv), f. 25; in Monatsb. Akad. Berlin, 1861, p. 1098; Zweite Nordpol. II (1874), pp. 445, 460, pl. iii, f. 23.
Leidy in Proc. Acad. Philad. 1880, pp. 336, 338.
Maggi in Rend. R. Ist. Lomb. (2) XXI (1888), p. 301.

Difflugia alveolata

Pritchard Hist. Infus., ed. 4 (1861), p. 907, pl. xxi, f. 11.
Ehrenberg in Abh. Akad. Berlin, 1871 (1872), p. 264.

Euglypha pusilla

Entz in Termész füzetek, I (1877), pp. 162–163, 194, pl. x, ff. 6–8.

Euglypha β

Vejdovsky Thier Org. Brunnenw. Prag (1882), pp. 38–39, pl. ii, f. 1 *j*, *k*.

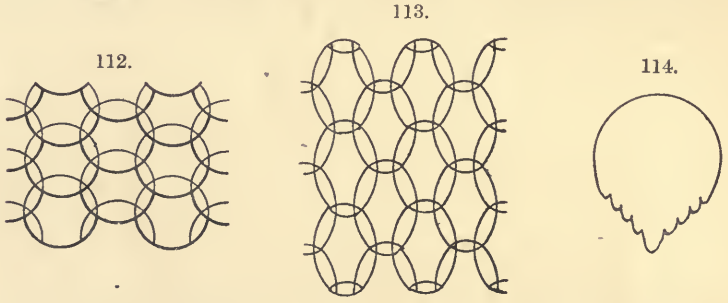
Test of medium size, elongate-oviform with hemispherical crown, not compressed, glabrous; the body-scales circular to broadly oval in shape; the aperture circular, devoid of neck and bordered by one

or two rows of 8–12 finely-serrated scales; plasma normal; nucleus large, containing one nucleole which is often central and sometimes granular; the pseudopodia long, fine, radiating, generally straight, seldom branched.

Length, 45–100 μ; diameter 24–50 μ; aperture 10–20 μ; nucleus 10–15 μ in diameter; scales 10–16 μ in longest diameter.

Habitat.—Mosses, sphagnum, and submerged vegetation; generally distributed.

England.—Cumberland and Westmorland (*Brown*); Isle of Man; N. and W. Yorkshire; Cheshire (*Cash*);



Figs. 112–114.—*Euglypha tuberculata.* 112, circular type of body-scales. × 1000. 113, oval type. × 1000. 114, aperture-scale × 2000.

Derbyshire (*Brown*); Shropshire; Bedfordshire; Cambridgeshire; Essex (*Scourfield*); Kent; Devonshire; Cornwall.

Scotland.—Shetlands; Orkneys; Ross-shire (*West*); Hebrides! (*West*); Inverness-shire (*West, Penard*); Perthshire (*West, Brown*); Argyllshire (*Brown*); ? Forth area (*Evans*); Ayrshire, Kirkcudbrightshire, and Wigtonshire (*Brown*).

Ireland.—Mayo; Galway; Wicklow; Kerry.

The glabrous, uncompressed, ovoid test and circular or broadly-oval scales (figs. 112 and 113) readily distinguish *E. tuberculata* from all other species of *Euglypha*.

In the United States a variety occurs (var. *cirrata*

Wailes) in which one or two of the apical scales are produced into short spines.

Var. **minor** Taránek.

Euglypha alveolata var. *minor*
Taránek in Sitzb. böhm. Ges. Wiss. 1881 (1882), p. 233.
Wailes in Jrn. Linn. Soc., Zool. XXXII (1912), pp. 144, 146.

Test similar to that of the type but smaller; aperture bordered by a single row only of serrated scales. Plasma and pseudopodia as in the type.

Length 28–40 μ; diameter 14–20 μ.

Habitat.—Submerged vegetation. Rare.

England.—St. Just, Cornwall (*W. West*, coll.); Goathland, North Riding, Yorkshire.

The following references probably pertain to *Euglypha tuberculata*, but in the absence of descriptions or figures it is possible that *E. acanthophora* may be the species recorded.

Euglypha alveolata
Pritchard Infus. Anim., ed 3 (1852), p. 213.
Archer in Qrt. Jrn. Micr. Sci. (n. s.), VI (1866), pp. 185, 186; *op. cit.* (n. s.) VII (1867), p. 174; in Proc. Dublin Micr. Club, I, 2 (1868), pp. 51, 52, 118; in Qrt. Jrn. Micr. Sci. (n. s.), XIV (1874), p. 107; in Proc. Dublin Micr. Club, II, 3 (1875), p. 301.
Parona in Boll. Scient. II (1880), pp. 47, 48; *op. cit.* IV (1882), pp. 52, 57; in Arch. Sci. nat. (3) X (1883), p. 238.
Vejdovský in Sitzber. böhm. Ges. Wiss. 1880, pp. 136, 138; Thier. Org. Brunnenw. Prag (1882), p. 32.
Lanessan Traité Zool., Prot. (1882), pp. 53, 67.
Tarr in Rep. N. York State Mus. XXXV (1884), p. 167.
Daday in Értes. Akad. Budapest, III (1885), p. 161; in Termész. Füzetek, XX (1897), pp. 151–173 *passim*; in Anh. Termész. Füzetek, XXI (1898), pp. 7, 9; in Horváth's Zool. Ergebn. Zichy (1901), p. 387; in Zoologica, XVIII, xliv (1905), p. 19; in Math. Termész. értes. XXIV (1906), pp. 37, 45, 52, 70; *loc. cit.* XXV (1907), pp. 405, 418; in Deutsch-Ost.-Africa, XXIII (1910), p. 10; in Sitzb. Akad. Wien, CXIX (1910), p. 541; in Zoologica, XXXIII, lix (1910), pp. 12–13.
Imhof in Viertelj. nat. Ges. Zürich, XXX (1885), p. 384; in Jahresb. nat. Ges. Graubünd. XXX (1887), pp. 92, 110.
Schneider in Sitzb. Akad. Berlin, 1886, p. 895.
Whitelegge in Proc. Linn. Soc. N. S. Wales (2) I, ii (1886), p. 502; in Jrn. Roy. Soc. N. S. Wales, XXIII, ii (1889), p. 299.

Fielde in Proc. Acad. Philad. 1887, p. 122.
Barrois Faune d'eaux douces Açores, II–III (1888), p. 11; in Mém. Soc. Sci. Lille, (5) VI (1896), pp. 48–119 *passim*, 143.
De Guerne Excurs. zool. Fayal, etc. (1888), p. 31.
Harvey in Amer. Natur. XXII (1888), p. 73.
Sacchi in Boll. Scient. X (1888), p. 45; in Jrn. Microg. XII (1888), p. 347.
Certes in Mission scient. Cap Horn, VI, Prot. (1889), p. 20.
Penard in Jahrb. nassau. Ver. Naturk. XLII (1889), p. 144; *op. cit.* XLIII (1890), p. 71; in Arch. Sci. nat. (3) XXVI (1891), p. 144; in Amer. Natur. XXV (1891), p. 1071; in Rev. Suisse Zool. IX (1901), p. 237.
Hertwig Lehrb. Zool. (1891), 1, p. 157; ed. 5 (1900), p. 168.
Perry in Proc. Amer. Soc. Micr. XII (1891), p. 95.
Levander in Arch. Ver. Mecklenb. XLVI (1892), p. 114.
Longhi in Atti Soc. Ligust. III (1892), p. 146.
Lord in Trans. Manch. Micr. Soc. 1891 (1892), p. 56; in Sci. Gossip, XXVIII (1892), p. 129; in Trans. Manch. Micr. Soc. 1904 (1905), p. 56.
Gruber in Ber. nat. Ges. Freiburg, VIII (1893), p. 26.
Jelliffe in Amer. M. Micr. Jrn. XIV (1893), p. 289.
Studer in Arch. Sci. nat. (3) XXX (1893), p. 642.
Henneguy Leçons sur la Cellule (1896), pp. 110, 354.
Francé in Res. wiss. Balatons. II (1897), I, pp. 3, 10.
Schaudinn in Deutsch-Ost-Africa, IV (1897), xvii, p. 10.
André in Jabresb. nat. Ges. Graubünd. (N. F.) XLI (1898), pp. 58, 59.
Fick in Zool. Centralbl. V (1898), p. 325.
Hempel in Bull. Illinois Lab. V (1898), p. 321.
Averintzeff in Trudui S.-Peterb. Obshch. XXX, I (1900), p. 240.
Godet in Bull. Soc. Neuchatel, XXVIII (1900), p. 78.
Zschokke in Nouv. Mém. Soc. Helvet. XXXVII (1900), pp. 53–59.
Jennings in Bull. U. S. Fish Comm. XIX (1901), p. 111.
Lagerheim in Geol. Fören. Stockholm Förh. XXIII (1901), 6, pp. 471–487 *passim*, 516–517, 519.
Zykoff in Bull. Soc. nat. Moscou, XVII (1903), p. 17.
Forel Le Léman, III (1904), p. 137.
Kemma in Mém. Soc. malac. Belg. XXXIX (1905), p. 96.
Murray in Proc. Roy. Soc. Edinb. XXV (1905), p. 56; in Ann. Scott. Nat. Hist. 1907, p. 95; in Surv. Scott. Lochs, I (1910), p. 326.
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Cushmann in Amer. Natur. XL (1906), pp. 372–373.
Odell in Ottawa Natur. XIX (1905). p. 19.
Thallwitz in Ann. Biol. lacustre, I (1906), p. 260.
Evans in Proc. R. Phys. Soc. Edinb. XVII (1907), table 1.
Butler in Brit. Assoc. Handb. Dublin (1908), p. 219.
Heinis in Zool. Anzeig. XXXIII (1908), p. 713; in Arch. Hydrobiol. V (1910), p. 108; in Rev. Suisse Zool. XIX (1911), p. 255.
Kofoid in Bull. Illinois Lab. VIII (1908), p. 112.
Richters in Zool. Jahrb., Syst. XXVI (1908), pp. 198, 210.
Thiébaud in Ann. Biol. lacustre, III (1908), p. 66.
Edmondson in Science, (2) XXXII (1910), p. 350; in Univ. Colorado Stud. IX (1912), p. 69.
Padovani in Zool. Anzeig. XXXVII (1911), p. 100.
Cunha in Mem. Inst. Oswaldo Cruz, V (1913), pp. 101, 102.
Schmidt in Arch. Protist. XXIX (1913), p. 220.

4. **Euglypha cristata** Leidy.

(Plate XXXIV, figs. 1 and 2; Pl. XXXV, figs. 6–8; and fig. 115 in text.)

Euglypha cristata

Leidy in Proc. Acad. Philad. 1874 (1875), p. 226; *op. cit.* 1878, p. 172; 1879, p. 163; (?) 1880, p. 339; (pars) Freshw. Rhiz. N. Amer. (1879), pp. 218–219, 290, pl. xxxvii, ff. 2–4.

Parona in Boll. Scient. II (1880), p. 47.

Hitchcock Synops. Freshw. Rhiz. (1881), p. 37.

Taránek in Sitzb. böhm. Ges. Wiss. 1881, pp. 224, 234.

Penard in Jahrb. nassau. Ver. Naturk. XLIII (1890), p. 71; (pars) in Mém. Soc. Genève, XXXI, 1, II (1890), pp. 180–181, pl. ix, ff. 85–90; in Amer. Natur. XXV (1891), p. 1071; Faune Rhiz. Léman (1902), pp. 511–512, 4 figs.; in Arch. Protist. II (1903), p. 271; *op. cit.* IX (1909), p. 265.

Perry in Proc. Amer. Soc. Micr. XII (1891), p. 95.

Cash in Proc. Manch. Micr. Soc. 1891 (1892), p. 52, pl. ii, f. 25.

Schewiakoff in Mém. Acad. St. Pétersb. (7) XLI, VIII (1893), p. 98.

Scourfield in Proc. Zool. Soc. Lond. 1897, p. 788.

Averintzeff in Trudui S.-Peterb. Obshch. XXX, I (1900), p. 240; *op. cit.* (pars) XXXVI, II (1906), pp. 285–287; in Ann. Biol. lacustre, I (1906), pp, 323-324; in Arch. Protist. VIII (1906) pp. 106–107.

Eyferth Einfach. Lebensf., ed. 3 (1900), p. 267.

Zychokke in Nouv. Mém. Soc. Helvet. XXXVII (1900), p. 53.

Levander in Acta Soc. Fauna Fenn. XX, VIII (1901), p. 11.

West in Jrn. Linn. Soc., Zool. XXIX (1903), p. 115.

Odell in Ottawa Natur. XIX (1905), p. 19.

Schouteden (pars) in Ann. Biol. lacustre, I (1906), pp. 366, 367.

Cockerell in Univ. Colorado Stud. VI (1909), p. 306.

Brown in Naturalist, 1910, p. 93; in Brit. Assoc. Handb. Sheffield (1910), pp. 499, 500; in Ann. Scott. Nat. Hist. (1911), p. 229; in Scott. Natur. 1913, p. 208.

Heinis in Arch. Hydrobiol. V (1910), p. 109.

Hopkinson in Irish Natur. 1910, p. 3.

Wailes & Penard in Proc. R. Irish Acad. XXXI, LXV (1911), pp. 17, 36, 40, 60.

Edmondson in Univ. Colorado Stud. IX (1912), p. 69.

Popoff in Arch. Protist. XXV (1912), p. 10.

Raukauff in Zool. Anzeig. XXXIX (1912), pp. 372–375, ff. 1–4.

Wailes in Scott. Natur. 1912, p. 61; in Jrn. Linn. Soc., Zool. XXXII (1912), pp. 125, 146, 160; *loc. cit.* (1913), p. 213; in Naturalist, 1913, p. 147; in Trans. Liverp. Biol. Soc. XXVI (1913), p. 20.

Schmidt in Arch. Protist. XXIX (1913), pp. 221, 226.

Test small, elongated, not compressed, with a long, slightly-constricted neck, thence tapering to a hemispherical fundus furnished with a tuft of divergent spines, 3 to 8 in number; the body-scales oval; the aperture circular and bordered by a single row of 5 or

6 denticulated scales; plasma colourless and containing few opaque granules; nucleus placed posteriorly and containing a central nucleole; pseudopodia extremely fine.

Length 33–70 μ; diameter 12–23 μ; aperture 6–12 μ; scales 4·5–9·5 μ in length and 2·5–6·5 μ in breadth; spines 10–15 μ in length.

Habitat.—Mosses and sphagnum.

England.—Westmorland and Lancashire (*Brown*); N. Yorkshire; Sheffield district, W. Yorkshire (*Brown*); Cheshire (*Cash*); Shropshire; Bedfordshire; Essex (*Scourfield*); Isle of Wight.

Wales.—Sychnant Pass, Carnarvonshire (*Cash*).

Scotland.—Orkneys; Harris, Outer Hebrides (*West*); Inverness-shire, Elginshire, Aberdeenshire, Argyllshire, Perthshire, and Wigtownshire (*Brown*).

Ireland.—Donegal; Clare Island, Inisturk, Caher Island, and Belclare, Mayo; Inishbofin, Galway; Wicklow (*Hopk.*).

Euglypha cristata is probably generally distributed, but it never occurs very numerously, and this fact together with its inconspicuousness (its length usually ranging between 40 and 55 μ) may account for the paucity of records. Active individuals are rarely seen. Glabrous individuals occasionally occur.

The species is peculiar among the *Euglyphæ* in collecting the supply of reserve scales around the exterior of the aperture instead of within the test; this may be due to the restricted volume of the test compared to the area of its surface.

Var. **major** Wailes. (Pl. XXXV, fig. 7.)

Euglypha cristata
Leidy (pars) Freshw. Rhiz. N. Amer. (1879), p. 219, pl. xxxvii, f. 1.
Euglypha cristata var. *major*
Wailes and Penard in Proc. R. Irish Acad. XXXI, lxv (1911), pp. 40 (note), 62.
Wailes in Scott. Natur. 1912, pp. 61, 63-64; in Jrn. Linn. Soc., Zool. XXXII (1912), pp. 125, 144, 146-147, pl. xii, f. 31.

Test larger than in the type, usually glabrous; the constriction of the neck slight or absent; plasma and pseudopodia as in the type.

Length 70–90 μ; diameter 20–24 μ.

Habitat.—Submerged vegetation.

Wales.—Criccieth, Carnarvonshire (*Cash*).

Scotland.—Loch Kirbister, Orkney Islands.

Ireland.—Caher Island, Mayo; Inishbofin, Galway.

This variety occurs in the United States in a smaller and rather more robust form; length 60–70 μ, diameter 21–24 μ, and the larger forms occasionally are furnished with spines (v. Leidy), which, however, have always been absent in the British individuals recorded up to the present time.

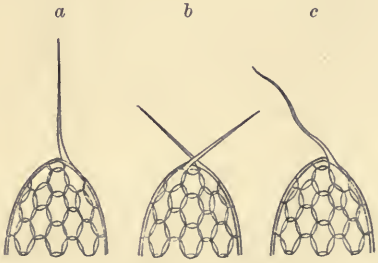

Fig. 115.—Types of spines of *Euglypha cristata* var. *acicularis*. × 450.

Var. **acicularis** Wailes. (Fig. 115.)

Euglypha cristata var. *acicularis*
Wailes in Jrn. Linn. Soc., Zool. XXXII (1912), pp. 144, 147, pl. xii, ff. 32, 33. (*Vide* Proc. R. Irish Acad. XXXI, lxv, p. 40 (note).)

Test larger than in the type; fundus slightly more acute and furnished with one or two long spines which are frequently flexuous; plasma and pseudopodia similar to those of the type.

Length 75–95 μ; diameter 23–24 μ; aperture 10–14 μ; spines 23–40 μ in length.

Habitat.—Submerged sphagnum.

Ireland.—Clare Island, Mayo; Inishbofin, Galway.

When two spines are present they are inclined in opposite directions (fig. 115 *b*), when there is only one spine it may be inclined (fig. 115 *c*), or, as is generally the case, bent near its base so as to lie in the line of the longitudinal axis of the test (fig. 115 *a*); the scales which furnish the spines are a little distance away from the apex and are not terminal scales as in *E. mucronata* Leidy.

From *E. cristata* var. *major* the test differs in possessing a more acute apex and in the possession of the characteristic spines.

It can hardly be confused with *E. mucronata* Leidy, which has a quite differently shaped test and an apical spine.

5. **Euglypha mucronata** Leidy.

(Plate XXXIV, fig. 5, and fig. 116 in text.)

Euglypha mucronata
Leidy in Proc. Acad. Philad. 1878, p. 172; *cp. cit.* 1879, p. 163; Freshw. Rhiz. N. Amer. (1879), pp. 219–220, 290, pl. xxxvii, ff. 11–14.
Parona in Boll. Scient. II (1880), p. 47.
Hitchcock Synops. Freshw. Rhiz. (1881), p. 37.
Blochmann Mikr. Thierw. Süsswass. (1886), p. 14; ed. 2 (1895), p. 18.
Certes in Mission scient. Cap Horn, VI (1889), p. 20.
Schewiakoff in Mém. Acad. St. Pétersb. (7) XLI, viii (1893), p. 98.
Eyferth Einfach. Lebensf., ed. 3 (1900), p. 267.
West in Jrn. Linn. Soc., Zool. XXVIII (1901), p. 328.
Penard Faune Rhiz. Léman (1902), p. 577, f. 10 (p. 572).
Daday in Zoologica, XVIII, xliv (1905), p. 20.
Odell in Ottawa Natur. XIX (1905), p. 19.
Wailes & Penard in Proc. R. Irish Acad. XXXI, lxv (1911), p. 36.
Wailes in Jrn. Linn. Soc., Zool. XXXII (1912), pp. 125, 144, 149.
Schmidt in Arch. Protist. XXIX (1913), pp. 221, 226.
Euglypha a
Vejdovsky (pars) Thier. Org. Brunnenw. Prag (1882), p. 38, pl. ii, f. 1 d.
Euglypha cristata forma *β*
Averintzeff in Trudui S.-Peterb. Obshch. XXXVI, ii (1906), pp. 285–287.

Test of medium size, elongated, not compressed; the fundus conical, about one third the length of the test, thence tapering to the aperture; the apex furnished with one or two terminal spines; the aperture

circular bordered by a single row of 6 to 8 denticulated scales; plasma normal.

Length (without spine) 100–140 μ; diameter 32–60 μ; aperture 15–20 μ; spine 12–44 μ in length.

Habitat.—Submerged sphagnum.

ENGLAND.—Hawkeshead, Lancashire (*West*).

This species was first recorded from New Jersey, U.S.A. The size of the individual recorded from England by West was 123 μ in length and 60 μ in breadth; this breadth is greater than observed by Leidy or myself in United States specimens.

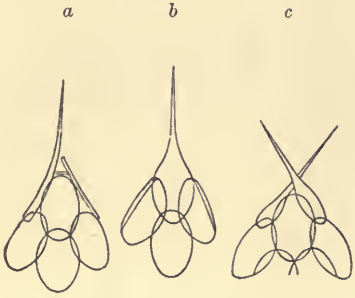

FIG. 116.—Spines of *Euglypha mucronata*. × 1000. *a*, narrow view; *b*, broad view; *c*, double spine.

The terminal spine is usually single but may be double; it may be straight or slightly curved, inclined or coincident with the axis of the test; a single straight spine about 23 μ in length is the typical form at Lakehurst, N.J.

In the accompanying figures (fig. 116 *a–c*) is shown how the spines originate from the terminal scale or scales of the test; the apex is completely closed by the accurate fitting together of the adjoining scales and by a transverse diaphragm placed across the apex at the base of the spine; the spines are oval in section at the base, about 2 μ in breadth and 1·25 μ in thickness; the aperture scales are rounded with three raised blunt denticulations on each.

No active individuals were observed by me nor does

Leidy appear to have seen any; among his illustrations are two tests containing cysts, and he records the occurrence of two glabrous tests. This species is easily recognizable and can hardly be confounded with any other species of *Euglypha*. Leidy states that it is not infrequent in sphagnum bogs, but it appears to be rare at Lakehurst, N.J., where it occurs in association with *E. brachiata* Leidy.

6. **Euglypha brachiata** Leidy.

(Plate XXXIV, fig. 3, and Pl. XXXV, fig. 11.)

Euglypha brachiata

Leidy in Proc. Acad. Philad. 1878, p. 172; *op. cit.* 1879, p. 163; 1880, p. 339; (pars) Freshw. Rhiz. N. Amer. (1879), pp. 220–221, 290, pl. xxxvii, ff. 5, 6, 8–10.

Parona in Boll. Scient. II (1880), p. 47.

Hitchcock Synops. Freshw. Rhiz. (1881), p. 37.*

Schewiakoff in Mém. Acad. St. Pétersb. (7) XLI (1893), viii, p. 98.

Eyferth Einfach. Lebensf., ed. 3 (1900), p. 267.

West in Jrn. Linn. Soc., Zool. XXVIII (1901), p. 328.

Scharff in Irish Natur. XI (1902), p. 26.

Certes in Mem. Acc. Lincei, XXI (1903), p. 293.

Daday in Zoologica, XVIII (1905), xliv, p. 19.

Murray in Proc. Roy. Soc. Edinb. XXV (1905), p. 615; in Ann. Scott. Nat. Hist. 1907, p. 96; in Bathym. Surv. Scott. Lochs, I (1910), p. 326.

Odell in Ottawa Natur. XIX (1905), p. 19.

Evans in Proc. R. Phys. Soc. Edinb. XVII (1907), table 1.

Thiébaud in Ann. Biol. lacustre, III (1908), p. 66.

Brown in Naturalist, 1910, p. 93; in Brit. Assoc. Handb. Sheffield (1910), p. 501.

Penard in Brit. Antarct. Exped. I (1911), pp. 220, 233–235, pl. xxii, f. 4.

Wailes & Penard in Proc. R. Irish Acad. XXXI, lxv (1911), pp. 36, 38, 59.

Wailes in Jrn. Linn. Soc. XXXII (1912), pp. 125, 146, pl. xii, ff. 28–30.

Edmondson in Univ. Colorado Stud. IX (1912), p. 69.

Popoff in Arch. Protist. XXV (1912), p. 10.

Cunha in Mem. Inst. Oswaldo Cruz, V (1913), p. 102.

Euglypha

Delage & Hérouard Traité Zool. concrète, I (1896), f. 137.

Euglypha cristata forma γ.

Averintzeff in Trudui S.-Peterb. Obshch. XXXVI, ii (1906), p. 287.

Test of medium size, elongate, not compressed, slightly constricted near the centre; fundus somewhat acute; aperture circular, bordered by a double

* In first line of description "with" is evidently an error for "without."

row of 6 or 7 slightly-incurved, denticulated scales; the neck furnished with 2 to 6 long recurved spines arising from scales situated among the three rows adjoining the aperture; the spines generally acicular but sometimes ribbon-shaped; a second row may rarely be present; body-scales circular or sub-circular; nucleus large, placed posteriorly; plasma and pseudopodia normal.

Length 92–120 μ; diameter 30–37 μ; aperture 12–15 μ; length of spines 50–65 μ; nucleus 16–20 μ in diameter.

Habitat.—Submerged sphagnum.

England.—Hawes Water, Westmorland, and Sheffield district, W. Yorkshire (*Brown*).

Wales.—Capel Curig, Carnarvonshire (*West*).

Scotland.—Loch Ness, Inverness-shire (*Murray*); Forth area (*Evans*, *Murray*).

Ireland.—Lakes east of Recess, Galway (*West*).

Tests of this species with ribbon-shaped or flattened spines are rarer than those with acicular spines.

In the United States is found var. *librata* Wailes, which is furnished with oar-shaped appendages arising from the median portion of the test. (Leidy, Freshw. Rhiz. N. Amer., pl. xxxvii, f. 7; Wailes, in Jrn. Linn. Soc., Zool. XXXII, pl. xii, f. 29.)

7. **Euglypha bryophila** Brown.

(Plate XXXIV, fig. 4, and Pl. XXXV, figs. 9 and 10.)

Euglypha cristata
Penard (pars) in Mém. Soc. Genève, XXXI (1890), II, pl. ix, ff. 91, 92.

Euglypha bryophila
Brown in Jrn. Linn. Soc., Zool. XXXII (1911), pp. 82–83, pl. ix, ff. 14, 15; in Ann. Scott. Nat. Hist. 1911, p. 231; in Scott. Natur. 1912, p. 112; 1913, pp. 208, 210.
Wailes & Penard in Proc. R. Irish Acad. XXXI, LXV (1911), pp. 17, 36, 38–39, 61, pl. iii, f. 17 *a–c*.
Wailes in Naturalist, 1913, p. 147.

Euglypha a
Vejdovsky (pars) Thier. Org. Brunnenw. Prag (1882), p. 38, pl. ii, f. 1 c.

Test small, hyaline, oviform, slightly compressed; apex bearing a tuft of divergent spines 3 to 6 in number; aperture circular, bordered by a single row of 8 denticulated or pointed scales; body-scales oval, slightly imbricated, arranged in alternating longitudinal rows; nucleus small, with a single nucleole placed posteriorly; plasma and pseudopodia normal.

Length 35–52 μ; breadth 0·5 to 0·6 of the length; thickness 0·8 to 0·85 of the breadth; aperture 7 to 10 μ; body-scales 7 to 9 μ long, 5 μ wide; spines 12 to 17 μ in length; nucleus 4–6 μ in diameter.

Habitat.—Mosses.

England.—Isle of Man; Yorkshire; Derbyshire (*Brown*); Shropshire; Bedfordshire; Cornwall.

Scotland.—Inverness-shire, Aberdeenshire, Perthshire, Argyllshire, Isle of May, Ayrshire, and Wigtownshire (*Brown*).

Ireland.—Roonah and Clare Island, Mayo; Kerry.

8. **Euglypha filifera** Penard.

(Plate XXXIV, figs. 6–8; Pl. XXXV, figs. 12 and 13; and fig. 117 in text.)

Euglypha setigera
Perty (pars) Kenntn. kleinst. Lebensf. (1852), p. 187, p. viii, f. 19 *a*.
Euglypha ciliata
Leidy (pars) Freshw. Rhiz. N. Amer. (1879), pp. 215, 216, pl. xxxvi, ff. 7, 11–13; pl. xxxvii, f. 28.
Euglypha filifera
Penard in Mém. Soc. Genève, XXXI, 1, ii (1890), pp. 179–180, pl. ix, ff. 69–73; in Jahrb. nassau. Ver. Naturk. XLIII (1890), p. 71; Faune Rhiz. Léman (1902), p. 510, 4 figs.; in Brit. Antarct. Exped. I (1911), pp. 220, 236.
Zschokke in Nouv. Mém. Soc. Helvet. XXXVII (1900), pp. 55, 56.
Levander in Acta Soc. Fauna Fenn. XX (1900), viii, p. 12.
Averintzeff in Trudui S.-Peterb. Obshch. XXXVI (1906), ii, p. 291.
Schouteden in Ann. Biol. lacustre, I (1906), pp. 366, 368, f. 43.
Heinis in Arch. Hydrobiol. V (1910), p. 109.
Brown in Ann. Scott. Nat. Hist. 1911, p. 229; in Naturalist, 1912, p. 181; in Scott. Natur. 1912, p. 112; 1913, p. 208.
Wailes & Penard in Proc. R. Irish Acad. XXXI, lxv (1911), pp. 17, 36, 40, 60, 61.
Edmondson in Univ. Colorado Stud. IX (1912), p. 69.
Wailes in Scott. Natur. 1912, p. 61; in Jrn. Linn. Soc. XXXII (1912), pp. 125, 160; *loc. cit.* (1913), p. 213; in Naturalist, 1913, p. 147.

Test small, elongate oviform, slightly compressed; the lateral margins and crown furnished with a few long, acicular spines arranged in a single, or rarely a double, row at regular distances, attached to the test by small hemispherical nodules; aperture circular, bordered by eight finely-serrated scales; body-scales oval; nucleus large, containing several nucleoles; plasma and pseudopodia normal.

Length 55–70 μ; breadth 25–35 μ; thickness 0·6 to 0·8 of the breadth; aperture 10–14 μ; length of spines 13–23 μ; body-scales 9–10 μ long, 4·5–5 μ wide.

Figs. 117–119.—*Euglyphæ* figured by Perty (Kennt. kleinst. Lebensf.). 117, *E. filifera* (*setigera* Perty); 118, *E. lævis* Perty; 119, *E. ciliata* (*setigera* Perty).

Habitat.—Sphagnum and submerged vegetation.

England.—Cumberland and Lancashire (*Brown*); Yorkshire; Derbyshire (*Brown*); Bedfordshire; Isle of Wight; Devonshire.

Wales.—Cader Idris, Merionethshire (*Cash*).

Scotland.—Shetlands; St. Kilda (Outer Hebrides), Inverness-shire, Elginshire, Aberdeenshire, Perthshire, Argyllshire, Isle of May, Ayrshire, and Wigtownshire (*Brown*).

Ireland.—Armagh; Clare Island and mainland, Mayo; Galway; Kerry.

The spines, which are generally arranged in a single row, may be either solitary, and usually 6 to 10 in number, or in pairs and even in tufts of 3 or 4; in Europe the disposal of the spines in a double row is rare, but in North America it is not uncommon.

In the United States individuals up to 85 μ in length are not rare, and 93 μ is sometimes attained. A small form, var. *pyriformis* Wailes, which has a distinct neck, occurs there; also var. *spinosa* Wailes, which has long spines all over the test.

9. **Euglypha strigosa** (Ehrenberg) Leidy.

(Plate XXXVI, figs. 1–6; Pl. XXXIX, figs. 1–4; and fig. 120 in text.)

Difflugia strigosa
Ehrenberg in Abh. Akad. Berlin, 1871 (1872), pp. 143, 257, pl. ii B, f. 31.
Difflugia Setigerella strigosa
Ehrenberg in Abh. Akad. Berlin, 1871 (1872), p. 247.
Euglypha strigosa
Leidy in Proc. Acad. Philad. 1878, p. 172; *op. cit.* 1880, pp. 336, 339.
Parona in Boll. Scient. II, pp. 47, 48.
Maggi in Rend. R. Ist. Lomb. (2) XXI (1888), p. 301.
Penard in Mém. Soc. Genève, XXXI, 1, II (1890), p. 179, pl. ix, ff. 58–68; in Jahrb. nassau. Ver. Naturk. XLIII (1890), p. 71; in Arch. Sci. nat. (4) VII (1899), p. 269; Faune Rhiz. Léman (1902), pp. 502–504, 5 figs.; in Arch. Protist. II (1903), p. 269; in Brit. Antarct. Exped. I (1911, pp. 220, 236; in Deux. expéd. antarct. franç. (1911), pp. 4, 10.
Averintzeff in Trudui S.-Peterb. Obshch. XXXVI, II (1906), pp. 288–289.
Schouteden in Ann. Biol. lacustre, I (1906), pp. 266, 367, f. 41.
Evans in Proc. R. Phys. Soc. Edinb. XVII (1907), table 1.
Heinis in Zool. Anzeig. XXXIII (1908), p. 713; in Arch. Hydrobiol. V (1910), p. 109; in Rev. Suisse Zool. XIX (1911), p. 255.
Brown in Jrn. Linn. Soc., Zool. XXX (1910), p. 362; in Ann. Scott. Nat. Hist. 1911, pp. 229, 230; in Naturalist, 1912, p. 181; in Scott. Natur. 1912, p. 112; 1913, pp. 208, 210.
Hopkinson in Irish Natur. 1910, p. 3.
Wailes & Penard in Proc. R. Irish Acad. XXXI, LXV (1911), pp. 17, 36, 42, 60, 62.
Edmondson in Univ. Colorado Stud. IX (1912), p. 69.
Wailes in Scott. Natur. 1912, p. 61; in Jrn. Linn. Soc., Zool. XXXII (1912), pp. 125, 149, 160; *loc. cit.* (1913), p 213; in Murray's Nat. Hist. Bolivia and Peru (1913), pp. 32, 37; in Naturalist, 1913, p. 148.
Euglypha ciliata var. *strigosa*
Leidy (pars) Freshw. Rhiz. N. Amer. (1879), pp. 216, 290, pl. xxxv, f. 20.
Averintzeff in Trudui S.-Peterb. Obshch. XXX (1900), I, p. 249.
West in Jrn. Linn. Soc., Zool. XXVIII (1901), p. 327.

Test of medium size, broadly oviform or pyriform, compressed, ciliated; transverse section elliptical; aperture circular, bordered by 10 to 14 denticulated,

thickened scales; nucleus large, containing two or three nucleoles, placed posteriorly; plasma normal; pseudopodia numerous, spreading, frequently branched.

Length 45–100 μ; breadth 30–60 μ; thickness 20–30 μ; aperture 12–23 μ; nucleus 10–20 μ in diameter; cils 5–15 μ in length; body-scales 7–10·5 μ in length, 4·5–5·5 μ in breadth.

Habitat.—Mosses and aquatic vegetation.

England.—Durham; Westmorland (*Cash*, *Brown*); Lancashire (*Cash*); Yorkshire; Derbyshire (*Brown*); Nottinghamshire; Rutlandshire; Shropshire; Bedfordshire; Cambridgeshire; Hertfordshire; Buckinghamshire; Oxfordshire; Hampshire; Isle of Wight; Devonshire; Cornwall; Scilly Islands.

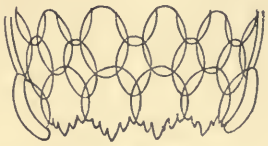

Fig. 120.—Aperture scales of *Euglypha strigosa*. × 1600.

Wales.—Llyn Ogwen (*West*); Llyn Crafnant, Dolgam, Moel Siabod, and Bettwys-y-Coed (*Hopk.*), and Sychnant Pass (*Cash*), Carnarvonshire.

Scotland.—Shetlands; Orkneys (*West*); St. Kilda (*Brown*), Outer Hebrides; Inverness-shire, Elginshire, and Aberdeenshire (*Brown*); Perthshire (*Cash*, *Brown*); Argyllshire and Isle of May (*Brown*); Mid-Lothian and Pentland Hills (*Cash*); Dumfries; Ayrshire, Kirkcudbrightshire, and Wigtownshire (*Brown*).

Ireland.—Armagh; Islands off Clew Bay and mainland, Mayo; Galway; Wicklow (*Hopk.*); Limerick.

This is the most generally distributed and numerous of the *Euglyphæ*, although in some localities *E. ciliata* exceeds it in numbers. The thickened aperture-scales generally suffice for its identification; the circular aperture also distinguishes it from *E. ciliata* and *E. compressa*; the cils are occasionally confined to the

margin of the test but they are usually scattered over its surface; they may be solitary or in pairs; they usually measure 6–10 μ in length.

The denticulations of the aperture-scales (fig. 120) are intermediate in character between those of *E. ciliata* and *E. compressa*; they are less sharp than in the former and less blunt than in the latter; the number of teeth is usually five, but occasionally three or seven occur in each scale, and when viewed in the ordinary position of the test, that is lying on one side, the points appear rounded; this is owing to their incurved form; when they are seen in a plane that is tangential to the points, these are seen to be acute.

Forma **glabra** Wailes. (Plate XXXVI, fig. 4; Pl. XXXIX, fig. 4.)

Euglypha strigosa f. *glabra*
Wailes & Penard in Proc. R. Irish Acad. XXXI. lxv (1911), pp. 37, 42.
Wailes in Jrn. Linn. Soc., Zool. XXXII (1912), pp. 125, 144; *loc. cit.* (1913), p. 213.

Similar to the type but glabrous; plasma and pseudopodia as in the type.

Occurs in similar situations and in association with the type, but is less common.

Forma **heterospina** Penard. (Pl. XXXVI, fig. 5.)

Euglypha ciliata var. *strigosa*
Leidy (pars) Freshw. Rhiz. N. Amer. (1879), p. 216, pl. xxxvii, f. 31.
Euglypha heterospina
Penard in Mém. Soc. Genève, XXXI, 1, ii (1890), p. 180, pl. ix, ff. 74–79.
Euglypha strigosa forma *heterospina*
Wailes & Penard in Proc. R. Irish Acad. XXXI, lxv (1911), pp. 37, 42.
Edmondson in Univ. Colorado Stud. IX (1912), p. 69.
Wailes in Jrn. Linn. Soc., Zool. XXXII (1912), pp. 125, 144; *loc. cit.* (1913), pp. 208, 213; in Murray's Nat. Hist. Bolivia and Peru (1913), pp. 32, 37.

Test similar to that of the type but thickly covered with cils varying in length up to about 20 μ; plasma and pseudopodia normal.

Dimensions similar to those of the type. Occurring in association with it, especially in sphagnum. The cils vary from 6 to 20 μ in length on the same test; the longest are often curved and are the least numerous.

It is widely distributed but not common.

Var. **muscorum** Wailes. (Pl. XXXVI, fig. 6.)

Euglypha ciliata
Leidy (pars) Freshw. Rhiz. N. Amer. (1879), p. 216, pl. xxxvi, f. 18.
Euglypha strigosa var. *muscorum*
Wailes & Penard in Proc. R. Irish Acad. XXXI, lxv (1911), pp. 37, 42.
Wailes in Jrn. Linn. Soc., Zool. XXXII (1912), pp. 125, 144, 150, 160; in Murray's Nat. Hist. Bolivia and Peru (1913), pp. 32, 37.

Test broader in proportion to its length than in the type, and of a more or less pyriform outline in broad view; body-scales small; either glabrous or furnished with short cils; plasma and pseudopodia as in the type.

Length 45–60 μ; breadth 33–45 μ; aperture 12–18 μ in diameter; body-scales about 5 μ in length and 3 μ in breadth.

Usually restricted to mosses, amongst which it is found in association with the type. In the British Isles it appears to be generally distributed.

The test figured by Leidy measures, length 98 μ; breadth 83 μ; aperture 28 μ; which is abnormally large for this variety.

A heterospinous form of the variety occurs but it is very rare.

10. **Euglypha rotunda** Wailes.

(Plate XXXIV, fig. 9; Pl. XXXV, figs. 14–16; and fig. 121 in text.)

Euglypha rotunda
Wailes & Penard in Proc. R. Irish Acad. XXXI, lxv (1911), pp. 17, 41, 60, 61, 62, pl. iv, f. 19 *a–g*.
Penard in Deux. expéd. antarct. franç. (1911), pp. 4, 8–9.
Wailes in Scott. Natur. 1912, p. 61; in Jrn. Linn. Soc., Zool. XXXII (1912), pp. 125, 144, 160; in Murray's Nat. Hist. Bolivia and Peru (1913), pp. 32, 37; in Naturalist, 1913, p, 148.
Brown in Scott. Natur. 1913, pp. 208, 210.

Test small, oviform, moderately compressed, glabrous; aperture circular, bordered by eight pointed scales; body-scales oval, about twice as long as broad, slightly imbricated; plasma and pseudopodia normal; nucleus containing a single nucleole.

Length 22–52 μ; breadth 0·5 to 0·7 of the length; thickness 0·6 to 0·7 of the breadth; aperture 6–12 μ in diameter; body-scales 5–8 μ in length, 2·5 to 4 μ in breadth; nucleus 8–10 μ in diameter.

Habitat.—Mosses in damp and wet situations.

England.—Isle of Man; Yorkshire; Shropshire; Bedfordshire; Cambridgeshire; Hertfordshire; Buckinghamshire; Oxfordshire; New Forest, Hampshire; Isle of Wight; Somersetshire; Devonshire; Cornwall.

Fig. 121.—Forms of aperture-scales of *Euglypha rotunda*. × 1000.

Scotland.—Shetlands; Outer Hebrides; Inverness-shire, Perthshire, and Argyllshire (*Brown*); Skye, Inner Hebrides; Dumfriesshire.

Ireland. — Donegal; Armagh; Mayo; Galway; Limerick; Kerry.

11. **Euglypha lævis** (Ehrenberg) Perty.

(Plate XXXIV, figs. 10–12; Pl. XXXIX, figs. 5–7; and figs. 118 and 122 in text.)

Difflugia lævis

Ehrenberg in Ber. Akad. Berlin, 1845, p. 307; Microgeol. (1856), pp. 12, 33; in Abh. Akad. Berlin, 1871 (1872), pp. 253–254, pl. iii, I, f. 5.

Euglypha lævis

Perty in Mitth. nat. Ges. Bern, 1849, pp. 163, 164, 168; Kenntn. kleinst. Lebensf. (1852), p. 187, pl. viii, f. 18.

Parona in Boll. Scient. II (1880), p. 24.

Maggi in Rend. R. Ist. Lomb. (2) XXI (1888), p. 301.

Penard in Mém. Soc. Genève, XXXI, 1, II (1890), p. 181, pl. ix, ff. 93–96; in Amer. Natur. XXV (1891), p. 1071; in Jahrb. nassau. Ver. Naturk. XLIII (1891), p. 71; in Rev. Suisse Zool. VII (1899), I, p. 110; *op. cit.* IX (1901), p. 237; Faune Rhiz. Léman (1902), pp. 512–513, 2 figs.; in Arch. Protist. II (1903), p. 269; *op. cit.* IX (1909), p. 265; in Brit. Antarct. Exped. I (1911), pp. 204, 207, 220, 236; in Deux. expéd. antarct. franç. (1911), pp. 4, 10.

Levander in Atti. Soc. Ligust. III (1892), p. 145.
Longi in Atti. Soc. Ligust. V (1894), pp. 18–19.
Forel Le Léman, III (1904), p. 137.
Averintzeff in Trudui S.-Peterb. Obshch. XXXVI (1906), II, pp. 293–294; in Zool. Anzeig. XXXI (1907), p. 245.
Schouteden in Ann. Biol. lacustre, I (1906), pp. 367, 368.
Thiébaud in Ann. Biol. lacustre, III (1908), pp. 66, 121.
Heinis in Zool. Anzeig. XXXIII (1908), p. 713; in Arch. Hydrobiol. V (1910), p. 109; in Rev. Suisse Zool. XIX (1911), p. 255.
Kofoid in Bull. Illinois Lab. VIII (1908), p. 112.
Cockerell in Univ. Colorado Stud. VI (1909), p. 306.
Brown in Ann. Scott. Nat. Hist. 1911, pp. 229, 230; in Naturalist, 1912, p. 181; in Scott. Natur. 1912, p. 112; 1913, pp. 208, 210.
Wailes & Penard in Proc. R. Irish Acad. XXXI, LXV (1911), pp. 17, 40–41, 60, 61.
Edmondson in Univ. Colorado Stud. IX (1912), p. 69.
Wailes in Scott. Natur. 1912, p. 61; in Trans. Liverp. Biol. Soc. XXVI (1912), p. 20; in Jrn. Linn. Soc., Zool. XXXII (1912), pp. 125, 144, 160; *loc. cit.* (1913), p. 213; in Murray's Nat. Hist. Bolivia and Peru (1913), p. 27; in Naturalist, 1913, p. 147.

Euglypha alveolata
Leidy (pars) Freshw. Rhiz. N. Amer. (1879), p. 209, pl. xxxv, ff. 11–13.

Euglypha γ
Vejdovsky Thier. Org. Brunnenw. Prag (1882), p. 39, pl. ii, f. 1 *g*, *h*.

Test small, oviform, glabrous; transverse section elliptical to sub-circular; aperture elliptical to sub-circular, bordered by a single row of pointed scales; body-scales oval, slightly imbricated; nucleus containing a single nucleole; plasma and pseudopodia normal.

Fig. 122.—Aperture-scales of *Euglypha lævis*. × 1000.

Length 22–55 μ; breadth 12–30 μ; aperture 5–15 μ; thickness 8–26 μ.

Habitat.—Mosses and sphagnum.

England.—Generally distributed inland; also Isle of Man; Isle of Wight; Scilly Islands.

Wales.—General in North Wales.

Scotland.—Generally distributed inland; also Shetlands; St. Kilda (*Brown*), Outer Hebrides; Isle of May (*Brown*).

Ireland.—Armagh; Clare Island and mainland, Mayo; Galway; Kerry.

Two forms of this species occur; in one the test has an elliptical transverse section and an elliptical aperture, in the other the transverse section and aperture are both sub-circular; but the pointed aperture-scales (fig. 122) are always characteristic and distinguish it from small glabrous forms of other species and from *E. rotunda*.

12. **Euglypha ciliata** (Ehrenberg) Leidy.

(Plate XXXVII; Pl. XXXVIII, figs. 1–7; Pl. XXXIX, figs. 8–11; and figs. 119, 123, and 124 in text.)

Difflugia ciliata
Ehrenberg in Ber. Acad. Berlin, 1848, p. 379; in Abh. Akad. Berlin, 1871 (1872), p. 143, pl. ii B, f. 26.
Euglypha setigera
Perty (?) in Math. nat. Ges. Bern, 1849, p. 158; (pars) Kenntn. kleinst. Lebensf. (1852), p. 187, pl. viii, f. 19 *b*.
Maggi (?) in Rend. R. Ist. Lomb. (2) IX (1876), p. 543; in Atti Soc. Ital. XXI (1878), p. 319.
Zacharias in Forschb. Plon, X (1903), pp. 241–242, pl. viii, f. 19.
Difflugia pilosa
Ehrenberg Microgeol. (1854), pl. xxxiv, v B, f. 6; in Abh. Acad. Berlin, 1871 (1872), pl. ii B, f. 28.
Difflugia Setigerella ciliata
Ehrenberg in Abh. Acad. Berlin, 1871 (1872), p. 247.
Difflugia Setigerella pilosa
Ehrenberg in Abh. Acad. Berlin, 1871 (1872), p. 247.
Euglypha ciliata
Leidy (pars) in Proc. Acad. Philad. 1878, p. 172; *op. cit.* 1879, p. 163; 1880, p. 339; (pars) Freshw. Rhiz. N. Amer. (1879), pp. 214–218, pl. xxxvi, ff. 8–10, 16, 17, 20–22; pl. xxxvii, f. 30.
Hitchcock Synops. Freshw. Rhiz. (1881), pp. 36-37.
Penard (pars) in Mém. Soc. Genève, XXXI, 1, II (1890), pp. 178–179, pl. ix, ff. 41–48; in Jahrb. nassau. Ver. Naturh. XLIII (1890), p. 71; in Amer. Natur. XXV (1891), pp. 1071, 1075; in Rev. Suisse Zool. IX (1901), p. 237; Faune Rhiz. Léman (1902), pp. 499–502, 3 figs.; in Arch. Protist. II (1903), p. 269; in Proc. Roy. Soc. Edinb. XXV (1905), p. 596; Sarcodinés in Cat. Invert. Suisse, pp. 101–102; in Jrn. R. Micr. Soc. 1907, p. 278; in Arch. Protist. XVII (1909), p. 265; in Brit. Antarct. Exped. I (1911), pp. 220, 235; in Deux. expéd. antarct. franç. (1911), pp. 4, 9.
Lord (pars) in Sci. Gossip, XXVII (1891), pp. 267, 268, ff. 217, 218.
Cash in Trans. Manch. Micr. Soc. 1891 (1892), p. 52, pl. ii, f. 29.
Schewiakoff in Mém. Acad. St. Pétersb. (7) XLI (1893), VIII, pp. 6, 78, 98.
Fričˇ & Vávre in Arch. Landesf. Böhmen, X (1897), pp. 46–69 *passim*, f. 17.
Scourfield in Proc. Zool. Soc. Lond. 1897, p. 788.
André in Jahresb. Ges. Graubünd. (N. F.) XLI (1898), pp. 58, 59.

Averintzeff in Trudui S.-Peterb. Obshch. XXX, I (1900), p. 240; *op. cit.* XXXVI, II (1906), pp. 287–288.
Zschokke in Nouv. Mém. Soc. Helvet. XXXVII (1900), pp. 53, 55, 56, 59.
Levander in Acta Soc. Fauna Fenn. XX, VIII (1901), pp. 8, 11, 12.
Daday (pars) in Zoologica, XVIII, XLIV (1905), p. 19; in Math. Termész. értes. XXV (1907), pp. 405, 418; in Zoologica, XXXIII, LIX (1910), p. 13.
Murray in Proc. Roy. Soc. Edinb. XXV (1905), p. 615; in Ann. Scott. Nat. Hist. 1907, p. 95; in Bathym. Surv. Scott. Lochs, I (1910), p. 326.
Schouteden in Ann. Biol. lacustre, I (1906), pp. 366, 367, f. 40.
Brown in Naturalist, 1909, p. 107; in Jrn. Linn. Soc., Zool. XXX (1910), p. 362; in Brit. Assoc. Handb. Sheffield (1910), pp. 500, 501; in Ann. Scott. Nat. Hist. 1911, pp. 229, 230; in Naturalist, 1912, p. 60; in Scott. Natur. 1912, p. 112; 1913, pp. 208, 210.
Hopkinson in Irish Natur. 1910, p. 3.
Wailes & Penard in Proc. R. Irish Acad. XXXI, LXV (1911), pp. 17, 36, 38, 60, 61, 62.
Edmondson in Univ. Colorado Stud. IX (1912), p. 69.
Wailes in Scott. Natur. 1912, p. 60; in Jrn. Linn. Soc., Zool. XXXII (1912), pp. 125, 144, 160; *loc. cit.* (1913), p. 213; in Murray's Nat. Hist. Bolivia and Peru (1913), pp. 32, 37; in Naturalist, 1913, p. 147.
Schmidt in Arch. Protist. XXIX (1913), p. 221.

Test of medium size, oviform, compressed; elliptical in transverse section; usually furnished with short cils which may be confined to the margins or distributed over the surface of the test, occasionally glabrous; aperture oval, bordered by 8 to 14 scales, with three or five denticulations in each; body-scales oval; nucleus large, containing one large or a few small nucleoles; plasma and pseudopodia normal.

Length 40–90 μ; breadth 24–60 μ; aperture 10–23 μ in length and 7–16 μ in breadth; thickness 18–36 μ; nucleus 10–20 μ in diameter; cils 6–10 μ in length.

Habitat.—Mosses, sphagnum, and aquatic vegetation.

England. — Generally distributed. Cumberland, Westmorland, and Lancashire (*Brown*).

Wales.—North Wales, general! (*Cash*, *Hopk.*, *West*).

Scotland. — Generally distributed inland; also Shetlands, Orkneys, and Outer Hebrides (*West*); St. Kilda (*Brown*); Isle of May (*Brown*, *Murray*).

Ireland. — Donegal; Armagh; Mayo; Wicklow (*Hopk.*); Limerick; Kerry.

Leidy records as *E. ciliata* individuals belonging to

several spined or ciliated species of *Euglypha*, and his example has been followed by many observers, hence the records of this species are disproportionately numerous; generally *E. strigosa* is the more numerously represented, but gatherings of moss are occasionally

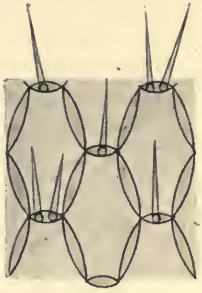

Fig. 123.—Body-scales and spines of *Euglypha ciliata*. × 2000.

found in which *E. ciliata* is the prevalent species; in its larger forms it is distinguished from *E. compressa* by its oval transverse section, denticulated aperture-scales, and its smaller body-scales; small glabrous individuals are distinguished from *E. lævis* by the denticulated aperture-scales (fig. 124) and larger and more broadly-oval body-scales (fig. 123). The ellip-

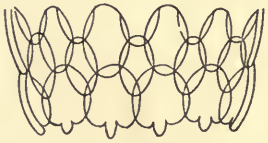

Fig. 124.—Aperture-scales of *Euglypha ciliata*. × 1600.

tical aperture distinguishes it from *E. strigosa* which invariably possesses a circular one. Tests of that species which have been slightly crushed accidentally can usually be identified by the thickened aperture-scales, but if these, as may rarely happen, are of the same thickness as the other scales of the test, and there is no trace of a neck, such crushed tests of *E. strigosa* cannot be distinguished from those of *E. ciliata*. This

difficulty is of course usually only experienced with distorted empty tests; if the animals are active and healthy their identification presents no difficulty.

If freshwater algæ are carefully collected, individuals belonging to this species or to *E. strigosa* may frequently be watched creeping along the filaments or branches.

Forma **glabra** f. nov. (Pl. XXXVIII, fig. 4; Pl. XXXIX, figs. 8–11.)

Test as in the type but glabrous; plasma and pseudopodia normal.

Found in association with typical individuals, but rather scarce.

Forma **heterospina** f. nov. (Pl. XXXVII, fig. 3; Pl. XXXVIII, fig. 6.)

Euglypha ciliata
Leidy (pars) Freshw. Rhiz. N. Amer. (1879), p. 216, pl. xxxvi, ff. 16, 17.

Test as in the type, but thickly covered with cils of various lengths; plasma and pseudopodia normal.

Found in sphagnum, but rare. The cils vary from 5 to 18 μ in length, the longer ones are often curved; they are similar in appearance and disposition to those of *E. strigosa* var. *heterospina*, which, however, is much more frequently observed than this variety.

The following references may pertain to this or to an allied ciliated species such as *E. strigosa* :—

Euglypha ciliata
Parona in Boll. Scient. II (1880), pp. 47, 48.
Taránek in Sitzber. böhm. Ges. Wiss. 1881, p. 234; in Abh. böhm. Ges. Wiss. (6) XI, viii (1882), p. 33.
Tarr in Rep. N. York State Mus. XXXV (1884), p. 167.
Greeff in Sitzber. Ges. nat. Marburg, 1888, pp. 113–115.
Harvey in Amer. Natur. XXII (1888), p. 73.
Maggi in Rend. R. Ist. Lomb. (2) XXI (1888), p. 302.
Certes in Mission scient. Cap Horn, VI, Prot. (1889), p. 20.
Perry in Proc. Amer. Micr. Soc. XII (1891), p. 95.
Lord in Trans. Manch. Micr. Soc. 1891 (1892), p. 56; *op. cit.* 1904 (1905), p. 56.
Levander in Acta Soc. Fauna Fenn. XII, ii (1894), pp. 6, 21; *op. cit.* XVIII, vi (1900), p. 33.

Daday in Termész. Füzetek, XX (1897), pp. 183, 185; in Anh. Termész. Füzetek, XXI (1898), pp. 6, 9; in Horváth's Zool. Ergebn. Zichy (1901), pp. 215, 387; in Zool. Jahrb., Syst. XIX (1903), p. 42.
Entz in Res. Erforsch. Balatons. II, 1 (1897), p. xxiv; in Math. Termész. értes. XV (1897), pp. 172, 173, 178; in Math. nat. Ber. Ungarn, XV (1899), pp. 183, 184, 188.
Eyferth Einfach. Lebensf., ed. 3 (1900), pp. 266–267.
Lagerheim in Geol. Fören. Stockholm Förh. XXIII (1901), 6, p. 472.
West in Jrn. Linn. Soc., Zool. XXVIII (1901), p. 327; in Ann. Scott. Nat. Hist. 1905, pp. 90, 91, 92.
Cushman & Henderson in Amer. Natur. XXXIX (1904), p. 154.
Odell in Ottawa Natur. XIX (1905), p. 19.
Cushman in Amer. Natur. XL (1906), p. 373.
Thallwitz in Ann. Biol. lacustre, I (1906), p. 260.
Evans in Proc. R. Phys. Soc. Edinb. XVII (1907), table 1.
Heinis in Zool. Anzeig. XXXIII (1908), p. 713; in Arch. Hydrobiol. V (1910), p. 108; in Rev. Suisse Zool. XIX (1911), p. 255.
Hoogenraad in Tijds. Nederl. Dierk. Ver. (2) X (1908), pp. 413, 424.
Kofoid in Bull. Illinois Lab. VIII (1908), p. 112.
Landacre in Proc. Ohio Acad. IV (1908), p. 429.
Richters in Zool. Jahrb., Syst. XXVI (1908), pp. 198, 210.
Thiébaud in Ann. Biol. lacustre, III (1908), p. 66.
Cockerell in Univ. Colorado Stud. VI (1909), p. 306.

13. **Euglypha compressa** Carter.

(Plate XXXVIII, figs. 8–10; Pl. XXXIX, figs. 12–15; and figs. 125–127 in text.)

Euglypha compressa
Carter in Ann. Nat. Hist. (3) XIII (1864), pp. 32–33, pl. i, f. 13.
Parfitt in Trans. Devon. Assoc. III (1869), p. 67.
Leidy in Proc. Acad. Philad. 1874 (1875), p. 226.
Schulze in Arch. mikr. Anat. XI (1875), pp. 101–102, pl. v, ff. 3, 4.
Maggi in Rend. R. Ist. Lomb. (2) IX (1876), p. 543; in Atti Soc. Ital. XXI (1879), p. 319.
Parona in Boll. Scient. II (1880), pp. 47, 48.
Penard in Mém. Soc. Genève, XXXI, 1, II (1890), p. 181, pl. ix, ff. 80–84; in Amer. Natur. XXV (1891), p. 1071; Faune Rhiz. Léman (1902), pp. 507–510, 7 figs.; in Arch. Protist. II (1903), pp. 269–271, f. xi (1, 2); *op. cit.* IX (1909), p. 265; in Brit. Antarct. Exped. I (1911), pp. 207, 220, 235; in Deux. expéd. antarct. franç. (1911), pp. 4, 9–10.
Prowazek in Arb. zool. Inst. Wien, XII (1900), p. 298, pl. i, f. 12.
Averintzeff in Trudui S.-Peterb. Obshch. XXXVI (1906), II, pp. 289–290.
Schouteden in Ann. Biol. lacustre, I (1906), pp. 366, 367.
Heinis in Zool. Anzeig. XXXIII (1908), p. 713; in Arch. Hydrobiol. V (1910), p. 109; in Rev. Suisse Zool. XIX (1911), p. 255.
Murray in Bathym. Surv. Scott. Lochs, I (1910), p. 326.
Brown in Jrn. Linn. Soc., Zool. XXX (1910), pp. 362, 366, pl. 1, ff. 11, 12; in Brit. Assoc. Handb. Sheffield (1910), p. 500; in Ann. Scott. Nat. Hist. 1911, pp. 229, 231; in Naturalist, 1912, p. 181; in Scott. Natur. 1912, p. 112; 1913, pp. 208, 210.

Wailes & Penard in Proc. R. Irish Acad. XXXI, lxv (1911), pp. 17, 39–40, pl. iii, f. 18 *a*, *b*.
Wailes in Scott. Natur. 1912, p. 61; in Jrn. Linn. Soc., Zool. XXXII (1912), pp. 125, 144, 160; *loc. cit.* (1913), p. 213; in Naturalist, 1913, p. 147.

Euglypha ampullacea
Hertwig & Lesser in Arch. mikr. Anat. X (1874), Suppl., pp. 123–124, 132, pl. iii, f. 6.
Archer in Qrt. Jrn. Micr. Sci. (n. s.) XVII (1877), p. 203, pl. xiii, f. 7; in Proc. Dublin Micr. Club, III, 3 (1880), p. 273, pl. x, f. 7.
Eyferth Einfach. Lebensf. (1878), p. 34; ed. 2 (1885), p. 52.
Blochmann Mikr. Thierw. Süsswass (1886), pp. 13–14; ed. 2 (1895), p. 17.
Francé in Res. Erforsch. Balatons. II (1897), i, p. 10.
Averintzeff in Trudui S.-Peterb. Obshch. XXX (1900), i, p. 249; *op. cit.* XXXVI (1906), ii, pp. 289–290.
Murray in Proc. Roy. Soc. Edinb. XXV (1905), p. 615.
Schmidt in Arch. Protist. XXIX (1913), p. 220.

Euglypha ciliata
Leidy (pars) Freshw. Rhiz. N. Amer. (1879), p. 216, pl. xxxvi, ff. 1–6, 15; pl. xxxvii, f. 29.
Penard (pars) in Mém. Soc. Genève, XXXI (1890), ii, pl. ix, ff. 49–53.
Daday (pars) in Zoologica, XVIII, xliv (1905), p. 19.

Euglypha a
Vejdovský (pars) Thier. Org. Brunnenw. Prag (1882), p. 38, pl. ii, f. i a, b.

? Euglypha zonata
Maggi in Rend. R. Ist. Lomb. (2) XXI (1888), p. 310, pl., f. 7.

Test large, broadly oviform, truncate, considerably compressed; transverse section lenticular with acute margins; aperture elliptical, bounded by a single row of bluntly-denticulated or lobed scales; test furnished with spines on the margin only, arising at regular intervals either singly or in tufts of two or three; body-scales oval, large; nucleus large, containing several nucleoles; plasma and pseudopodia normal.

Fig. 125.—Forms of aperture-scales of *Euglypha compressa*. × 1000.

Length 70–132 μ; breadth 40–80 μ; aperture 18–28 μ; thickness 20–45 μ; body-scales 9–12 μ in length; spines 5–35 μ in length.

Habitat.—Sphagnum and aquatic vegetation.

England.—Durham; Cumberland, Westmorland,

and Lancashire (*Brown*); N. and W. Yorkshire; Derbyshire (*Brown*); Rutlandshire; Bedfordshire; Cambridgeshire; Essex (*Scourfield*); Buckinghamshire; Isle of Wight; Devonshire; Cornwall.

Wales.—Frequent in North Wales.

Scotland.—Shetlands; St. Kilda (*Brown*); Outer Hebrides; Loch Ness, Inverness-shire (*Penard, Brown*); Elginshire, Aberdeenshire, Perthshire, and Argyllshire (*Brown*); Skye, Inner Hebrides; Isle of May, Bass Rock, and Wigtownshire (*Brown*).

Ireland.—Clare Island and mainland, Mayo; Galway.

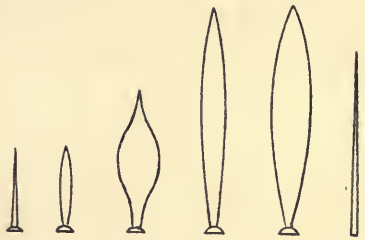

Fig. 126.—Various types of spines of *Euglypha compressa*; the last figure a side view. × 1000.

The spines (fig. 126) vary greatly in length and shape but are always of a stout form; they may be slightly flattened, lanceolate, or even spathulate, but are always arranged so that the narrow edges only are seen when viewed from the direction of the fundus of the test. The aperture varies in shape from narrowly to broadly oval. The thickness of the test may vary from one half to five sixths of the breadth, but is usually about one half.

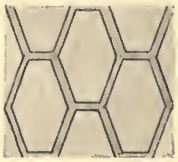

Fig. 127.—Hexagonal appearance occasionally seen in tests of *Euglypha compressa*. × 1000.

Forma **glabra** f. nov. (Pl. XXXVIII, f. 10.)

Euglypha ciliata
Leidy (pars) Freshw. Rhiz. N. Amer. (1879), pp. 216, 217, pl. xxxvi, f. 23.

Test as in the type but devoid of spines; plasma and pseudopodia as in the type.

This form is not very rare and is found usually in association with normal spined individuals.

The hexagonal plates as drawn by Leidy represent the chitinous cement joining the oval scales together (fig. 127); in this species the cement is abnormally thick and distinct as explained by Penard (v. 'Faune Rhiz. Léman' (1902), p. 508, ff. 4, 5).

14. **Euglypha denticulata** Brown.

(Plate XXXVI, figs. 7–13.)

Euglypha denticulata
Brown in Naturalist, 1912, p. 181; in Scott. Natur. 1912, pp. 111, 112, pl. v, ff. 5–11.
Wailes in Jrn. Linn. Soc., Zool. XXXII (1913), p. 213.

Test small, glabrous, in broad view ovoid and not infrequently unsymmetrical, compressed, formed of elliptical, imbricated scales in alternating longitudinal rows; transverse section elliptical; aperture small, elliptical, about twice as long as broad, with an irregularly-dentate border formed of eight or nine pointed scales; plasma colourless, granular; nucleus containing a central nucleole, placed posteriorly; pseudopodia numerous, straight, divergent, extremely fine.

Length 23–49 μ (usually 36–46 μ); breadth 15–36 μ; aperture 6·5–10 μ; thickness one half to two thirds of the breadth; nucleus 8–12 μ in diameter; nucleole about 3·5 μ; scales of a medium-sized test (length 42 μ) 6 μ × 3 μ.

Habitat.—Ground moss.

England.—Cumberland, Westmorland, and Lancashire (*Brown*); Yorkshire; Surrey (*Brown*).

Scotland.—St. Kilda, Outer Hebrides; Aberfoyle, Perthshire; and Isle of May (*Brown*).

Ireland.—Mayo.

Owing to the small size and transparency of the test the details of its construction are not easily seen; in its often unsymmetrical outline and irregular aperture it closely resembles *Assulina muscorum* when the coloured membrane which lines the test and forms the irregular margin of the aperture in that species is wanting or is dissolved away; the often irregular arrangement of the scales near the fundus and aperture of the test is another point of resemblance between the two species; the similarity of the nuclei is also very evident. Taking all these points into consideration it might perhaps be considered a variety of *Assulina muscorum* rather than a true *Euglypha*.

It is very widely distributed and in our experience always associated with *A. muscorum*.

It occurs on the continent of Europe, in N. and S. America, and in Java.

Genus 33. **PLACOCISTA*** Leidy, 1879.

Euglypha Carter (pars) in Ann. Nat. Hist. (3) XV (1865), p. 290.
Placocista Leidy Freshw. Rhiz. N. Amer. (1879), p. 221.
Placocysta Blochmann Micr. Thierw. Süsswass., ed. 1 (1886), p. 14.

Test ovoid, hyaline, compressed; lenticular in transverse section; composed of oval or subcircular silicious scales regularly imbricated; aperture wide, linear, with flexible undulate borders; nucleus large, placed posteriorly; contractile vesicles two or more; plasma grey or colourless, partially filling the test, the central zone loaded with granules, and may contain *Zoochlorellæ* living symbiotically; pseudopodia filose, branching and numerous, generally arising from a protruded portion of plasma.

The members of this genus are distinguished from the *Euglyphæ* by the linear orifice and the absence of

* "Greek, *plax*, a plate; *kista*, a box" (Leidy).

denticulated aperture-scales; the plasma and pseudopodia are very similar; it is not improbable that the aperture is capable of distension. Of the four species comprising the genus two are provided with spines and two are glabrous. *P. glabra* Penard, a robust sphagnum-inhabiting species, has not been recorded from the British Isles, and *P. lens* Penard has been recorded only from Loch Ness. In the United States of America is found a form of *P. spinosa* the test of which is sparsely covered with acicular spines.

Synopsis of the British Species.

Test large, bearing lanceolate spines which are confined to the margin. (1) *P. spinosa.*

Test smaller, sub-circular in broad view, bearing all over its surface short acicular spines of varying length. (2) *P. jurassica.*

Test broadly ovoid, glabrous; inhabiting deep lakes. (3) *P. lens.*

1. **Placocista spinosa** (Carter) Leidy.

(Plate XL, figs. 1–6; and figs. 128–130 in text.)

Euglypha spinosa

Carter in Ann. Nat. Hist. (3) XV (1865), pp. 290, 293, pl. xii, f. 13.
Archer in Qrt. Jrn. Micr. Sci. (n. s.) XII (1872), p. 88; *op. cit.* XVI (1876), p. 237; in Proc. Dublin Micr. Club, II, 1 (1873), p. 108.
Leidy in Proc. Acad. Philad. 1874 (1875), p. 226; *op. cit.* 1878, p. 172.
Parona in Boll. Scient. II (1880), pp. 47, 48.
Schewiakoff in Mém. Acad. St. Pétersb. (7), XLI (1893), viii, p. 98.

Placocista spinosa

Leidy Freshw. Rhiz. N. Amer. (1879), pp. 221–224, 290, pl. xxxviii; in Proc. Acad. Philad. 1879, p. 162; *op. cit.* 1880, p. 339.
Hitchcock Synops. Freshw. Rhiz. (1881), p. 38.
Averintzeff in Arch. Protist. VIII (1906), p 114; in Trudui S.-Peterb. Obshch. XXXVI, ii (1906), pp. 105, 107, 295–296, pl. i, ff. 8, 11; pl. ii, f. 38; pl. iv, f. 60.
Schouteden in Ann. Biol. lacustre, I (1906), pp. 368, 369, f. 44.

Placocysta spinosa

Blochmann Mikr. Thierw. Süsswass. (1886), p. 14; ed. 2 (1895), p. 18.
Penard in Mém. Soc. Genève, XXXI, 1, ii (1890), p. 183, pl. x, ff. 10–24; Faune Rhiz. Léman (1902), p. 580, f. 17 (p. 572); in Rev. Suisse Zool. XIII (1905), p. 611; *op. cit.* XIV (1906), pp. 131–136, pl. iv, ff. 8–10; in Brit. Antarct. Exped. I (1911), pp. 221, 250.
Eyferth Einfach. Lebensf., ed. 3 (1900), p. 267.
West in Jrn. Linn. Soc., Zool. XXVIII (1901), p 328; in Ann. Scott. Nat. Hist. 1905, p. 90.

Murray in Proc. Roy. Soc. Edinb., XXV (1905), pp. 609, 615; in Ann. Scott. Nat. Hist. 1907, p. 96; in Bathym. Surv. Scott. Lochs, I (1913), p. 326.
Odell in Ottawa Natur. XIX (1905), p. 19.
Evans in Proc. R. Phys. Soc. Edinb. XVII (1907), table 1.
Brown in Jrn. Linn. Soc., Zool. XXX (1910), pp. 362, 366; in Ann. Scott. Nat. Hist. 1911, pp. 229, 231; in Naturalist, 1912, p. 182; in Scott. Natur. 1913, p. 208.
Heinis in Arch. Hydrobiol. V (1910), p. 109.
Hopkinson in Irish Natur. 1910, p. 3.
Wailes & Penard in Proc. R. Irish Acad. XXXI, lxv (1911), p. 18.
Wailes in Scott. Natur. 1912, p. 61; in Jrn. Linn. Soc., Zool. XXXII (1912), pp. 126, 150; in Naturalist, 1913, p. 148.

Test large, ovoid, hyaline, compressed; transverse section lenticular; formed of oval or sub-circular silicious scales regularly imbricated and arranged in

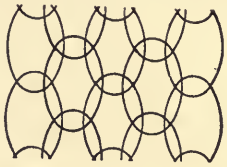

Fig. 128.—Body-scales of *Placocista spinosa*. × 1000.

alternating longitudinal rows; aperture linear with undulate margins formed by sub-circular scales; margin of test furnished at regular intervals with lanceolate spines, either solitary or in pairs, attached to the test at the imbrications of the scales by small hemispherical nodules; nucleus large, placed posteriorly and containing a single nucleole; two contractile vesicles generally visible; plasma colourless, granular, sometimes containing *Zoochlorellæ* in symbiotic relationship, partly filling the test; pseudopodia numerous, filose, branching.

Length 116–174 μ; breadth 71–100 μ; aperture 35–70 μ; thickness two thirds to one half the width; body-scales 12–20 μ in length, 7–10 μ in breadth; spines 5–35 μ in length; nucleus 22–35 μ in diameter.

Habitat.—Sphagnum.

England.—Cumberland (*Brown*); Westmorland (*West*, *Brown*); Lancashire (*West*); N. and W. Yorkshire; Shropshire; Isle of Wight; Cornwall.

Wales. — Snowdon (*West*), Llyn Crafnant and Dolgam, Capel Curig (*Hopk.* coll.), Carnarvonshire; Towyn, Merionethshire (*Cash*).

Scotland.—Shetlands; Hebrides; Inverness-shire and Aberdeenshire (*Brown*); Perthshire (*Cash*, *Brown*); Argyllshire (*Brown*); Midlothian (*Cash*); Wigtownshire (*Brown*).

Ireland.—Clare Island and mainland, Mayo; Galway; Wicklow (*Archer*, *Hopk.*); Kerry (*Archer*).

In the British Isles this species is found at all altitudes at which sphagnum flourishes and is perhaps more numerous at the higher elevations (*i. e.* 800–2000 ft.). Freshly gathered sphagnum is the best material in which to seek active individuals. The pseudopodia are seldom seen.

The *Zoochlorellæ* occasionally found in the plasma have the appearance of being perfectly healthy and of living there symbiotically.

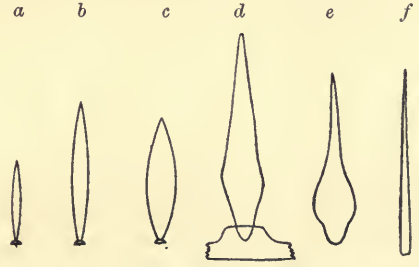

Fig. 129.—Various types of spines of *Placocista spinosa*. *a–c*, × 800; *d–f*, × 1040 (after Penard); *f*, side view.

The small, button-like processes (fig. 129 *a–c*) by which the spines are attached to the test are of a chitinous nature and are dissolved by strong sulphuric acid whilst the silicious scales and spines remain unaffected. The spines are usually solitary but may arise in pairs or rarely in threes; they are, except very rarely, flattened, and vary in broad view from linear to lanceolate in shape; the broad view is always approximately in the plane of the broad view

of the test (fig. 129*d*). In length they vary greatly but are usually of about the same length on the same test.

Although in a few localities, such as the moors of the North Riding of Yorkshire and the swamps of New Jersey, U.S.A., living individuals are fairly numerous, none were observed in process of division or conjugation.

In the United States a variety is found in which the spines are acicular and scattered over the whole surface of the test.

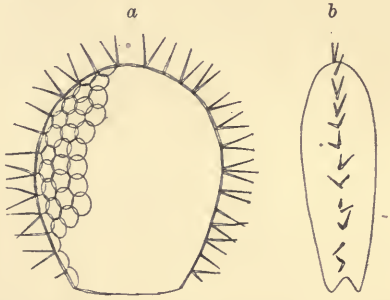

Fig. 130.—Test of *Placocista spinosa*, with abnormally distended aperture. × 270. From Llyn Llydaw, Snowdon. (*G. S. West.*)

The aperture is sometimes found widely distended (fig. 130 *a*), in side view showing as a notch with convex sides (fig. 130 *b*), but this probably only occurs permanently in empty tests, the living animal usually keeping it closed.

2. **Placocista jurassica** Penard.

(Plate XL, figs. 7–9; and Pl. XLII, fig. 1.)

Placocysta jurassica

Penard in Rev. Suisse Zool. XIII (1905), pp. 611–612, pl. xiv, ff. 29, 30; *op. cit.* XIV (1906), p. 136; Sarcodinés in Cat. Invert. Suisse (1905), pp. 105–106; in Brit. Antarct. Exped. I (1911), pp. 220, 250.

Evans in Proc. R. Phys. Soc. Edinb. XVII (1907), p. 11, table 1.

Heinis in Arch. Hydrobiol. V (1910), p. 109.

Brown in Jrn. Linn. Soc., Zool. XXXII (1911), p. 83, pl. ix, ff. 16–18; in Ann. Scott. Nat. Hist. 1911, p. 229; in Scott. Natur. 1912, pp. 109, 112.

Wailes in Naturalist, 1913, p. 148.

Placocista jurassica

Schouteden in Ann. Biol. lacustre, I (1906), pp. 368, 369.

Test smaller than in the preceding species and of broader proportions, being sub-circular to ovoid in broad view; transverse section lenticular; furnished with acicular spines of various lengths which cover the whole surface of the test but are less numerous on the central portions; body-scales sub-circular or broadly oval, regularly imbricated; aperture-scales sub-circular, forming undulate margins to the linear aperture; nucleus large, containing from one to three nucleoles; contractile vesicles obscure, usually two or more; plasma colourless; pseudopodia not observed.

Length 70–76 μ; breadth 50–54 μ; aperture 20–28 μ; thickness about half the breadth; nucleus 17–20 μ in diameter; spines 6–18 μ in length.

Habitat.—Sphagnum. Rare.

England. — Harrop Tarn, Cumberland (*Brown*); Chat Moss, Lancashire (*Cash*); Leckby Carr, N. Yorkshire.

Wales.—Snowdon, Carnarvonshire (*Saunders*, coll.).

Scotland. — St. Kilda, Outer Hebrides (*Brown*); Pentland Hills (*Cash*); Stranraer, Wigtownshire (*Brown*).

The spines may be solitary or in tufts of two to four (Pl. XLII, fig. 1); they are never flattened; they may vary considerably in numbers and length. The test is often opaque and rarely glabrous.

3. **Placocista lens** Penard.

(Plate XL, fig. 10.)

Euglypha lens

Penard in Rev. Suisse Zool. VII (1899), pp. 78–79, 115, pl. vii, ff. 20–24; *op. cit.* IX (1901), pp. 234, 237.

Forel Le Léman, III (1904), p. 137.

Placocysta lens

Penard Faune Rhiz. Léman (1902), pp. 514–515, 3 figs.; Sarcodinés grands Lacs (1905), pp. 56–57, 109, 110, 2 figs.; Sarcodinés in Cat. Invert. Suisse (1905), p. 106; in Proc. Roy. Soc. Edinb. XXV (1905), pp. 595, 603–604, 608.

MURRAY in Proc. Roy. Soc. Edinb. XXV (1905), p. 615; in Bathym. Surv. Scott. Lochs, I (1913), p. 326.

Placocista spinosa

AVERINTZEFF (pars) in Trudui S.-Peterb. Obshch. XXXVI, II (1906), pp. 295–296.

SCHOUTEDEN (pars) in Ann. Biol. lacustre, I (1906), pp. 368–369.

Test small, transparent, hyaline, glabrous, sub-circular in broad view, compressed, especially anteriorly; transversely lenticular; aperture linear with undulate, compressed lips, and a delicate membraneous border; plasma bluish-grey, granular, partially filling the test; nucleus large, granular, containing from two to five nucleoles; one or more contractile vesicles usually present; pseudopodia filose, simple, radiating.

Length 65–80 μ; breadth about nine tenths of the length; aperture about half the breadth; thickness about three sevenths of the breadth.

Habitat.—Deep lakes.

SCOTLAND.—Loch Ness, Inverness-shire (*Penard*).

Possessing a particularly fragile test, this species has been recorded exclusively from the depths or shores of large lakes. The only species with which it can be confounded is *P. glabra* Penard, but that is found only in sphagnum, it is larger, 90–105 μ in length, has an aperture equal to about two thirds the breadth, and its test is more robust and less transparent. It has not been recorded from the British Isles.

Dr. Penard, when kindly sending the writer a mounted specimen of this species, pointed out a feature which had previously escaped observation, namely, the presence beyond the aperture of a very delicate, hyaline membrane with faint dot-like markings. The presence of an exterior lip brings this species into close relationship with the members of the genus *Sphenoderia*, but considering the general shape, construction, and appearance of the test it seems better, for the present at any rate, to leave it in the genus *Placocista*, where it may perhaps be regarded as a transitionary species.

Genus 34. **ASSULINA** Ehrenberg, 1872.

Difflugia (pars) Ehrenberg Ber. Akad. Berlin, 1848, p. 379.
Euglypha (pars) Leidy Proc. Acad. Philad. 1874 (1875), p. 226.
Assulina (pars) Ehrenberg Abh. Akad. Berlin, 1871 (1872), p. 246.
Assulina Leidy Freshw. Rhiz. N. Amer. (1879), p. 224.

Test brown or colourless, ovoid, glabrous, compressed, formed of elliptical, imbricated, silicious scales, disposed more or less regularly in diagonal rows; aperture oval, terminal, truncate or with a short neck, bordered by a thin chitinous dentate membrane; plasma grey or colourless, granular; nucleus large, placed posteriorly; contractile vesicles one or more; pseudopodia filose, more or less numerous, divergent, sometimes branched.

Compared with the members of genus *Euglypha* the *Assulinæ* have less numerous and less branched pseudopodia, the plasma is less clear and contains more fine granules often of a sandy colour. The dentate or jagged, transparent and nearly colourless membrane bordering the aperture together with the highly compressed test and narrow aperture are distinctive of this genus. The brown colour of the tests, when present as it usually is, suffices to distinguish the genus easily; this colour is due to a brown chitinous membrane which lines the tests, and also partly perhaps in many cases to the cementing material joining the scales together. The deposits of this cement are abnormally thick and usually hide the true shape of the oval scales, giving them the false appearance of a tile-like arrangement similar to that of a house-roof, the scales appearing to overlap from the fundus downwards, whilst in reality they are arranged the reverse way. The test of *A. seminulum* var. *scandinavica* is, however, an exception, as it is often colourless, and the outlines of its broadly-oval or sub-circular scales are plainly seen. The form of

the test is subject to great variation; whilst figs. 1 and 6, Pl. XLI, show the typical form of each species, individuals of *A. seminulum* up to 100 μ or more in length similar to fig. 5 are not uncommon; also elongated and small-apertured forms of *A. muscorum* similar to fig. 2, Pl. XLIII, are occasionally seen. In addition to these normal variations in the form of the test, deformations in the test of *A. muscorum* are very very common, usually consisting of asymmetry and obliqueness of the aperture. These deformities appear to be due to the desiccation from which this moss-inhabiting species is likely periodically to suffer. The larger species which inhabits moister situations is rarely affected.

A. muscorum is found in nearly every part of the world wherever moss can grow freely, and flourishes in all latitudes and at all elevations at which mosses are found. *A. seminulum* is far less ubiquitous, being as a rule restricted to sphagnum growing in permanent pools and marshes. The animals are timid, and, considering the large numbers in which they often occur, active individuals are rarely observed. They are but rarely seen in conjunction.

Synopsis of the British Species.

Test moderately large; length 60–100 μ or more.	(1) *A. seminulum.*
Test small; length 27–58 μ.	(2) *A. muscorum.*

1. **Assulina seminulum** (Ehrenberg) Leidy.

(Plate XLI, figs. 1–5; Pl. XLIII, fig. 1; and fig. 131 in text.)

Difflugia seminulum
Ehrenberg in Ber. Akad. Berlin, 1848, p. 379; *op. cit.* 1849, table; Mikrogeol. (1854), pl. xxxv, B, A. ii, f. 1; in Monatsb. Akad. Berlin, 1861 (1862), pp. 1077, 1102; in Abh. Akad. Berlin, 1871, p. 246.
Pritchard Hist. Infus., ed. 3 (1852), p. 209; ed. 4 (1861), p. 553.
Difflugia Assulina seminulum
Ehrenberg in Abh. Akad. Berlin, 1871 (1872), p. 246.

Difflugia semen
EHRENBERG in Abh. Akad. Berlin, 1871 (1872), p. 257.
Euglypha brunnea
LEIDY in Proc. Acad. Philad. 1874 (1875), p. 226; *op. cit.* 1876, p. 55; 1877 (1878), p. 321.
Euglypha tincta
ARCHER in Qrt. Jrn. Micr. Sci. (N. S.) XVI (1876), p. 108; *op. cit.* XVII (1877), pp. 103, 330; XVIII (1878), p. 105; in Proc. Dublin Micr. Club III, 1 (1876), pp. 110–111; *op. cit.* III, 2 (1878), p. 198; III, 3 (1880), pp. 284–285, 311–312.
Euglypha seminulum
LEIDY in Proc. Acad. Philad. 1878, p. 172.
TARÁNEK in Sitzber. böhm. Ges. Wiss. 1881, p. 234; in Abh. böhm. Ges. Wiss. (6) XI, VIII (1882), p. 33.
SCHEWIAKOFF in Mém. Acad. St. Pétersb. (7) XLI (1893), VIII, p. 98.
RICHTERS in Zool. Jahrb., Syst. XXVI (1908), pp. 197, 210.
Assulina seminulum
LEIDY (pars) Freshw. Rhiz. N. Amer. (1879), pp. 225–226, 290, pl. XXXVII, ff. 15–25; in Proc. Acad. Philad. 1879, p. 163; *op. cit.* 1880, pp. 336, 339.
HITCHCOCK Synops. Freshw. Rhiz. (1881), p. 39.
BLOCHMANN Mikr. Thierw. Süsswass. (1886), p. 14; ed. 2 (1895), p. 18.
GREEFF in Sitzber. Ges. nat. Marburg, 1888, pp. 115–117.
HARVEY in Amer. Natur. XXII (1888), p. 73.
MAGGI in Rend. R. Ist. Lomb. (3) XXI (1888), p. 301.
CERTES in Mission scient. Cap Horn, VI (1889), pp. 16–17, pl. ii, f. 1.
CASH in Trans. Manch. Micr. Soc., 1891 (1892), p. 52.
ENTZ in Math. Termész. értes. XV (1897), pp. 172, 178; in Math. nat. Ber. Ungarn, XV (1899), pp. 183, 188.
SCOURFIELD in Proc. Zool. Soc. Lond. 1897, pp. 788–789.
PENARD in Arch. Sci. nat. (4) VII (1899), p. 243; Faune Rhiz. Léman (1902), pp. 516–519, 7 figs.; Sarcodinés in Cat. Invert. Suisse (1905), pp. 106–107; in Brit. Antarct. Exped. I (1911), pp. 220, 225.
AVERINTZEFF in Trudui S.-Petersb. Obshch. XXX, I (1900), p. 240; (pars) *op. cit.* XXXVI, II (1906), pp. 297–298.
EYFERTH Einfach. Lebensf., ed. 3 (1900), p. 267.
LEVANDER in Acta Soc. Fauna Fenn. XX, VIII (1901), pp. 8, 11.
WEST in Jrn. Linn. Soc., Zool. XXVIII (1901), p. 329; in Ann. Scott. Nat. Hist. 1905, pp. 90, 92.
MURRAY in Proc. Roy. Soc. Edinb. XXV (1905), p. 615; in Ann. Scott. Nat. Hist. 1907, p. 96; in Bathym. Surv. Scott. Lochs, I (1913), p. 326.
ODELL in Ottawa Natur. XIX (1905), p. 19.
CUSHMAN in Amer. Natur. XL (1906), p. 373.
EDMONDSON in Proc. Davenport Acad. XI (1906), p. 22, pl. v, f. 30; in Univ. Colorado Stud. IX (1912), p. 68.
SCHOUTEDEN in Ann. Biol. lacustre, I (1906), p. 369.
EVANS in Proc. R. Phys. Soc. Edinb. XVII (1907), table 1.
HEINIS in Zool. Anzeig. XXXIII (1908), p. 713; in Arch. Hydrobiol. V (1910), p. 109; in Rev. Suisse Zool. XIX (1911), p. 255.
LANDACRE in Proc. Ohio Acad. IV (1908), p. 429.
BROWN in Naturalist, 1909, p. 107; in Jrn. Linn. Soc., Zool. XXX (1910), p. 362; in Brit. Assoc. Handb. Sheffield (1910), p. 500; in Ann. Scott. Nat. Hist. 1911, pp. 229, 230; in Naturalist, 1912, pp. 181, 182; in Scott. Natur. 1913, pp. 208, 210.

Honigmann in Abh. Mus. Magdeburg, II (1909), p. 62.
Hopkinson in Irish Natur. 1910, p. 3.
Wailes & Penard in Proc. R. Irish Acad. XXXI, lxv (1911), pp. 15, 21–22.
Wailes in Scott. Natur. 1912, pp. 60, 62; in Jrn. Linn. Soc., Zool. XXXII (1912), pp. 126, 150; in Naturalist, 1913, p. 147.
Schmidt in Arch. Protist. XXIX (1913), pp. 221, 226.

Assulina semilunum

Penard in Mém. Soc. Genève, XXXI, 1, ii (1890), pp. 175–176, pl. viii, ff. 68–90; in Jahrb. nassau. Ver. Naturk. XLIII (1890), p. 71; in Amer. Natur. XXV (1891), pp. 1074, 1079.

Test moderately large; brown or colourless; in broad view pyriform, ovoid, or sub-circular, compressed; transverse section lenticular; composed of imbricated, elliptical, silicious scales; aperture oval, bordered by a thin chitinous membrane, with undulate or irregularly-dentate margin; nucleus large, containing two to six nucleoles; plasma not entirely filling the test, granular, usually containing numerous food-particles; one contractile vesicle usually present and numerous vacuoles; pseudopodia few, straight, divergent, slender, seldom branched.

Length usually 60–90 μ, but may attain 150 μ; breadth 50–75 μ; aperture 16–25 μ; thickness about two fifths of the breadth.

Habitat.—Sphagnum and mosses in marshy situations.

Generally distributed in the British Isles. It is found at considerable elevations, *e. g.* Lochnagar, 3500 feet (*G. S. West*), Croaghmore, Clare Island, 1520 feet, and at about the same elevation in N. Wales and N. Yorkshire.

England.—Cumberland, Westmorland, and Lancashire (*Brown*); N. and W. Yorkshire; Derbyshire (*Brown*); Shropshire; Bedfordshire; Cambridgeshire; Essex (*Scourfield*); Buckinghamshire; Oxfordshire; Surrey (*Brown*); Hampshire; Isle of Wight.

Wales.—Moel Siabod and Capel Curig, Carnarvonshire (*Hopk.*); Towyn, Merionethshire (*Cash*).

Scotland.—Shetlands; Orkneys, Ross-shire, and Hebrides (*West*); Loch Ness (*Penard*), Inverness-shire (*West, Brown*); Elginshire (*Brown*); Aberdeenshire

(*West, Brown*); Perthshire (*Cash, Brown*); Argyllshire (*Brown*); Mid-Lothian (*Cash*); Dumfriesshire; Wigtownshire (*Brown*).

Ireland.—The Islands off Clew Bay, and mainland, Mayo; Galway; Wicklow (*Archer*).

The arrangement of the scales on the fundus of the test is of a more or less radial character (fig. 131), giving place gradually to a diagonal arrangement towards the middle and anterior end of the test; superficially the scales have the appearance of overlapping from the fundus downwards, but an examination of the test in section shows that the usual arrangement of the scales holds good, *i. e.* the anterior

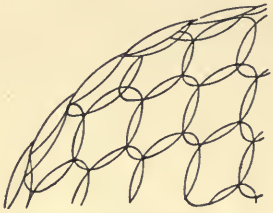

Fig. 131.—Portion of test of *Assulina seminulum*. × 1200. Gormire, N. Yorks.

ones overlap those nearer the apex; the reverse appearance is probably due to the unusual thickness of the chitinous material which cements them together; owing either to this thickness, or perhaps to an admixture of silicious matter with the chitin, the tests are not disintegrated by strong sulphuric acid.

The pseudopodia are seldom observed, and when the tests are of a brown colour little can be seen of the contents, but the nucleus can usually be located as a light circular patch on which the outlines of the scales are distinguishable.

Near Lough Nahanagan, Wicklow, 2000 feet, an unusual form occurs; the test is colourless, in broad view narrowly oviform, moderately compressed, of the following dimensions: length about 100 μ; breadth 60–65 μ; thickness about two-thirds of the breadth.

Tests which are pyriform in broad view (Pl. XLI, fig. 4) occur in some localities; at Goathland, Yorkshire, a large one was seen measuring 150 μ in length and 115 μ in breadth.

Var. **scandinavica** Penard. (Pl. XLI, fig. 5; Pl. XLIII, fig. 1.)

Assulina scandinavica
PENARD in Mém. Soc. Genève, XXXI, 1, II (1890), pp. 176–177, pl. ix, ff. 1–13.
Assulina seminulum var. *scandinavica*
PENARD Faune Rhiz. LÉMAN (1902), p. 519; in Brit. Antarct. Exped. I, 6 (1911), p. 225.
EVANS in Proc. R. Phys. Soc. Edinb. XVII (1907), table 1.
WAILES & PENARD in Proc. R. Irish Acad. XXXI, LXV (1911), pp. 15, 22.
WAILES in Scott. Natur. 1912, p. 60.
BROWN in Scott. Natur. 1913, p. 208.

Test usually larger than in the type, brown or colourless, ovoid or sub-circular, composed of oval or rarely circular scales regularly imbricated in alternating longitudinal rows; plasma and pseudopodia normal.

Length 80–120 μ; breadth 70–110 μ; aperture 15–30 μ; scales 9–12 μ in greater diameter.

Habitat.—Sphagnum in upland districts.

ENGLAND.—The moors in the North Riding of Yorkshire, 800 to 1000 feet.

WALES.—Bettws-y-Coed, Carnarvonshire (*Hopk.* coll.).

SCOTLAND.—Shetlands; Forth area (*Evans*); Dumfriesshire.

IRELAND.—Clare Island, Mayo, 750 to 1000 feet; Galway.

Although far less common than the type, this variety is probably widely distributed in the upland districts of the British Isles.

The scales of the test are always easily distinguishable and never hidden by the brown chitinous cement as is usually the case in the tests of the typical *A. seminulum*.

2. **Assulina muscorum** Greeff.

(Plate XLI, figs. 6–9; Pl. XLIII, figs. 2–6.)

Assulina seminulum

Leidy (pars) Freshw. Rhiz. N. Amer. (1879), pl. xxxvii, ff. 15–16, 26.

Averintzeff (pars) in Trudui S.-Peterb. Obsheh. XXXVI (1906), ii, p. 298.

Assulina muscorum

Greeff in Sitzber. Ges. nat. Marburg, 1888, pp. 117–118.

Heinis in Zool. Anzeig. XXXIII (1908), pp. 713–714; in Arch. Hydrobiol. V (1910), pp. 109–110; in Rev. Suisse Zool. XIX (1911), p. 255.

Penard in Arch. Protist. IX (1909), p. 265; in Brit. Antarct. Exped. I, 6 (1911), pp. 204, 207, 220, 225; in Deux. expéd. antarct. franç. (1911), Rhiz. pp. 4, 5.

Brown in Naturalist, 1910, p. 93; *op cit.* 1912, p. 181; in Brit. Assoc. Handb. Sheffield (1910), p. 500; in Ann. Scott. Nat. Hist. 1911, pp. 229, 230; in Scott. Natur. 1912, p. 112; 1913, p. 210.

Wailes & Penard in Proc. R. Irish Acad. XXXI, lxv (1911), pp. 14, 21, 60, 61, 62.

Edmondson in Univ. Colorado Stud. IX (1912), p. 69.

Wailes in Scott. Natur. 1912, p. 60; in Jrn. Linn. Soc., Zool. XXXII (1912), pp. 126, 150, 159; *loc. cit.* (1913), p. 213; in Naturalist, 1913, p. 147; in Murray's Nat. Hist. Bolivia and Peru (1913), p. 32.

Assulina minor

Penard in Mém. Soc. Genève, XXXI (1890), ii, p. 177, pl. ix, ff. 14–25; in Jahrb. nassau. Ver. Naturk. XLIII (1890), p. 71; in Amer. Natur. XXV (1891), pp. 1071, 1074, 1075; in Arch. Sci. nat. (4) VII (1899), p. 243; Faune Rhiz. Léman (1902), pp. 519–520, 4 figs.; in Arch. Protist. II (1903), p. 272; in Proc. Roy. Soc. Edinb. XXV (1905), p. 593; Sarcodinés in Cat. Invert. Suisse (1905), p. 107.

Lagerheim in Geol. Fören. Stockholm Förh. XXIII (1901), pp. 477, 516.

Evans in Proc. R. Phys. Soc. Edinb. XVII (1907), table 1.

Murray in Ann. Scott. Nat. Hist. 1907, p. 96; in Bathym. Surv. Scott. Lochs, I (1913), p. 326.

Cockerell in Univ. Colorado Stud. VI (1909), p. 305.

Hopkinson in Irish Natur. 1910, p. 3.

Edmondson in Univ. Colorado Stud. IX (1912), p. 69.

Test small, brown or rarely colourless, oviform, compressed; transverse section oval or lenticular; longitudinal section lenticular, truncate anteriorly at the aperture; formed of imbricated oval plates usually arranged in alternating diagonal rows or occasionally irregularly; plasma colourless with a central band of granules and sometimes containing chlorophylous particles, nearly or quite filling the test; nucleus of

moderate size, containing a single nucleole; numerous vacuoles usually present; pseudopodia filose, seldom branched, straight, radiating, and few in number.

Length 28–58 μ; breadth 19–50 μ; aperture 6–16 μ; thickness one half to two thirds of the breadth; scales 3–4 μ in length.

Habitat.—Mosses and sphagnum. Common.

Generally distributed in the British Isles and usually numerous.

Although empty tests are nearly everywhere numerous, living animals are not very common, and active individuals are rarely observed. In situations where moss is liable to considerable desiccation, individuals are few and their tests are often distorted; a large proportion of the empty tests are found with the two sides pressed together; this weakness may be due to the lenticular shape of the tests in transverse section.

The affinities of *Euglypha denticulata* Brown to this species have already been referred to on p. 42.

Genus 35. **SPHENODERIA** Schlumberger, 1845.

Sphenoderia Schlumberger in Ann. Sci. nat. (3) III (1845), p. 256.
Euglypha (pars) Carter in Ann. Nat. Hist. (3) XV (1865), p. 290.
Difflugia (pars) Ehrenberg in Abh. Akad. Wiss. Berlin, 1871 (1872), p. 264.

Test globular or ovoid, hyaline, composed of regularly-imbricated silicious plates or scales; aperture terminal, lipped, linear or circular; nucleus usually large, placed posteriorly; plasma colourless, partly filling the test; one or two contractile vesicles usually present; pseudopodia long, filose, delicate, straight or forked.

Four species of this genus are known, all of which have been recorded in the British Isles. *S. dentata*

Penard, although differing considerably both in form of the test and of the aperture from the other members of the genus, may be appropriately included in it.

S. pulchella G. S. West * belongs to the genus *Paulinella*.

Synopsis of the British Species.

Section A.—Aperture linear.

Test more or less globular, formed of numerous circular or broadly-oval scales. (1) *S. lenta.*

Test ovoid, formed of four transverse rows of oval scales. (2) *S. fissirostris.*

Test small, ovoid, compressed; each broad face formed principally by two large oval plates. (3) *S. macrolepis.*

Section B.—Aperture circular.

Test ovoid, not compressed, formed of circular or broadly-oval scales; aperture having a thin dentate lip. (4) *S. dentata.*

1. **Sphenoderia lenta** Schlumberger.

(Plate XLII, figs. 2–13; and figs. 132–135 in text.)

Sphenoderia lenta

Schlumberger in Ann. Sci. nat. (3) III (1845), p. 256.

Ehrenberg in Abh. Akad. Berlin, 1871 (1872), p. 236.

Leidy (pars) Freshw. Rhiz. N. Amer. (1879), pp. 229–232, 290, 292, pl. xxxiv, ff. 25–33, 35–39, 41; in Proc. Acad. Philad. 1879, p. 163.

Hitchcock Synops. Freshw. Rhiz. (1881), pp. 40–41.

Taránek in Sitzber. böhm. Ges. Wiss. 1881, pp. 224, 235.

Penard in Mém. Soc. Genève, XXXI, 1, ii (1890), pp. 183–184, pl. x, ff. 25–29; in Jahrb. nassau. Ver. Naturk. XLIII (1890), p. 72; in Rev. Suisse Zool. IX (1901), p. 238; *op. cit.* XIII (1905), p. 603; XVI (1908), pp. 462, 466; Faune Rhiz. Léman (1902), pp. 520–523, 7 figs.; Sarcodinés grands Lacs (1905), pp. 108, 117; Sarcodinés in Cat. Invert. Suisse (1905), pp. 107–108; in Proc. Roy. Soc. Edinb. XXV (1905), pp. 595, 597; in Rev. Suisse Zool. XVI (1908), pp. 462, 466.

Cash in Trans. Manch. Micr. Soc. 1891 (1892), p. 52, pl. ii, f. 5.

Entz in Math. Termész. értes. XV (1897), pp. 172, 176, 178; in Math. nat. Ber. Ungarn, XV (1899), pp. 183, 186, 188.

Daday in Anh. Termész. Füzetek, XXI (1898), pp. 7, 9.

Eyferth Einfach. Lebensf., ed. 3 (1900), p. 268.

Lagerheim in Geol. Fören. Stockholm Förh. XXIII (1901), p. 472.

* 'Jrn. Linn. Soc.,' Zool., vol. xxix (1903), p. 115.

West in Jrn. Linn. Soc., Zool. XXVIII (1901), pp. 328–329; in Ann. Scott. Nat. Hist. 1905, p. 90.
Murray in Proc. Roy. Soc. Edinb. XXV (1905), p. 615; in Bathym. Surv. Scott. Lochs, I (1913), p. 326.
Odell in Ottawa Natur. XIX (1905), p. 19.
Averintzeff in Arch. Protist. VIII (1906), p. 117, f. 2; in Trudui S.-Peterb. Obshch. XXXVI, II (1906), p. 118, pl. ii, f. 31; *ibid.* pp. 300–301.
Schouteden in Ann. Biol. lacustre, I (1906), pp. 369, 370.
Evans in Proc. R. Phys. Soc. Edinb. XVII (1907), table 1.
Brown in Naturalist, 1909, p. 107; in Jrn. Linn. Soc., Zool. XXX (1910), p. 362; in Brit. Assoc. Handb. Sheffield (1910), pp. 500, 501; in Ann. Scott. Nat. Hist. 1911, pp. 229, 230; in Naturalist, 1912, pp. 181, 182; in Scott Natur. 1912, pp. 181, 182; 1913, p. 208.
Hopkinson in Irish Natur. 1910, p. 3; in Trans. Herts Nat. Hist. Soc. XIV, 3 (1911), p. 232.
Hartog in Encycl. Brit., ed. 11, XXIII (1911), p. 247, f. 6 B (1–7).
Wailes & Penard in Proc. R. Irish Acad. XXXI, LXV (1911), pp. 19, 52.
Wailes in Scott. Natur. 1911, p. 61; in Jrn. Linn. Soc., Zool. XXXII (1912), pp. 126, 152; in Naturalist, 1913, p. 148.
Schmidt in Arch. Protist. XXIX (1913), p. 221.

Euglypha globosa

Carter in Ann. Nat. Hist. (3) XV (1865), pp. 290, 293, pl. xii, f. 14.
Hertwig & Lesser in Arch. mikr. Anat. X (1874), Suppl., pp. 129–132, pl. iii, f. 7.
Leidy in Proc. Acad. Philad. 1874, p. 226; *loc. cit.* 1878, p. 172.
Schulze in Arch. mikr. Anat. XI (1875), pp. 102–104, pl. v, ff. 5–8.
Eyferth Einfach. Lebensf. (1878), p. 34; ed. 2 (1885), p. 52.
Parona in Boll. Scient. II (1880), pp. 47, 48.
Claus Lehrb. Zool., ed. 2 (1883), p. 163, f. 125; Text-book Zool. (transl.), (1884) p. 186, f. 125; Traité Zool. (transl.), ed. 2 (1884), p. 205, f. 207; Lehrb. Zool., ed. 4 (1887), p. 195, f. 148.
Blochmann Mikr. Thierw. Süsswass. (1886), p. 14; ed. 2 (1895), p. 18.
Zune Analyse eaux potables (1894), p. 162, f. 93.

Test hyaline, transparent, ovoid or globular, formed of sub-circular or broadly-oval scales, regularly imbricated; aperture terminal, linear, formed by a thin chitinous collar one side of which is inclined inwards; nucleus large, containing one or two nucleoles, placed posteriorly; plasma colourless, granular, only partly filling the test; two contractile vesicles usually present, one near the nucleus, the other near the aperture; pseudopodia long, numerous, attenuate, radiating, straight or forked.

Length 30–64 μ; breadth 20–46 μ; aperture 10–22 μ; thickness equal to the breadth or 5 per cent. to 10 per cent. less.

Habitat.—Sphagnum and submerged vegetation.

England.—Cumberland and Westmorland (*Brown*); Lancashire (*Cash*, *Brown*); Yorkshire; Cheshire (*Cash*); Derbyshire (*Brown*); Shropshire; Essex (*Scourfield*); Hertfordshire! (*Hopk.*); Hampshire; Isle of Wight; Cornwall.

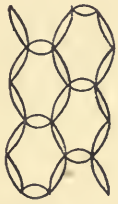

Fig. 132.—Scales of *Sphenoderia lenta*. × 1000.

Wales.—Nant Francon, and Moel Siabod (1200 feet), Carnarvonshire (*Hopk.* coll.)

Scotland.—Shetlands; Orkneys (*West*); Sutherlandshire; Outer Hebrides (*West*); Inverness-shire (*Penard*, *Brown*); Elginshire, Aberdeenshire, Perthshire, and Argyllshire (*Brown*); Skye; Ayrshire and Wigtownshire (*Brown*).

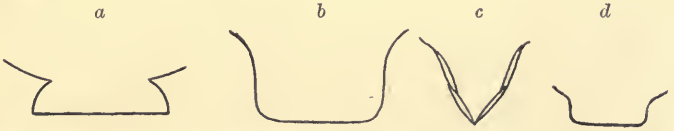

Fig. 133.—Types of apertures of *Sphenoderia lenta*. × 1000. *a*. Length of test 48 μ: Pilmoor. *b*. Length of test 42 μ: New Forest. *c*. Narrow view of same. *d*. Length of test 32 μ: Isle of Wight.

Ireland.—Donegal; Armagh; Clare Island and mainland, Mayo; Galway; Wicklow! (*Hopk.*); Kerry.

There is some difficulty in correctly ascertaining the shape of the orifice owing to the curious construction of the neck or collar (figs. 133 and 134). Where the collar joins the test the orifice is long and narrow with semicircular ends, beyond this the flat sides of the collar approach each other so that in side view it has a conical shape; in broad view the outer

margin of one side is concave and its outline is seen in two diagonal lines proceeding from the outer corners showing where one lip is bent inwards in the middle. There are two types of neck, one tapers gradually from the test (fig. 133 *b–d*), the other has a deep notch all round where it joins the test (figs. 133 *a*

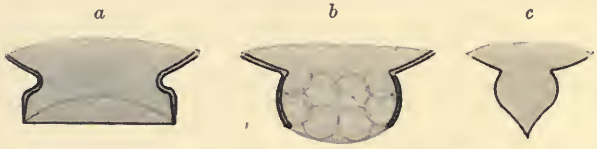

Fig. 134.—Types of apertures of *Sphenoderia lenta*. × 1000. *a*. Length of test 52 μ: N. Yorks. *b*. Length of test 53 μ: Scourie. *c*. Narrow view of same.

and 134). The collar usually appears homogeneous or faintly granular but occasionally faint indications of discs are perceptible on it.

The nucleus, which is 8 μ to 25 μ in diameter, is finely granular and contains one or two pale nucleoles; the pseudopodia are not often observed. Conjugating

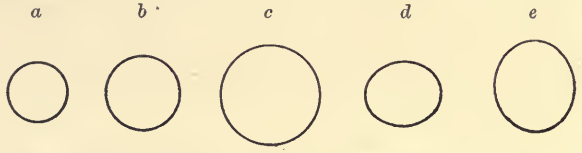

Fig. 135.—Various types of scales of *Sphenoderia lenta*. × 1000. *a*. Scale 8 μ diameter from a test 30 μ in length: Scourie. *b*. Scale 10 μ diameter from a test 64 μ in length: Scallaway. *c*. Scale 13 μ diameter from a test 52 μ in length: Pilmoor. *d*. Scale 10 × 8 μ diameter from a test 52 μ in length: Donegal. *e*. Scale 12 × 10 μ diameter from a test 55 μ in length: Goathland.

individuals are occasionally seen. Cysts, which are rare, are spherical and about three quarters of the diameter of the test.

2. **Sphenoderia fissirostris** Penard.

(Plate XLIII, figs. 7–10.)

Sphenoderia fissirostris

Penard in Mém. Soc. Genève, XXXI, 1, II (1890), pp. 184–185, pl. x, ff. 30–40; in Jahrb. nassau. Ver. Naturk. XLIII (1890), p. 72; in Rev. Suisse Zool. VII (1899), p. 14; Faune Rhiz. Léman (1902),

p. 523, 2 figs.; Sarcodinés in Cat. Invert. Suisse (1905), p. 108; in Brit. Antarct. Exped. I, 6 (1911), pp. 221, 253.
FOREL Le Léman, III (1904), p. 137.
AVERINTZEFF in Trudui S.-Peterb. Obshch. XXXVI, II (1906), p. 301.
SCHOUTEDEN in Ann. Biol. lacustre, I (1906), pp. 369, 370.
BROWN in Naturalist, 1910, p. 93; in Brit. Assoc. Handb. Sheffield (1910). pp. 499, 500; in Ann. Scott. Nat. Hist. 1911, pp. 229, 231; in Naturalist, 1912, p. 181; in Scott. Natur. 1912, pp. 109, 112; 1913, p. 208.
HOPKINSON in Irish Natur. 1910, p. 3.
WAILES & PENARD in Proc. R. Irish Acad. XXXI, LXV (1911), pp. 19, 52, 60, 61, 62.
WAILES in Scott. Natur. 1912, p. 61; in Jrn. Linn. Soc., Zool, XXXII (1913), p. 213; in Naturalist, 1913, p. 148.
Sphenoderia lenta var. *fissirostris*
WEST in Jrn. Linn. Soc., Zool. XXVIII (1901), p. 329.

Test small, ovoid, hyaline, composed of comparatively large elliptical imbricated plates of various sizes, arranged more or less regularly in four transverse rows; transverse section sub-circular; aperture small, linear, with conical collar or neck; nucleus large, with one or more nucleoles; two contractile vesicles usually present; plasma colourless, granular, nearly filling the test; pseudopodia few, attenuate, radiating.

Length 28–45 μ; breadth 20–30 μ; aperture 8–16 μ; thickness 5 per cent. to 10 per cent. less than the breadth; nucleus 10–12 μ in diameter.

Habitat.—Wet sphagnum.

ENGLAND.—Cumberland, Westmorland, and Lancashire (*Brown*); Derbyshire (*Brown*); Bedfordshire; Isle of Wight; Devonshire; Cornwall.

WALES.—Frequent in North Wales.

SCOTLAND.—Shetlands; Orkneys; St. Kilda (*Brown*), Outer Hebrides; Inverness-shire; Elginshire, Aberdeenshire, Perthshire, and Argyllshire (*Brown*); Skye; Dumfriesshire; Kirkcudbrightshire and Wigtownshire (*Brown*).

IRELAND.—Armagh; Clare Island and mainland, Mayo; Galway; Wicklow! (*Hopk.*); Limerick; Kerry.

Whilst the test is small, the plates composing it are large in proportion to its size; their arrangement may

vary not only in different individuals but even on the opposite sides of the same test. The row adjoining the aperture is usually formed of similar plates, but the central series often has a larger or smaller central plate with others arranged around it varying in size to suit their positions, but in any case the scales, visible in side view, number four (rarely five) counted in vertical series from the apex to the aperture; the imbrications of the plates are clearly visible at the margins.

Usually but few individuals are found in any gathering, but occasionally, as at Flitwick, Beds, they may be numerous. The pseudopodia are seldom observed. The neck is never notched as in *S. lenta*, from which *S. fissirostris* is also distinguished by its elongate form and the shape and restricted number of the scales.

3. **Sphenoderia macrolepis** Leidy.
Plate XLIII, figs. 11–13.)

Sphenoderia macrolepis
Leidy Freshw. Rhiz. N. Amer. (1879), p. 232, fig. on p. 290; Proc. Acad. Philad. 1879, p. 163.
Hitchcock Synops. Freshw. Rhiz. (1881), p. 41.
Eyferth Einfach. Lebensf., ed. 3 (1900), p. 268.
Penard Faune Rhiz. Léman (1902), p. 577, f. 11, p. 572.
Averintzeff in Arch. Protist. VIII (1906), p. 113; in Trudui S.-Peterb. Obshch. XXXVI, II (1906), pp. 301–302.
Schouteden in Ann. Biol. lacustre, I (1906), pp. 369, 370.
Brown in Jrn. Linn. Soc., Zool. XXXII (1911), pp. 83–84, pl. ix, f. 19; in Ann. Scott. Nat. Hist. 1911, pp. 229, 231; in Scott. Natur. 1913, p. 208.
Wailes & Penard in Proc. R. Irish Acad. XXXI, LXV (1911), pp. 19, 52–53, pl. vi, f. 32.
Wailes in Scott. Natur. 1912, pp. 61, 64–65; in Jrn. Linn. Soc., Zool. XXXII (1912), pp. 126, 152.
Euglypha macrolepis
Blochmann Mikr. Thierw. Süsswass. (1886), p. 14; ed. 2 (1895), p. 18.

Test small, hyaline, oviform, formed of various-sized oval plates and discs; transverse section oval; neck conical in side view; aperture linear; nucleus not large, placed posteriorly; plasma clear, colourless, with a varying number of granules; one contractile vesicle usually present; pseudopodia few, simple, and radiating.

Length 27–45 μ; breadth 24–34 μ; aperture about half the breadth; thickness about two thirds the breadth; nucleus about 6 μ in diameter.

Habitat.—Sphagnum. Rare.

England.—Easedale Tarn, Westmorland (*Brown*); Isle of Wight; Haldon Moor, Devonshire.

Wales.—Bettws-y-Coed, Carnarvonshire (*Hopk.*).

Scotland.—Scourie, Sutherlandshire; Stranraer, Wigtownshire (*Brown*).

Ireland.—Belclare and Clare Island, Mayo; Inishbofin, Galway; Cahircivean, Kerry.

Although rare, this species is probably widely distributed in the British Isles, but owing to its small size is liable to be overlooked; the average size of American individuals is, length 30–33 μ; breadth 20–23 μ, which is rather less than in Great Britain. It is not common in the United States.

The two large plates forming each side of the test, in broad view, are always very uniform in shape and proportionate size, but the other plates and discs have a considerable range of shape and disposition; the aperture is terminal and linear, but the lips, as in the other species of the genus, have probably a considerable range of elasticity.

The outlines of the plates forming the test are not distinguishable in tests containing the living animal.

Until quite recently only a few records of this species had been published since it was first described by Leidy in 1879 from New Jersey, U.S.A.

4. **Sphenoderia dentata** (Moniez) Penard.

(Plate XLIII, figs. 14 and 15; and figs. 136–138 in text.)

Sphenoderia lenta

Leidy (pars) Freshw. Rhiz. N. Amer. (1879), p. 231, pl. xxxix, f. 40.

Euglypha β

Vejdovský (pars) Thier. Org. Brunnenw. Prag (1882), pp. 38–39, pl. ii, f. 1 J, K.

Euglypha dentata

Moniez in Rev. Biol. nord France, I (1888), p. 86.

Sphenoderia dentata

Penard in Mém. Soc. Genève, XXXI, 1, II (1890), p. 185, pl. x, ff. 41–50; in Jahrb. nassau. Ver. Naturk. XLIII (1890), p. 72; in Arch. Sci. nat. (3) XXVI (1891), p. 149; in Amer. Natur. XXV (1891), pp. 1071, 1081; Faune Rhiz. Léman (1902), pp. 523–525, 3 figs.; in Proc. R. Soc. Edinb. XXV (1905), p. 595; Sarcodinés in Cat. Invert. Suisse (1905), p. 108; in Brit. Antarct. Exped. I, 6 (1911), p. 221.

Forel Le Léman, III (1904). p. 135.

Murray in Proc. Roy. Soc. Edinb. XXV (1905), p. 595; in Bathym. Surv. Scott. Lochs, I (1913), p. 326.

Averintzeff in Trudui S.-Peterb. Obhsch. XXXVI, II (1906), p. 300.

Schouteden in Ann. Biol. lacustre, I (1906), p. 369.

Evans in Proc. R. Phys. Soc. Edinb. XVII (1907), table 1.

Heinis in Zool. Anzeig. XXXIII (1908), p. 714; in Arch. Hydrobiol. V (1910), p. 110; in Rev. Suisse Zool. XIX (1911), p. 255.

Cockerell in Univ. Colorado Stud. VI (1909), p. 306.

Brown in Naturalist, 1910, p. 93; in Brit. Assoc. Handb. Sheffield (1910), p. 501; in Ann. Scott. Nat. Hist. 1911, pp. 229, 230; pl. v, ff. 12–15; in Naturalist, 1912, p. 181; in Scott. Natur. 1912, pp. 109, 113; 1913, pp. 208, 210, 232.

Hopkinson in Trans. Herts Nat. Hist. Soc. XIV, 3 (1911), p. 232.

Wailes & Penard in Proc. R. Irish Acad. XXXI, LXV (1911), pp. 19, 52, 60.

Wailes in Scott. Natur. 1912, p. 61; in Trans. Liverp. Biol. Soc. XXVI (1912), p. 20; in Jrn. Linn. Soc., Zool. XXXII (1912), pp. 126, 153; in Murray's Nat. Hist. Bolivia and Peru (1913), pp. 32, 40; in Naturalist, 1913, p. 148.

Test oviform, hyaline, not compressed; composed of circular or oval silicious scales regularly imbricated, arranged in alternating diagonal rows; aperture circular, terminal, bordered by a dentate chitinous fringe; nucleus large, containing one or more nucleoles, placed posteriorly; plasma colourless, more or less granular, partly filling the test; one or two contractile vesicles usually present; pseudopodia attenuate, simple, radiating, not numerous.

Length 35–61 μ; diameter 20–33 μ; aperture 8–13 μ; nucleus 10–16 μ in diameter; circular scales 5–9 μ in diameter; oval scales 9–13 μ in length and 6–10 μ in breadth.

Habitat.—Mosses and sphagnum.

Sphenoderia dentata is generally distributed throughout the British Isles and may be looked for wherever moss is to be found.

The dentate chitinous border of the aperture (fig. 138) is similar to that of *Assulina*; it is very thin, transparent, and colourless, and its outlines are often difficult to distinguish; rarely individuals are found in which it is absent.

Fig. 136.—Oval scales of *Sphenoderia dentata*. × 1000.

The test resembles that of *Euglypha alveolata*, but is easily distinguished by the character of the aperture. The test may vary in diameter from half to two thirds of its length, but always retains its circular transverse section; it is usually very constant in its form

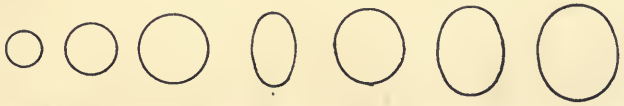

Fig. 137.—Various types of scales of *Spenoderia dentata*. × 1000.

and general appearance. The scales when oval are usually a fifth to a sixth of the length of the test; when they are circular their diameter may vary from a sixth to a tenth of that. The nucleus may contain a single nucleole or have a granular central portion. It is one of the species which are characteristic of the drier mosses.

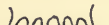

Fig. 138.—Aperture membrane of *Sphenoderia dentata*. × 1000.

Genus 36. **PAULINELLA** Lauterborn, 1895.

Paulinella Lauterborn in Zeits. wiss. Zool. LIX (1895), p. 537.

Sphenoderia (pars) West in Jrn. Linn. Soc., Zool. XXIX (1903), p. 115.

Test small, transparent, oviform, not compressed, composed of curved silicious plates in alternating transverse rows; aperture single, terminal; plasma only partially filling the test; nucleus single, placed posteriorly; pseudopodia filose.

This genus was instituted by Lauterborn for the reception of *P. chromatophora* which up to the present time remains the only species belonging to it.

1. **Paulinella chromatophora** Lauterborn.

(Plate XLIV, figs. 1–8.)

Paulinella chromatophora

Lauterborn in Zeits. wiss. Zool. LIX (1895), pp. 534–544, pl. xxx; in Jrn. R. Micr. Soc. 1895, pp. 542–543; in Zool. Centralbl. II (1895), pp. 486–487.

Eyferth Einfach. Lebensf., ed. 3 (1900), p. 269.

Levander in Medd. Soc. Fauna Fenn. XXVIII (1902), pp. 26–27 A, 161 B; in Festschr. Palmen, I (1905), II, pp. 19, 47.

Penard Faune Rhiz. Léman (1902), pp. 579–580, f. 14 (p. 572); Sarcodinés grands Lacs (1905), pp. 62–64, 107, 3 figs.; Sarcodinés in Cat. Invert. Suisse (1905), p. 111; in Proc. Roy. Soc. Edinb. XXV (1905), pp. 595, 604; in Rev. Suisse Zool. XIII (1905), pp. 603–610, pl. xiv, ff. 20–28.

Kepner in Bull. Woods Holl, IX (1905), pp. 128–129.

Murray in Proc. R. Soc. Edinb. XXV (1905), p. 615; in Bathym. Surv. Scott. Lochs, I (1913), p. 326.

Averintzeff in Trudui S.-Peterb. Obshch. XXXVI, II (1906), p. 316.

Schouteden in Ann. Biol. lacustre, I (1906), p. 372, f. 57.

Brown in Jrn. Linn. Soc., Zool. XXX (1910), pp. 360, 362, 367, pl. l, ff. 14, 15.

Test small, transparent, colourless or of a pale lemon colour, not compressed, formed of curved silicious plates with circular ends, arranged in eleven or twelve alternating transverse rows, five plates in each row; transverse section circular; aperture small, terminal, oval, provided with a short parallel neck; plasma clear, bluish, containing few granules

and devoid of food-particles, one or two curved chromatophores always present; one contractile vesicle usually visible; pseudopodia few, filose, straight and radiating.

Length 20–32 μ; diameter 14–23 μ; aperture 3–4 μ.

Habitat. — Submerged vegetation in fresh- and brackish-water.

England.—Sprinkling Tarn, Cumberland; Easdale Tarn and Windermere, Westmorland; and Highlow Tarn and tarn on Clarfe Heights, Lancashire (*Brown*).

Scotland.—Loch Ness, Inverness-shire (*Penard*).

The test of this species is of a unique character and the horse-shoe-shaped chromatophores which according to Lauterborn and Penard are always present have never been found elsewhere; these bodies appear to be a species of Alga living in symbiotic relationship so close that they act as true chromatophores; their colour is a bright blue-green and they undergo transverse division.

The absence of all trace of food-particles in some 600 or 700 individuals observed by Lauterborn and Penard points to the chromatophores as having nutritive functions.

Multiplication appears to take place by sporulation, as Penard found many half-grown forms (12–14 μ in length) which give rise by repeated division to full-sized individuals; some of the small forms were observed in conjunction.

The colour of the test is probably due to a thin chitinous lining which becomes darker with age.

Var. **pulchella** (G. S. West) var. nov. (Pl. XLIV, figs. 5 and 6.)

Sphenoderia pulchella
West in Jrn. Linn. Soc., Zool. XXIX (1903), pp. 115–116, pl. xiii, ff. 13–15.

Test larger than in the type and similar in construction but having six plates in each transverse row

instead of five; plasma similar to that of the type but without chromatophores.

Length 33–42 μ; diameter 21–25 μ; aperture 5–7·8 μ.

Habitat.—Submerged vegetation.

Ireland.—Glenties and near Lough Machugh, Donegal, and Recess, Galway (*West*).

The above are the only recorded occurrences of this form. Judging from the test alone it should be regarded as a variety only, but if the absence of chromatophores should prove to be a constant feature, it might entail such modifications of the methods of nutrition and reproduction as to entitle it to specific rank.

The aperture of the test is shown circular and not oval as in the type.

Genus 37. **CYPHODERIA** Schlumberger, 1845.

Difflugia (pars) Ehrenberg Ber. Akad. Berlin, 1840, p. 199.
Cyphoderia Schlumberger Ann. Sci. nat. (3) VII (1845), p. 254.
Lagynis Schultze Organism. Polythalm. (1854) p. 56.

Test retort-shaped, curved, yellow to colourless, devoid of adherent extraneous matter, formed either of a thin chitinous pellicle covered with discs, or of imbricated scales; transverse section circular or trigonal; aperture terminal, oblique, usually circular; plasma grey, granular, partly filling the test, containing numerous inclusions; nucleus large, placed posteriorly; contractile vesicles one or two; pseudopodia few, long, filose, simple or branched.

This genus is closely related to *Campascus* not only in general appearance but in the characters of the nucleus, the plasma, and the included bodies; in both genera the nucleus is large, granular, and includes small, bright nucleoles with a hyaline investment; the plasma is greyish, and includes, in addition to the

usual granules, small bright spherules which Rhumbler named pheosomes; they are extremely resistant to acids and other reagents; whilst their exact functions are unknown it is suggested by Penard that they may have an excretory action and be composed of urates. Small semi-crystalline bodies are also often present which may consist of oxalate of lime.

The tests of the members of this genus are formed in an unusual manner; instead of the plasma which forms the new individual being gradually protruded from the old test and the reserve scales being distributed over it at one operation, as it were, in the *Cyphoderiæ* the neck of the new test is formed first and the remainder of the test built up gradually upon it, finally finishing at the apex of the fundus.

Fig. 139.—Test of *Cyphoderia ampulla* var. *papillata*. × 260. From Wicken Fen, Cambs. (*G. S. West.*)

Those tests which are covered with non-imbricated discs consist of a fine chitinous pellicle on which the discs are orderly arranged and cemented in place; those which are formed of imbricated scales do not appear to possess this chitinous pellicle or lining.

The plasma is usually attached to the fundus of the test by a single epode which may be filamentous or may have in its length one or two expansions of the plasma; sometimes no epode is present.

The nucleus is always placed posteriorly; a large contractile vesicle is generally present near the aperture and a smaller one in its vicinity; in the plasma food-granules are usually numerous.

The species of *Cyphoderiæ* recorded from the British Isles may be looked for amongst sphagnum, mosses, and aquatic vegetation in any place not liable to desiccation, such as dripping rocks, ditches, streams, and

ponds; in addition to these localities certain species or varieties are peculiar to the fauna of deep lakes, where they have attained in most cases a considerable amount of specialisation, *e. g. C. ampulla* var. *major* in its large form 184–265 μ in length, *C. trochus* sp. ver., *C. calceolus*, *C. lævis*, and *C. myosurus*. None of these deep water forms has yet been recorded from the British Isles, and with the exception of Loch Ness no investigations of this Rhizopod fauna have been carried out; from that lake however some empty and perhaps imperfect tests were found by Penard which apparently belong to an undescribed species of this genus.

The writer has elsewhere* recorded the occurrence in Yorkshire of a single empty test doubtfully ascribed to *C. lævis*, but on further consideration has come to the conclusion that it may have been an abnormal form of *Trinema*.

Synopsis of the British Species.

Test circular in transverse section.
- Composed of non-imbricated discs. (1) *C. ampulla.*
- Composed of imbricated scales. (2) *C. trochus.*

1. **Cyphoderia ampulla** (Ehrenberg) Leidy.

(Plate XLV, figs. 2–6; Plate XLVI, figs. 1–6; and figs. 139–147 in text.)

Difflugia ampulla
Ehrenberg in Ber. Akad. Berlin, 1840, p. 199; in Abh. Akad. Berlin, 1871 (1872), pp. 234, 274, pl. iii, i, f. 11.
Pritchard Hist. Infus., ed. 4 (1861), p. 553.

Difflugia lagena
Ehrenberg in Abh. Akad. Berlin, 1841, i, p. 413, pl. iv, ii, f. 11; Mikr. Lebens in S. and N. Amer. (1843), pp. 72, 125, pl. iv, ii, f. 11; Microgeol. (1854), p. 198; in Abh. Akad. Berlin, 1871 (1872), pp. 145, 235, pl. ii, b, f. 2; *loc. cit.* p. 413, pl. iv, ii, f. 11.

Cyphoderia margaritacea
Schlumberger in Ann. Sci. nat. (3) III (1845), pp. 254–256.
Perty Kenntn. kleinst. Lebensf. (1852), p. 188.
Fresenius in Abh. senckenb. nat. Ges. II (1858), pp. 225, pl. xii, ff. 28–36.
Stein in Abh. böhm. Ges. Wiss. (5) X (1859), Ber. p. 42.

* Wailes & Penard, in 'Proc. Roy. Irish Acad.,' vol. xxxi, pt. 65.

Carter in Ann. Nat. Hist. (3) XIII (1864), pp. 33–34, pl. ii, f. 18.
Wallich in Ann. Nat. Hist. (3) XIII (1864), p. 245, pl. xvi, f. 48.
Archer in Qrt. Jrn. Micr. Sci. (n.s.) VII (1867), p. 174; in Proc. Dublin Micr. Club, I, 2 (1868), p. 118.
Wright in Qrt. Jrn. Micr. Sci. (n.s.) VII (1867), p. 175; in Proc. Dublin Micr. Club, I, 2 (1868), p. 118.
Parfitt in Trans. Devon. Assoc. III (1869), p. 67.
Hertwig & Lesser in Arch. mikr. Anat. X (1874), Suppl., pp. 123, 132–135.
Leidy in Proc. Acad. Philad. 1874 (1875), p. 227.
Schulze in Arch. mikr. Anat. XI (1875), pp. 106–139, ff. 12–22.
Allman in Jrn. Linn. Soc. XIII (1877), p. 227.
Eyferth Einfach. Lebensf. (1878), p. 34, pl. ii, f. 13; ed. 2 (1885), p. 52, pl. iii, f. 35.
Buetschli in Bronn's Thierreichs, I, 1 (1880), pl. iii, f. 13.
Parona in Boll. Scient. II (1880), pp. 47, 48; *op. cit.* IV (1882), pp. 52, 57; in Arch. Sci. nat. (3) X (1883), p. 238.
Plessis-Gouret Faune lacs Suisse (1885), p. 8.
Blochmann Mikr. Thierw. Süsswass. (1886), p. 14, pl. i, f. 31; ed. 2 (1895), p. 18, pl. i, f. 24.
Moebius in Abh. Akad. Berlin, 1888 (1889), II, p. 19; in Arch. Naturg. LVI, I (1890), p. 115.
Penard in Jahrb. nassau. Ver. Naturk. XLII (1889), p. 144; *op. cit.* XLIII (1890), p. 71; in Mém. Soc. Genève, XXXI, I (1890), II, pp. 174–175, pl. viii, ff. 50–64; in Arch. Sci. nat. (3) XXVI (1891), p. 146; in Amer. Natur. XXV (1891), p. 1071; in Rev. Suisse Zool. VII (1899), I, pp. 59–61, etc., pl. v, ff. 18–24; in Arch. Sci. nat. (4) VII (1899), pp. 243, 265, 266; Faune Rhiz. Léman (1902), pp. 472–475, 5 figs.
Sacchi in Boll. Scient. IX (1889), p. 68; in Jrn. Microg. XIV (1890), p. 109.
Daday in Termész. Füzetek, XV (1892), pp. 9, 27, etc.; in Zool. Jahrb., Syst. XIX (1904), pp. 473, 539, 540; in Math. Termész. értes. XXIV (1906), p. 49; in Deutsch-Ost-Africa, IV, XXIII (1910), p. 10.
Levander in Arch. Ver. Mecklenb. XLVI (1892), p. 114; in Zool. Anzeig. XVII (1894), p. 210; in Acta Soc. Fauna Fenn. XII (1894), II, pp. 4, 6, 21–22, pl. i, ff. 19, 20; *op. cit.* XVIII (1900), VI, p. 47; XX (1901), V, pp. 11, 21; in Festschr. Palmen, I (1905), II, pp. 19, 47.
Rhumbler in Zeits. wiss. Zool. LXI (1895), pp. 43, 46–68, pl. v, ff. 1–15, text-ff. 1–8; in Arch. Naturg. LXVIII, II (1907), 3, Prot., pp. 53–54.
Schewiakoff in Mém. Acad. St. Pétersb. (7) XLI, VIII (1893), p. 98.
Zacharius in Forschb. Plon. II (1894), p. 57.
Delage & Hérouard Traité Zool. concrète, I (1896), p. 112, f. 143.
André in Jahresb. nat. Ges. Graubund. XLI (1897), pp. 57–59.
Frenzel in Bibl. Zool. IV, XII (1897), p. 150.
Frič & Vávre in Arch. Landesf. Böhmen, X (1897), III, p. 69.
Fuhrmann in Rev. Suisse Zool. IV (1897), pp. 494, 504; in Bull. Soc. Neuchâtel, XXVIII (1900), p. 93.
Schaudinn in Deutsch-Ost-Africa, IV, XVII (1897), p. 10.
Godet in Bull. Soc. Neuchâtel XXVIII (1900), p. 78.
Averintzeff in Trudui S.-Peterb. Obshch. XXXI (1900), I, pp. 330, 347; *op. cit.* XXXVI (1906), II, p. 85.

Lagerheim in Geol. Fören. Stockholm Förh. XXIII (1901), 6, pp. 472, 473, 475.
Forel Le Léman, III (1904), p. 137.
Murray in Proc. Roy. Soc. Edinb. XXV (1905), p. 615.
Huber in Arch. Hydrobiol. II (1907), pp. 456, 460, 462.
Butler in Brit. Assoc. Handb. Dublin (1908), p. 218.
Hoogenraad in Tijds. Nederl. Dierk. Ver. (2) X (1908), pp. 413, 424.
Kofoid in Bull. Illinois Lab. VIII (1908), pp. 103, 325.
Samsonoff in Sitzb. Nat. Ges. Jurjew, XVII (1908), II, p. 48.
Thiebaud in Ann. Biol. lacustre, III (1908), p. 121.
Cockerell in Univ. Colorado Stud. VI (1909), p. 305.
Schmidt in Arch. Protist. XXIX (1913), pp. 220, 226.

Euglypha curvata
Perty Kenntn. kleinst. Lebensf. (1852), p. 187, pl. viii, f. 21.

Lagynis baltica
Schultze Organism. Polythalm. (1854), p. 56, pl. i, ff. 7, 8.
Purkyne in Ziva, III (1855), f. 1 (4).
Carpenter Foram. (Ray Soc. 1862), p. 34, pl. i, f. 21 *a*, *b*.

Euglypha ampulla
Claparède & Lachmann Étude Inf. et Rhiz. I (1859), p. 448.

Euglypha baltica
Wallich in Ann. Nat. Hist. (3) XIII (1864), p. 245.

Euglypha margaritacea
Wallich in Ann. Nat. Hist. (3) XIII (1864), pp. 240, 244, 245, pl. xvi, f. 48.
Zacharias in Forsch. deutsch. Land.-Volks. IV (1890), p. 429.

Difflugia aduncа
Ehrenberg in Abh. Akad. Berlin, 1871 (1872), p. 248, pl. iii, 1, ff. 8, 9.

Difflugia alabamensis
Ehrenberg in Abh. Akad. Berlin, 1871 (1872), pl. iii, 1, f. 10.

Difflugia uncinnata
Ehrenberg in Abh. Akad. Berlin, 1871 (1872), p. 258, pl. iii, 1, f. 13.

Difflugia margaritacea
Ehrenberg in Abh. Akad. Berlin, 1871 (1872), p. 264.

Cyphoderia ampulla
Leidy in Proc. Akad. Philad. 1878, p. 173; *op. cit.* 1879, p. 163; Freshw. Rhiz. N. Amer. (1879), pp. 202–204, 290, 291, pl. xxxiv, ff. 1–16.
Parona in Boll. Scient. II (1880), pp. 47, 48.
Gruber in Zeits. wiss. Zool. XXXVI (1881), p. 122, pl. iv, ff. 4–13; in Zacharias' Tier Süsswass. (1891), p. 140, f. 16 (8).
Hitchcock Synops. Freshw. Rhiz. (1881), p. 34.
Vejdovský in Sitzb. böhm. Ges. Wiss. 1880 (1881), pp. 136, 138; Thier. Org. Brunnenw. Prag (1882), p. 40.
Taránek in Sitzb. böhm. Ges. Wiss. 1881 (1882), p. 234.
Imhof in Zool. Anzeig. VII (1884), p. 321; *op. cit.* VIII (1885), p. 162; XI (1888), p. 565; in Viertelj. nat. Ges. Zürich, XXX (1885), p. 384; in Jahresb. nat. Ges. Graubund. XXX (1887), p. 65.
Tarr in Rep. N. York State Museum, XXXV (1884), p. 167.
Bolton in Midland Natur. IX (1886), p. 174.
Forel Lac Léman, ed. 2 (1886), p. 60; in Boll. Scient. IX (1887), p. 90.
Ludwig in Leunis' Synops. Thierk., ed. 3, II (1886), p. 1170.
Moniez in Rev. Biol. nord France, I (1888), p. 86.

Lord in Sci. Gossip, 1891, pp. 245–246, ff. 203–205; *op. cit.* 1892, p. 129; in Trans. Manch. Micr. Soc. 1891 (1892), p. 56; *op. cit.* 1904 (1905), p. 56.
Cash in Trans. Manch. Micr. Soc. 1891 (1892), p. 52.
Zacharias in Forschb. Plon, I (1893), p. 3; in Zool. Anzeig. XXII (1899), pp. 49, 51.
Zschokke in Verh. nat. Ges. Basel, XI (1895), pp. 43, 50, 110; in Nouv. Mém. Soc. Helvét. XXXVII (1900), pp. 55, 56.
Entz in Res. Erforsch. Balatons. II (1897), i, p. xxiv.
Frič & Vávre in Arch. Landesf. Böhmen, X (1897), iii, pp. 46–60 *passim*, f. 14 (17).
Fuhrmann in Rev. Suisse Zool. IV (1897), pp. 494, 505, 526; in Bull. Soc. Neuchâtel, XXVIII (1900), p. 93.
André in Jahresb. Ges. Graubünd. (n. f.) XLI (1898), pp. 57, 58, 59.
Eyferth Einfach. Lebensf., ed. 3 (1900), p. 268.
Averintzeff in Trudui S.-Peterb. Obshch. III (1900), i, p. 240; *op. cit.* (pars) XXXVI (1906), ii, p. 107, pl. i, ff. 7, 9, 10, 24; pl. ii, f. 28; pl. iv, f. 59; pp. 305–308; in Arch. Protist. VIII (1906), p. 114.
Godet in Bull. Soc. Neuchâtel, XXVIII (1900), p. 78.
Levander in Acta Soc. Fauna Fenn. XX (1901), viii, p. 12.
West in Jrn. Linn. Soc., Zool. XXVIII (1901), p. 330; in Ann. Scott. Nat. Hist. 1905, pp. 90, 91, 92.
Scharff in Irish Natur. XI (1902), p. 26.
Daday in Zool. Jahrb., Syst. XIX (1903), pp. 42, 94; in Zoologica, XVIII, xliv (1905), p. 20; in Math. Termész. értes. XXIV (1906), pp. 37, 69, 74; *op. cit.* XXV (1907), pp. 405, 418; in Zoologica, XXXIII, lix (1910), pp. 13, 32, 35.
Cushman & Henderson in Amer. Natur. XXXIX (1905), pp. 153–154.
Odell in Ottawa Natur. XIX (1905), p. 19.
Penard Sarcodinés grands Lacs (1905), pp. 108, 115, 118, 120; Sarcodinés in Cat. Invert. Suisse (1905), p. 97–98; in Proc. Roy. Soc. Edinb. XXV (1905), p. 608; in Rev. Suisse Zool. XVI (1908), pp. 462, 465; in Brit. Antarct. Exped. I (1911), p. 220, 229–230.
Schouteden (pars) in Ann. Biol. lacustre, I (1906), pp. 370–371, f. 48.
Thiebaud in Ann. Biol. lacustre, III (1908), p. 15.
Brown in Naturalist, 1909, p. 107; in Jrn. Linn. Soc., Zool. XXX (1910), pp. 360, 362; in Ann. Scott. Nat. Hist. 1911, pp. 229, 230; in Brit. Assoc. Handb. Sheffield (1910), pp. 500, 501; in Naturalist, 1912, p. 181; in Scott. Natur. 1912, pp. 60, 63.
Honigmann in Abh. Mus. Magdeburg, II (1909), p. 62, pl. ii, f. 8.
Heinis in Arch. Hydrobiol. V (1910), p. 108.
Hopkinson in Irish Natur. 1910, pp. 3, 4.
Wailes & Penard in Proc. R. Irish Acad. XXXI, lxv (1911), pp. 15, 28–29, 59, 60, 61, pl. i, ff. 6 *a*, *b*, 9 *a*, *b*; pl. ii, f. 9 *c–f*.
Edmondson in Univ. Colorado Stud. IX (1912), p. 69.
Wailes in Scott. Natur. 1912, pp. 60, 63; in Trans. Liverp. Biol. Soc. XXVI (1912), p. 20; in Jrn. Linn. Soc. XXXII (1912), pp. 126, 151; *op. cit.* XIII (1913), p. 213; in Murray's Nat. Hist. Bolivia and Peru (1913), pp. 32, 35–36; in Naturalist, 1913, p. 147.
Cunha in Mem. Inst. Oswaldo Cruz, V (1913), 2, p. 102.
Murray in Bathym. Surv. Scott. Lochs, I (1913), p. 326.

Cyphoderia

Verworn Allgem. Physiol., ed. 2 (1897), p. 447, f. 217; (transl.) Physiol. générale (1900), p. 489, f. 217.

Test yellow, or rarely colourless, translucent, composed of non-imbricated discs usually arranged in diagonal rows on a thin chitinous pellicle; transverse section circular; aperture circular, placed obliquely, with a curved neck; plasma grey, partly filling the test, containing many granules and food-particles; nucleus large, granular, containing numerous nucleoles and placed posteriorly; one large and one smaller contractile vesicle usually present; pseudopodia filiform, attenuate, long, straight or curved.

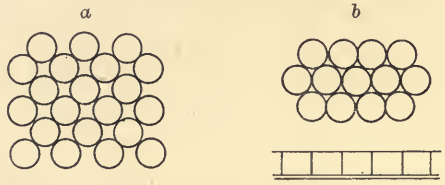

Fig. 140.—Portions of tests of *Cyphoderia ampulla*. × 2000. *b*, with section.

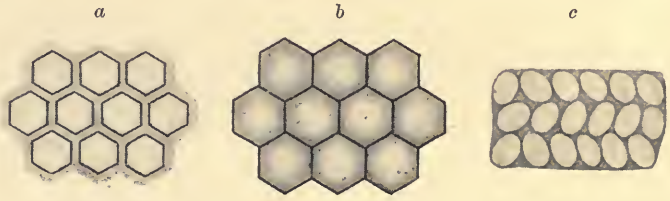

Fig. 141.—Portions of tests of the same. × 2000.

Length 61–190 μ (usually 100–140 μ); diameter 33–72 μ; aperture 10–22 μ.

Habitat.—Wet mosses, sphagnum, and aquatic vegetation.

England. — Cumberland (*Brown*); Westmorland (*West*, *Brown*); Lancashire (*Cash*); N. and W. Yorkshire; Isle of Man; Cheshire (*Cash*); Derbyshire (*Brown*); Warwickshire (*Bolton*); Bedfordshire; Essex (*Scourfield*); Surrey (*West*).

Wales.—North Wales! (*Cash*). Snowdon, Carnarvonshire, 3000 feet (*West*).

Scotland.—Shetlands and Orkneys! (*West*); St.

Kilda (*Brown*), Outer Hebrides! (*West*); Inverness-shire (*West, Brown*); Elginshire, Aberdeenshire, Perthshire, and Argyllshire (*Brown*); Forth area (*Evans*); Kirkcudbrightshire and Wigtownshire (*Brown*).

IRELAND.—Mayo and the islands off Clew Bay; Lough Corrib, Galway (*West*); King's County (*Wright*); Wicklow! (*Hopk.*); Kerry.

The presence of pheosomes and small crystalline bodies in the plasma of this and other species of the

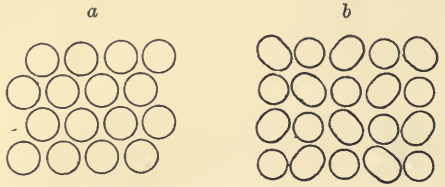

FIG. 142.—Portions of tests of *Cyphoderia ampulla*. × 2000.

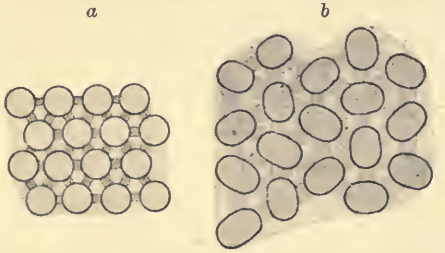

FIG. 143.—Portions of tests of the same. × 2000.

genus has already been noted. The test of *C. ampulla* has either a simple hemispherical fundus or the apex may be mamillated; the two forms are frequently found in association. The small discs of which the test is composed range from 1·5 to 2·5 μ (rarely 3 μ) in diameter and from 1·5 to 2 μ in thickness; they are arranged in various ways which may be grouped as follows:—

(1) The discs may be circular or oval touching one another, the angular interstices being of a lighter or darker colour; the discs are arranged in either parallel or alternating rows (figs. 140 *a* and *b*, 141 *c*).

(2) The discs have an hexagonal appearance and

either touch or are separated from one another (figs. 141 *a* and *b*). Penard first pointed out that when these tests are disintegrated by acid the residue consists of circular discs, the hexagonal appearance being probably due to the cementing material which is soluble in the acid.

(3) The discs are either circular or oval and are an appreciable distance apart; they may be all circular or all oval or may be mixed (figs. 142 and 143); the cementing material may be homogeneous or consist of two kinds, one more transparent than the other; the former is quickly dissolved by boiling sulphuric acid, the latter is more resistant but is eventually dissolved, leaving the discs isolated; this arrangement of discs is described by Wallich (1864). Both circular and oval discs as shown in figs. 143 *a* and *b* may be connected by these darker bands of cementing material.

C. truncata F. E. Schulze* may be a form of *C. ampulla*, but the neck is very short and rarely has an oblique aperture.

Var. **vitræa** Wailes. (Pl. XLVI, fig. 2, and fig. 144 in text.)

Cyphoderia ampulla var. *vitræa*
Wailes & Penard in Proc. Roy. Irish Acad. XXXI, lxv (1911), pp. 27, 28, 29-30, pl. i, ff. 6 *a*, 6 *b*.
Wailes in Scott. Natur. 1912, pp. 60, 63; in Naturalist, 1913, p. 147; in Murray's Nat. Hist. Bolivia and Peru (1913), pp. 32, 36.

Test similar in shape to the type but appearing homogeneous and transparent; plasma and pseudopodia as in the type.

Length 67–120 μ (average 100–110 μ); diameter 32–50 μ; aperture 12–18 μ.

Habitat.—Sphagnum and aquatic vegetation. Rare.

England.—Oldstead, N. Yorkshire; Flitwick, Bedfordshire (*J. Saunders*, coll.).

Scotland.—Shetlands; Orkneys.

Ireland.—Roonah, Mayo.

* 'Arch. f. mikr. Anat.,' Bd. xl (1875), pl. v, ff. 21, 22.

The pale lemon colour and transparency of the tests of this variety are very distinctive features. After treatment with boiling sulphuric acid there is left a residue of small circular discs, showing that the test

Fig. 144.—Outlines of tests of *Cyphoderia ampulla* var. *vitrœa*. × 260. *a*, normal form. *b*, with papillose fundus.

is in reality constructed in a similar manner to that of the type. It occurs in Switzerland (Penard), also numerously at La Paz, S. America.

Var. **papillata** Wailes. (Pl. XLVI, fig. 4, and fig. 145 *a* in text.)

Cyphoderia ampulla
Leidy (pars) Freshw. Rhiz. N. Amer. (1879), p. 203, pl. xxxiv, ff. 5, 6.
Cyphoderia ampulla var. *papillata*
Wailes & Penard in Proc. Roy. Irish Acad. XXXI, lxv (1911), pp. 26, 27, 28, 29, pl. i, f. 7.
Edmondson in Univ. Colorado Stud. IX (1912), p. 69.
Wailes in Jrn. Linn. Soc. XXXII (1912), p. 151; in Naturalist, 1913, p. 147.

Test similar to that of the type but having the fundus tapering to a more or less sharply-rounded apex; plasma and pseudopodia normal.

Fig. 145.—Outlines of tests of varieties of *Cyphoderia ampulla*. *a*, var. *papillata*. × 260. *b*, var. *major*. × 160.

Length 113–135 μ; diameter 43–49 μ; aperture 14–16 μ.

Habitat.—Sphagnum and aquatic vegetation.

England.—Pilmoor, N. Yorkshire; Cheshire (*Cash*); Wicken Fen, Cambridgeshire (*West*).

Ireland.—Clare Island, Mayo.

The discs forming the tests of this variety have, up to the present, been found arranged only as figs. 140 *b* and 142 *a*; in all cases they were 2 μ in diameter and when arranged as in fig. 142 *a* were 3 μ from centre to centre. The test is in shape very similar to that of *C. trochus* var. *palustris*, but its structure is quite different, as it is composed of discs and not of imbricated scales.

Var. **major** Penard. (Pl. XLVI, figs. 5 and 6, and figs. 145 *b*, 146, and 147 in text.)

Cyphoderia margaritacea var. *major*
Penard in Mém. Soc. Genève, XXXI, i, II (1890), p. 175, pl. viii, ff. 65–67.
Cyphoderia ampulla var. *major*
Wailes & Penard in Proc. Roy. Irish Acad. XXXI, LXV (1911), pp. 27, 28, 30–31, pl. i, f. 8, pl. ii, f. 10.
Wailes in Trans. Liverp. Biol. Soc. XXVI (1912), p. 20; in Naturalist, 1913, p. 147.

Test with hemispherical or slightly flattened fundus and short neck, composed of circular discs on a thin chitinous pellicle, each disc surrounded by circular or oval markings disposed in a regular order; nucleus larger than in the type; plasma and pseudopodia normal.

Length 80–190 μ; diameter 36–67 μ; aperture 13–23 μ.

Habitat.—Sphagnum, mosses, and aquatic vegetation.

England.—Port Erin, Isle of Man; Oldstead, N. Yorkshire; Flitwick, Bedfordshire.

Ireland.—Inishbofin, Galway.

First found by Penard in the deep waters of the Lake of Geneva in a large form averaging 220 μ in length (varying from 180 to 265 μ). The Swiss and British examples found in sphagnum (Flitwick), in moss on dripping rocks (Port Erin), and amongst aquatic vegetation (lake on Inishbofin), are smaller and tend to show that the deep-water form, as indeed

might be expected, is a specialized form of the sphagnum- and moss-inhabiting variety.

Whatever may be the size of the test it is at once identified by an examination of its structure. No

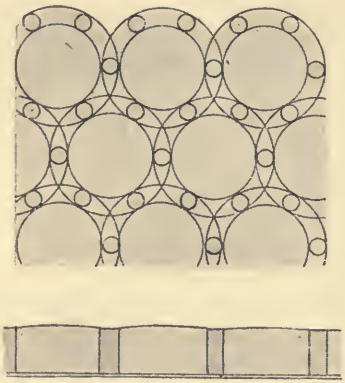

Fig. 146.—Portion of test of *Cyphoderia ampulla* var. *major*, and section of same. × 4000.

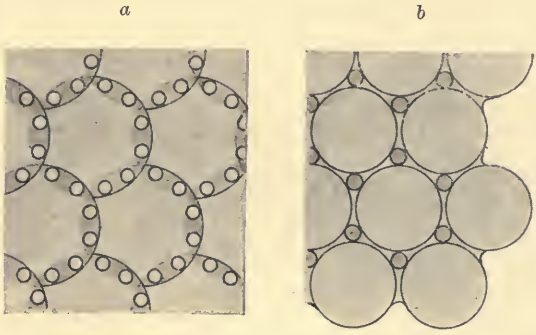

Fig. 147.—Portions of test of *Cyphoderia ampulla* var. *major*. × 4000. *a*, from Port Erin, Isle of Man; *b*, another specimen from same locality showing line of a fracture.

other known species of *Cyphoderia* possesses the small circular or oval "perforations" geometrically arranged around the scales; these "perforations" are in the living animal filled up by a chitinous cement which is dissolved out by cold sulphuric acid, the test itself remaining unaffected.

Three different arrangements of these "perforations" as found in tests from several localities are illustrated in figs. 146 and 147; the pattern of fig. 5, Pl. XLVI, has a superficial resemblance to the arrangement of the bars on tests of *Arcella vulgaris* which are in three sets of parallel lines disposed at angles of 60° apart.

The nucleus is large, granular, and contains a small number of bluish nucleoles surrounded by hyaline rings. The presence in the plasma of foreign bodies, perhaps urates and crystals of oxalate of lime, as in other members of the genus, has been noticed above.

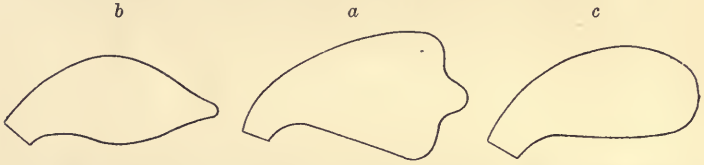

Fig. 148.—Outlines of tests of *Cyphoderia trochus* and two varieties. × 240. *a*, *C. trochus* (type); *b*, var. *palustris*; *c*, var. *amphoralis*.

2. **Cyphoderia trochus** Penard.

Plate XLV, fig. 1, and figs. 148–150 in text.)

Cyphoderia ampulla
Apstein Süsswasserplankton (1896), p. 153, f. 55.
Averintzeff (pars) in Trudui S.-Peterb. Obshch. XXXVI (1906), II, pp. 306, 307.
Schouteden (pars) in Ann. Biol. lacustre, I (1906), pp. 370–371.
Cyphoderia trochus
Penard in Rev. Suisse Zool. VII, i (1899), II, pp. 72–75, 106, 115, pl. vii, ff. 1–14; Faune Rhiz. Léman (1902), pp. 485–488, 10 figs.; Sarcodinés grands Lacs (1905), pp. 48–50, 110–123 *passim*, fig. p. 49; Sarcodinés in Cat. Invert. Suisse (1905), p. 90; in Rev. Suisse Zool. XVI (1908), p. 462.
Forel Le Léman, III (1904), p. 137.
Zschokke in Arch. Hydrobiol. I (1906), p. 4.
Kofoid in Bull. Illinois Lab. XVI (1908), p. 103.
Wailes & Penard in Proc. R. Irish Acad. XXXI, LXV (1911), p. 31, ff. 11, 14 *a–c*.

Test conical with mamillate fundus, tapering towards the curved neck; composed of circular bi-convex imbricated scales arranged in diagonal rows; aperture oval, oblique; plasma normal; pseudopodia filiform, long, and straight.

Length 110–120 μ.

Habitat.—Restricted to deep-water lakes. The type has not been recorded from the British Isles, where the species is represented by two varieties.

Var. **palustris** Penard. (Pl. XLV, fig. 1, and fig. 148 *b* in text.)

Cyphoderia trochus
Penard (pars) Faune Rhiz. Léman (1902), p. 488, ff. 1–7.
Cyphoderia trochus var. *palustris*
Wailes & Penard in Proc. R. Irish Acad. XXXI, lxv (1911), p. 31, pl. ii, ff. 12, 141 *a–c*.

Test more elongate than in the type, the fundus tapering more or less gradually to a pointed apex; formed of imbricated bi-convex scales; plasma and pseudopodia as in the type.

Length 100–125 μ.

Habitat.—Sphagnum.

Records of *C. trochus* from the British Isles may refer either to this variety or to *C. ampulla* var. *papillata*, these varieties of the two species being very similar in the shape of the tests but distinguishable by the difference in their structure, only the former having imbricated scales. In the absence of definite information on this point, records of *C. trochus* or its varieties cannot be confirmed. The writer has never found this variety in the British Isles.

The individual figured by Cash (Pl. XLV, fig. 1) apparently represents this variety as the test is of the typical form.

Var. **amphoralis** Wailes. (Figs. 148 *c*, 149, and 150.)

Cyphoderia ampulla
Penard (pars) in Proc. Roy. Soc. Edinb. XXV (1905), p. 602.
Cyphoderia ampulla var. *imbricata*
Penard (pars) Sarcodinés in Cat. Invert. Suisse (1905), p. 98.
Brown in Naturalist, 1912, p. 181.
Cyphoderia trochus var. *amphoralis*
Wailes in Proc. R. Irish Acad. XXXI, lxv (1911), pp. 31–32, pl. ii, ff. 13, 14 *a–c*; in Jrn. Linn. Soc., Zool. XXXII (1912), pp. 126, 128, 151; in Scott. Natur. 1912, pp. 60, 63.

Test with hemispherical or slightly flattened fundus, circular in transverse section; formed of imbricated bi-convex discs arranged in diagonal rows; plasma and pseudopodia as in the type.

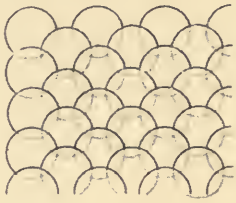

Fig. 149.—Portion of a test of *Cyphoderia trochus* var. *amphoralis*. × 2000.

Length 87–153 μ; diameter 38–52 μ; aperture 12–20 μ.

Habitat.—Sphagnum, mosses, and aquatic vegetation.

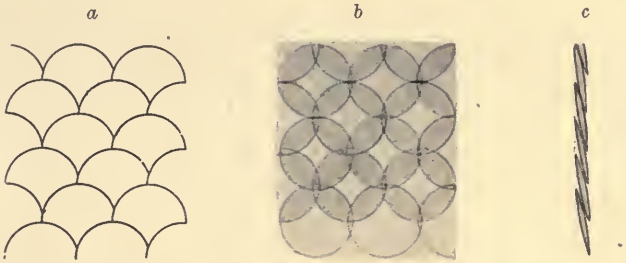

Fig. 150.—Portion of a test of *Cyphoderia trochus* var. *amphoralis*. × 2000. *a*, portion of surface; *b*, optical section of same; *c*, transverse section.

England.—Westmorland; Isle of Man; Yorkshire; Derbyshire (*Brown*); Bedfordshire; Hampshire; Isle of Wight.

Wales.—Llyn Crafnant, Carnarvonshire (*Hopk.*).

Scotland.—Shetlands; Loch Ness, Inverness-shire (*Penard*); Skye.

Ireland.—Mayo and the islands off Clew Bay; Wicklow; Kerry.

The test in this variety is similar in form to that of *C. ampulla*, but is composed of the imbricated discs which are typical of *C. trochus*. The discs usually vary from 4 to 5 μ in diameter, but sometimes do not exceed 3·5 μ, becoming even smaller, 3·5 to 2·75 μ, towards the apex; the amount of imbrication is also variable, as shown in figs. 149 and 150; the markings where three or four scales overlap, although similar in disposition are quite different in origin and appearance from the perforations in the tests of *C. ampulla* var. *major*.

The exposed edges of the scales occasionally have a dentate appearance which is probably due to the disposition of the chitinous cement by which they are fastened together.

In the few districts which we have investigated fairly thoroughly, *i. e.* North Riding of Yorkshire and Western Mayo, this variety is not uncommon, and it will no doubt be found to be widely distributed in the British Isles. Either this variety or var. *palustris* is probably the prototype of *C. trochus* sensu stricta, an exclusively deep-water form. Some of the records of *C. ampulla* doubtless refer to it.

Genus 38. **CAMPASCUS** Leidy, 1877.

Leidy in Proc. Acad. Philad. 1877, p. 294.

Test retort-shaped with curved neck, composed of a chitinous pellicle with a covering of amorphous scales; transverse section trigonal with rounded angles; aperture circular, oblique, furnished with a thin, transparent, disc-shaped collar; nucleus large with several nucleoles, placed posteriorly; one or more contractile vesicles; plasma similar to that of the *Cyphoderiæ*; pseudopodia few, straight, filose, unbranched.

In the form of the test, and in the constitution of and inclusions in the plasma, the members of this genus are very closely allied to the *Cyphoderiæ*; they

are however readily distinguished from that genus by the hyaline collar around the aperture of the test and by the absence of any uniformity in the shape or arrangement of the scales which cover the test. From *Nadinella* this genus is distinguished by the curved neck of the test.

Three members of the genus have been described, viz. *C. cornutus* Leidy, *C. triqueter* Penard, and *C. minutus* Penard. Only the last named has been recorded from the British Isles.

1. **Campascus minutus** Penard.

(Plate XLVI, figs. 7–9.)

Campascus minutus

Penard in Rev. Suisse Zool. VII (1899), pp. 58–59, 102, 106, 109, pl. v, ff. 15–17; *op. cit.* IX (1901), p. 231; Faune Rhiz. Léman (1902), pp. 469–470, 4 figs.; in Proc. Roy. Soc. Edinb. XXV (1905), pp. 593, 601–602, 608; Sarcodinés grands Lacs (1905), pp. 53–54, 110, 119, 126, fig. p. 53; Sarcodinés in Cat. Invert. Suisse (1905), pp. 96–97; in Rev. Suisse Zool. XVI (1908), pp. 461, 465.

Murray in Proc. Roy. Soc. Edinb. XXV (1905), p. 615; in Bathym. Surv. Scott. Lochs, I (1913), p. 336.

Zschokke in Arch. Hydrobiol. II (1906), p. 6.

Thiébaud in Ann. Biol. lacustre, III (1908), p. 66.

Wailes in Scott. Natur. 1912, pp. 60, 62; in Jrn. Linn. Soc., Zool. XXXII (1912), pp. 126, 151.

Campascus triqueter var. *minuta*

Averintzeff in Trudui S.-Peterb. Obshch. XXXVI, II (1906), p. 304.

Test small, yellow, translucent, retort shaped; formed of a thin chitinous pellicle with a covering of small, flat, amorphous scales; transverse section trigonal with broadly-rounded angles; nucleus grey, granular, containing one or more nucleoles; plasma grey, partly filling the test and containing pheosomes, crystalline bodies, and food-particles; one contractile vesicle usually present; pseudopodia straight, usually single.

Length 50–60 μ; breadth 32–36 μ; aperture 10–12 μ; thickness about 25 μ; diameter of collar 15–17 μ.

Habitat.—Deep lakes, sphagnum, and aquatic vegetation.

England. — Windermere, Westmorland (*Brown*); Dunham Marsh, Cheshire (*Cash*).

Scotland.—North Uist, Outer Hebrides; Loch Ness, Inverness-shire (*Penard*).

The plasma and its inclusions and the nucleus are similar to those of the genus *Cyphoderia* which have already been described.

Genus 39. **TRINEMA** Dujardin, 1841.

Difflugia (pars) Ehrenberg Infusionsth. (1838), p. 132.
Trinema Dujardin Zooph., Infus. (1841), p. 249.
Arcella (pars) Ehrenberg in Ber. Akad. Berlin, 1844, p. 256.

Test small, hyaline, oviform or elongate, compressed anteriorly, covered with circular silicious plates; aperture circular, oblique, invaginated; plasma colourless, granular; nucleus of moderate size with one or more nucleoles, placed posteriorly; pseudopodia filose, of extreme tenuity, usually few and unbranched.

This genus is generally distributed and is usually numerously represented in any gathering of moss or sphagnum.

Ehrenberg gave names to various forms which cannot now be identified; Leidy included under the name of *T. enchelys* two other species which have since then been given specific names by Penard and seem clearly differentiated; these three species are the only members of this genus which have, up till now, been recorded from the British Isles.

T. verrucosum Francé (1897) has a test sparsely covered with silicious nodules.

T. spinosum Penard (1890) is *Pamphagus armatus* Lauterborn (*Lecythium spinosum* of this work). *T. Sauvenati* Certes (1889) is not a Rhizopod but a Rotifer.

Synopsis of the British Species.

Test ovoid, tapering both in broad and narrow views towards the aperture; formed of easily distinguishable circular plates. (1) *T. enchelys.*

Test elongate, small, usually homogeneous in appearance. (2) *T. lineare.*

Test in broad view of nearly equal width, with semicircular ends, and formed of well-marked circular plates. (3) *T. complanatum.*

1. **Trinema enchelys** (Ehrenberg) Leidy.*

(Plate XLVII, figs. 1–10; Pl. XLVIII, figs. 1–3; and figs. 152 and 153 in text.)

Difflugia enchelys

Ehrenberg (pars) Infusionsth. (1838), p. 132, pl. ix, f. 4 *a*, *b*.

Pritchard (pars) Hist. Infus. (1842), p. 168; ed. 2 (1845), p. 168; ed. 3 (1852), p. 208; ed. 4 (1861), p. 553, pl. xxi, f. 19.

Gruber in Zeits. wiss. Zool. XXXVI (1891), p. 15.

Arcella enchelys

Ehrenberg in Ber. Akad. Berlin, 1844, pp. 256, 338; *op. cit.* 1845, pp. 138, 146, 148, 170, 319; in Abh. Akad. Berlin, 1847 (1849), pp. 444, 460, pl. i, II, f. 63; pl. vi, III, f. 64; Mikrogeol. (1854), pl. xiv, f. 96 *b*; pl. xxxix, II, f. 4.

Perty in Mitth. nat. Ges. Bern, 1849, p. 155; Kenntn. kleinst. Lebensf. (1852), p. 187.

Trinema acinus

Dujardin Hist. Zooph., Infus. (1841), p. 249, pl. iv, f. 1.

Perty Kenntn. kleinst. Lebensf. (1852), p. 187.

Purkyne in Ziva, III (1855), p. 212, f. 2 (4).

Fresenius in Abh. senckenb. nat. Ges. II (1858), p. 223, ff. 25–27.

Claparède & Lachmann Études Inf. et Rhiz. I, 2 (1859), pp. 453–456.

Pritchard Hist. Infus., ed. 4 (1861), p. 556. pl. xxi, f. 9.

Archer in Qrt. Jrn. Micr. Sci. (N. S.), VII (1867), p. 174; *op. cit.* XIV (1874), p. 107; in Proc. Dubl. Micr. Club, I, 2 (1868), p. 118; *op. cit.* II, 3 (1875), p. 301.

Barker in Qrt. Jrn. Micr. Sci. (N. S.), VIII (1868), pp. 188–189; in Proc. Dubl. Micr. Club, I, 4 (1870), p. 181.

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Schulze in Arch. mikr. Anat. XI (1875), pp. 104–106, pl. v, ff. 9–11.

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* Many of the references given under this species may record *Trinema lineare* Penard. Even when figured it is not always possible to identify the species. Some doubt may also attach to a few of the references under *T. lineare.*

Imhof in Viertelj. nat. Ges. Zürich, XXX (1885), p. 384; in Jahresb. nat. Ges. Graubünd. III (1887), p. 103.
Parona in Boll. Scient. II (1880), pp. 47, 48.
Lord in Sci. Gossip, 1891, pp. 268–269, ff. 219–223; *op. cit.* 1892, p. 129; in Trans. Manch. Micr. Soc. 1891 (1892), p. 56; *op. cit.* 1894 (1895), p. 56.
Cash in Trans. Manch. Micr. Soc. 1891 (1892), p. 52, pl. ii, ff. 6–8.
Levander in Acta Soc. Fauna Fenn. XII (1894), II, pp. 6, 22.
Francé in Res. Erforsch. Balatons. II, I (1897), pp. 9, 10.
Penard in Rev. Suisse Zool. VII (1899), I, p. 121.
Lagerheim in Geol. Fören. Stockholm Förh. XXIII (1901), pp. 471, 472.
Butler in Brit. Assoc. Handb. Dublin (1908), p. 219.
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Carter in Ann. Nat. Hist. (2) XX (1857), pp. 35, 41, pl. i, f. 19 *a–i*.

Euglypha enchelys

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Trinema (*Difflugia*) *encheli*

Crevier in Nat. Canad. II (1870), p. 73.

Trinema enchelys

Leidy in Proc. Acad. Philad. 1878, p. 172; *op. cit.* 1879, p. 163; 1880, pp. 336, 339–340; (pars) Freshw. Rhiz. N. Amer. (1879), pp. 226–229, 290, 292, 293, pl. xxxix, ff. 1–9, 14–17, 19–31, 34–38, 42–46, 51–60, 64–66.
Parona in Boll. Scient. II (1880), p. 47.
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De Guerne Excurs. zool. Fayal, &c. (1888), p. 31; in Compt. rend. Soc. Biol. 1888, p. 298.
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Barrois in Mém. Soc. Sci. Lille, (5) VI (1896), pp. 48–108 *passim*, 143.
Entz in Res. Erforsch. Balatons. II, i (1897), p. xxiv; in Math. Termesz. értes. XV (1897), p. 171–173, 176.
Averintzeff in Trudui S.-Peterb. Obshch. XXX, i (1900), p. 249; *op. cit.* (pars) XXXVI, ii (1906), pp. 87, 107, pl. ii, f. 30; pp. 311–313; in Arch. Protist. VIII (1906), p. 114; in Ann. Biol. lacustre, I (1906), pp. 321–322, f. 1; in Zool. Anzeig. XXXI (1907), pp. 245, 310–311, f. 1.
Eyferth Einfach. Lebensf., ed. 3 (1900), p. 268.
Godet in Bull. Soc. Neuchâtel, XXVIII (1900), p. 78.
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Odell in Ottawa Natur. XIX (1905), p. 19.
Cushmann in Amer. Natur. XL (1906), p. 373.
Edmondson in Amer. Natur. XL (1906), pp. 22–23, pl. v, ff. 33, 34; in Science, (2) XXXII (1910), p. 350; in Univ. Colorado Stud. IX (1912), p. 69,
Schouteden (pars) in Ann. Biol. lacustre, I (1906), p. 371, f. 49.
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Brown in Naturalist, 1909, p. 107; in Jrn. Linn. Soc., Zool. XXX (1910), pp. 360, 362; in Brit. Assoc. Handb. Sheffield (1910), pp. 500, 501; in Ann. Scott. Nat. Hist. 1911, pp. 229, 230; in Naturalist, 1912, p. 181; in Scott. Natur. 1912, p. 181; 1913, pp. 208, 210.
Hopkinson in Irish Natur. 1910, p. 3; in Trans. Herts Nat. Hist. Soc. XIV, 3 (1911), p. 232.
Wailes & Penard in Proc. R. Irish Acad. XXXI, lxv (1911), pp. 19, 60, 61.

Wailes in Scott. Natur. 1912, p. 61 b; in Trans. Liverp. Biol. Soc. XXVI (1912), p. 20; in Jrn. Linn. Soc. XXXII (1912), pp. 126, 152; *loc. cit.* (1913), p. 213; in Murray's Nat. Hist. Bolivia and Peru (1913), pp. 32, 40; in Naturalist, 1913, p. 148.
Cunha in Mem. Inst. Oswaldo Cruz, V (1913), pp. 101, 102.
Schmidt in Arch. Protist. XXIX (1913), p. 222.

Trinema

Delage & Hérouard Traité Zool. concrète, I (1896), p. 112, f. 142.

Test hyaline, oviform, compressed anteriorly, formed of circular silicious plates; aperture circular, subterminal, oblique and invaginated; plasma granular, partly filling the test; nucleus placed posteriorly, containing a central nucleole; one or two contractile vesicles usually present; pseudopodia attenuate, radiating, often long, sometimes numerous.

Length 32–103 μ; breadth 15–60 μ; aperture 6–20 μ in diameter; scales 4–12 μ in diameter; nucleus 6–12 μ in diameter.

Habitat.—Mosses, sphagnum, and aquatic vegetation.

Generally distributed.

Mosses may be looked upon as the usual habitat of this species, and from 40–60 μ as the ordinary limits of length when so occurring; in sphagnum and among aquatic vegetation it occurs less numerously but of larger average size, and individuals up to 80 μ in length are not uncommon; above this size they are rare and confined to limited areas.

The circular plates forming the test may be nearly flat or have a considerable convexity, that is be shaped like a watch-glass; they may be imbricated or connected together by rings of small circular or oval markings; the plates bordering the anterior of the aperture are usually small and circular; the invagination around it is formed by a number of small, circular, curved rods 0·5 to 0·75 μ in diameter cemented into a ring; the aperture is often only approximately circular and may show traces of seven to nine sides, according to the number of plates bordering it; the invagination is sometimes reversed, as in the genus *Arcella*, but tests with evaginated apertures are rare. The angle which

the plane of the aperture makes with the longitudinal axis of the test is normally small but is subject to considerable variation, and tests sometimes occur in which this angle may attain to 70° or 80°; the aperture is then nearly terminal. The amount of compression of the test varies; normally a transverse section

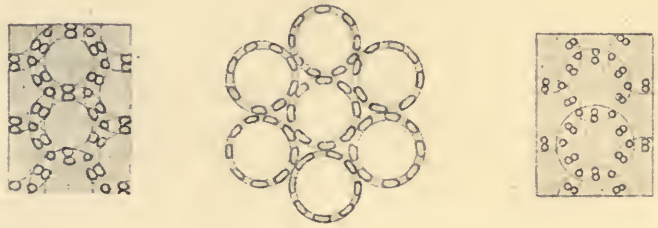

Fig. 151.—Portions of tests of *Trinema enchelys* with different types of scales. × 1000.

through the widest part is sub-circular, but a ventral compression of 25 per cent. is not uncommon, and occasionally tests with a lateral compression occur.

There is but little variation in the character of the plasma, which contains few inclusions; the pseudopodia

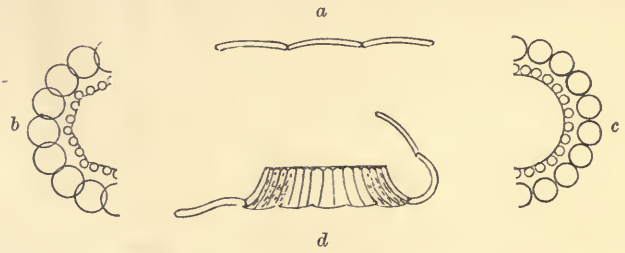

Fig. 152.—*Trinema enchelys*. *a*, scales in section; *b*, *c*, different types of aperture; *d*, aperture in side view. × 1000.

usually number three or four but may be twice or three times as many and may attain a length equal to twice that of the test. Conjugating individuals are not infrequent.

The comparatively large circular plates of which the test is composed distinguish this species from *Corythion dubium* or any form of *Difflugia constricta*.

It is doubtful whether Ehrenberg, when describing the species which he first called *Difflugia enchelys*, had before him *Trinema enchelys* or *T. lineare*, or individuals of both these species. Subsequently, however, when he came to the conclusion that they were distinct species, and *Arcellæ*, not *Difflugiæ*, he confined the name *enchelys* to the larger form, and called the smaller one *Arcella enchelys* (*hyalina*) or only *A. hyalina*. Subsequent writers again confused them, and probably many records given in the synonymy under *T. enchelys* pertain to *T. lineare*. Penard first clearly defined the two species.

Var. **galeata** Penard. (Pl. XLVIII, figs. 1–3.)

Trinema enchelys var. *galeata*
PENARD in Mém. Soc. Genève XXXI, i, II (1890), p. 186, pl. x, ff. 61, 63–66; Faune Rhiz. Léman (1902), p. 528 and note, ff. 5, 6.
BROWN in Scott. Natur. 1912, p. 112; 1913, p. 110.
WAILES in Jrn. Linn. Soc., Zool. XXXII (1913), pp. 208, 213.

Test similar to that of the type but the anterior portion of the orifice furnished with a wide border; the nucleus usually containing two or three nucleoles; plasma and pseudopodia normal.

Length 40–60 μ; breadth 20–40 μ.

Habitat.—Mosses.

This variety is not uncommon, being frequently found in association with the type in the drier mosses. It is generally distributed in the British Isles.

It much resembles *T. complanatum* but is distinguished by the presence of usually well-defined lines, visible in the ventral view, indicating where the wide border of the aperture joins the body of the test.

2. **Trinema lineare** Penard.

(Plate XLVII, figs. 11–21, and fig. 153 in text.)

Difflugia enchelys
EHRENBERG (pars) Infusionsth. (1838), p. 132.
PRITCHARD (pars) Hist. Infus. (1842), p. 168; ed. 2 (1845), p. 168; ed. 3 (1852), p. 206; ed. 4 (1861), p. 553.

Arcella hyalina
EHRENBERG in Abh. Akad. Berlin, 1841 (1843), pp. 300–368 *passim*, 444, pl. i, II, f. 31; iii, VI, f. 6; iv, I, f. 34; iv, V, f. 3; *op. cit.* 1871 (1872), p. 234; in Zweite Nordpolarf. II (1874), p. 460, pl. iii, f. 32.
Arcella enchelys (*hyalina*)
EHRENBERG in Abh. Akad. Berlin, 1847 (1849), table opp. p. 460; in Ber. Akad. Berlin, 1853, p. 255; Mikrogeol. (1854), pl. v, I, f. 39.
Arcella enchelys
EHRENBERG Mikrogeol. (1854), p. xiv, f. 96 *a*; p. 159, pl. xxxiii, IV, f. 1; pl. xxxiv, XII A, f. 7; p. 359, pl. xxi A, f. 5; xxi B, f. 5; in Monatsb. Akad. Berlin, 1856, p. 333.
Arcella enchelys a
EHRENBERG Mikrogeol. (1854), p. 277, pl. xxxiv, V B, f. 3; pp. 260, 262, pl. xxxv, A, II, f. 2.
Trinema acinus
LEIDY (pars) Freshw. Rhiz. N. Amer. (1879), pp. 226–228, pl. xxxix, ff. 34, 38, 43, 55–59.
Trinema lineare
PENARD in Mém. Soc. Genève, XXXI, i, II (1890), p. 187, pl. xi, ff. 5–17; in Jahrb. nassau. Ver. Naturk. XLIII (1890), p. 72; in Amer. Natur. XXV (1891), pp. 1071. 1075; in Rev. Suisse Zool. IX (1901), p. 238; Faune Rhiz. Léman (1902), pp. 529–530, 2 figs.; in Arch. Protist. II (1903), p. 272; Sarcodinés in Cat. Invert. Suisse (1905), p. 110; in Proc. Roy. Soc. Edinb. XXV (1905), p. 595; in Arch. Protist. IX (1909), p. 265; in Brit. Antarct. Exped. I (1911), pp. 221, 254; in Deux. éxped. antarct. franç. (1911), pp. 4, 13.
FOREL Le Léman, III (1904), 1, p. 137.
MURRAY in Proc. Roy. Soc. Edinb. XXV (1905), p. 615; in Bathym. Surv. Scott. Lochs, I (1913), p. 326.
THIÉBAUD in Ann. Biol. lacustre, I (1906), p. 796; *op. cit.* III (1908), pp. 66, 121.
EVANS in Proc. R. Phys. Soc. Edinb. XVII (1907), table 1.
HEINIS in Zool. Anzeig. XXXIII (1908), p. 714; in Arch. Hydrobiol. V (1910), p. 110; in Rev. Suisse Zool. XIX (1911), p. 256.
HOOGENRAAD in Tijds. Nederl. Dierk. Ver. (2) X (1908), p. 714.
COCKERELL in Univ. Colorado Stud. VI (1909), p. 30.
BROWN in Naturalist (1910), p. 93; *op. cit.* 1912, p. 181; in Jrn. Linn. Soc., Zool. (1910), pp. 362, 366; in Brit. Assoc. Handb. Sheffield (1910), pp. 500, 501; in Ann. Scott. Nat. Hist. 1911, pp. 229, 230; in Scott. Natur. 1913, pp. 186, 208, 210.
HOPKINSON in Irish Natur. 1910, p. 3.
WAILES & PENARD in Proc. R. Irish Acad. XXXI, LXV (1911), pp. 19, 60, 61.
WAILES in Scott. Natur. 1912, p. 61; in Jrn. Linn. Soc., Zool. XXXII (1912), pp. 126, 152; *loc. cit.* (1913), p. 213; in Murray's Nat. Hist. Bolivia and Peru (1913), pp. 32, 40; in Naturalist, 1913, p. 148.
EDMONDSON in Univ. Colorado Stud. IX (1912), p. 69.
CUNHA in Mem. Inst. Oswaldo Cruz, IX (1913), p. 108.
Trinema enchelys forma *β*
AVERINTZEFF in Trudui S.-Peterb. Obshch. XXXVI, II (1906), p. 312.

Test small, hyaline, elongate, smooth; composed of small circular plates; transverse section circular or

sub-circular; aperture circular, oblique, invaginated; plasma colourless, granular, partly filling the test; nucleus containing a single nucleole, placed posteriorly; two contractile vesicles usually present; pseudopodia long, attenuate, radiating, usually one to three in number.

Length 18–35 μ; breadth 7–17 μ; aperture 3–6 μ; scales 3–6 μ in diameter.

Habitat.—Mosses, sphagnum, and aquatic vegetation.

Generally distributed.

This small species is even more common than the preceding; scarcely a tuft of moss can be found which does not contain numerous individuals.

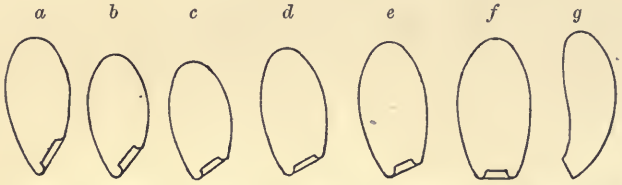

Fig. 153.—Outlines of tests of *Trinema lineare* showing angle of aperture varying from normal (*a*) to terminal (*f*), and abnormal evaginated aperture (*g*). × 650.

The curvature of the small scales forming the test is generally such as to present a continuous outline, but they may be convex, flat, or, rarely, slightly concave. The angle at which the aperture is placed varies more frequently in this species than in *T. enchelys;* while 30° is the normal angle between the plane of the aperture and the longitudinal axis of the test, every variety of inclination between this and 90°, or a terminal aperture, may occur. Abnormal evaginated apertures are also occasionally found.

In structure the test is similar to that of *T. enchelys*, but owing to its small size and extreme transparency the details can seldom be distinguished without special preparation and the use of a high magnification.

Conjugating individuals are not uncommon. From *T. enchelys*, the only species with which it is likely to

be confused, it is distinguished by its usually smaller test, with a smooth outline and more elongate form, but intermediate forms not unfrequently occur.

The identity of *Trinema lineare* with Ehrenberg's *Arcella hyalina* does not admit of doubt. Their tests are precisely alike in shape, size, and smooth hyaline appearance, and the fact that Ehrenberg appears to have found this species more common than *T. enchelys* is corroborative evidence. He seems to have found it nearly everywhere.

We cannot, however, adopt his specific name, as in his 'Infusionthierchen' (1838) he had called the species we now know as *Lecythium hyalinum*, *Arcella (?) hyalina*.

3. **Trinema complanatum** Penard.

(Plate XLVIII, figs. 4 and 5.)

? Arcella nidus-pendulus
Ehrenberg in Abh. Akad. Berlin, 1841, I, pp. 410, 441, pl. iii, I, f. 48; *op. cit.* 1871 (1872), pp. 235, 264.
Trinema acinus
Leidy (pars) Freshw. Rhiz. N. Amer. (1879), pp. 226–229, pl. xxxix, ff. 32, 33, 41, 47, 48, 61–63.
Trinema complanatum
Penard in Mém. Soc. Genève, XXXI, i (1890), II, p. 187, pl. x, ff. 1–4; in Jahrb. nassau. Ver. Naturk. XLIII (1890), p. 72; in Amer. Natur. XXV (1891), p. 1071; Faune Rhiz. Léman (1892), pp. 528–529, 2 figs.; in Arch. Protist. II (1902), p. 271; Sarcodinés in Cat. Invert. Suisse (1905), pp. 109–110; in Arch. Protist. IX (1909), p. 265; in Brit. Antarct. Exped. I (1911), pp. 221, 253.
Averintzeff in Trudui S.-Peterb. Obshch. XXXVI, II (1906), pp. 310–311; in Zool. Anzeig. XXXI, (1907), p. 246.
Schouteden in Ann. Biol. lacustre, I (1906), p. 371, f. 50.
Evans in Proc. R. Phys. Soc. Edinb. XVII (1907), table 1.
Cockerell in Univ. Colorado Stud. VI (1908), p. 30.
Heinis in Arch. Hydrobiol. V (1910), p. 110.
Hopkinson in Irish Natur. 1910, p. 3.
Brown in Ann. Scott. Nat. Hist. 1911, pp. 229, 230; in Naturalist, 1912, p. 181; in Scott. Natur. 1912, p. 112; 1913. pp. 208, 210.
Wailes & Penard in Proc. R. Irish Acad. XXXI, LXV (1911), pp. 19, 60.
Edmondson in Univ. Colorado Stud. IX (1912), p. 69.
Wailes in Scott. Natur. 1912, p. 61; in Jrn. Linn. Soc., Zool. XXXII (1912), pp. 126, 152; *loc. cit.* (1913), p. 213; in Murray's Nat. Hist. Bolivia and Peru (1913), pp. 32, 40; in Naturalist, 1913, p. 148.

Test small, hyaline, formed of circular, imbricated,

silicious plates; in broad view of nearly equal width with semicircular extremities; in narrow side view tapering sharply towards the aperture; transverse section oval; aperture circular, oblique, invaginated; plasma colourless, containing many bright granules, partly filling the test; nucleus large, with one large, or two to three small, nucleoles, placed posteriorly; pseudopodia few, long, attenuate, rarely branched.

Length 25–60 μ; breadth 14–40 μ; aperture 6·5–16 μ; thickness 12–30 μ; nucleus 6–12 μ in diameter.

Habitat.—Mosses and sphagnum.

England.—Generally distributed.

Wales.—Frequent in North Wales.

Scotland.—St. Kilda (*Brown*), Outer Hebrides; Inverness-shire, Elginshire, Aberdeenshire, Perthshire, Isle of May (Fifeshire), Argyllshire, Ayrshire, and Wigtownshire (*Brown*).

Ireland.—Armagh; Mayo and the islands off Clew Bay; Galway; Wicklow (*Hopk.*).

This is the least common of the species belonging to this genus; although it is to be found in sphagnum, it is more numerous and generally distributed in mosses. It is often seen alive but its pseudopodia are rarely observed; they are usually two in number, are frequently very long, up to twice or three times the length of the test, and active; occasionally they display short branches.

It rather closely resembles *Trinema enchelys* var. *galeata*, from which it is distinguished by its outline in oral view and the absence of the curved lines running from the aperture to the sides of the test.

It is also so nearly like Ehrenberg's *Arcella nidus-pendulus*, the test of which is the same in shape and has imbricated scales, that they may possibly be the same species. Ehrenberg's description is not, however, sufficiently full to enable us to be certain of the identity. His species is undoubtedly a *Trinema*, and at least very nearly allied to *T. complanatum*.

Genus 40. **CORYTHION** Taránek, 1881.

Arcella (pars) Ehrenberg in Abh. Akad. Berlin, 1841, p. 410.
? Euglypha (pars) Perty Kenntn. kleinst. Lebensf. (1852), p. 187.
Trinema (pars) Leidy Freshw. Rhiz. N. Amer. (1879), p. 226.
Corythion Taránek in Sitzb. böhm. Ges. Wiss. 1881, p. 232.

Test small, hyaline, composed of small non-imbricated, oval, silicious plates; compressed; in broad view sub-circular to oviform; transverse section elliptical; aperture sub-terminal, ventral, or oblique, circular or oval; plasma colourless, granular, only partially filling the test; nucleus placed posteriorly; contractile vesicles one or two in number; pseudopodia filose, more or less numerous, straight, radiating.

Synopsis of the British Species.

Test sub-circular or ovoid; transverse section oval or lenticular; aperture ventral. (1) *C. dubium.*
Test ovoid; transverse section oval; aperture sub-terminal, oblique. (2) *C. pulchellum.*

1. **Corythion dubium** Taránek.

(Plate XLVIII, figs. 6–18.)

Arcella constricta
Ehrenberg (pars) in Abh. Akad. Berlin, 1841, I, p. 410, pl. iv, I, f. 35; Mikrogeol. (1854), pl. xxxix, III, f. 3.
Arcella disphaera
Ehrenberg (pars) in Abh. Akad. Berlin, 1841, I, p. 410, pl. iv, II, f. 12.
Trinema acinus
Leidy (pars) in Freshw. Rhiz. N. Amer. (1879), pp. 226–228, pl. xxxix, ff. 10–13, 18.
Corythion dubium
Taránek in Sitzb. böhm. Ges. Wiss. 1881, p. 232, f. 3; in Abh. böhm. Ges. Wiss. (6) XI (1882), pp. 31, 43–46, 65, pl. iii, ff. 17–24.
Penard in Mém. Soc. Genève, XXXI, i (1890), II, pp. 188–189, pl. xi, ff. 18–26; in Amer. Natur. XXV (1891), pp. 1071, 1079; Faune Rhiz. Léman (1902), pp. 531–532, 5 figs.; in Arch. Protist. II (1903), p. 272; *op. cit.* IX (1909), p. 265; Sarcodinés in Cat. Invert. Suisse (1905), pp. 110–111; in Brit. Antarct. Exped. I (1911), pp. 220, 229, pl. xxii, f. 3; in Deux. expéd. antarct. franç. (1911), pp, 4, 6.

Fric & Vávre in Arch. Landesf. Böhmen, X (1897), III. pp. 46, 50, 60.
Averintzeff in Trudui S.-Peterb. Obshch. XXX, I (1900), p. 240; *op. cit.* XXXVI, II (1906), pp. 314–315.
Murray in Proc. R. Phys. Soc. Edinb. XXV (1905), p. 615; in Bathym. Surv. Scott. Lochs, I (1913), p. 326.
Schouteden in Ann. Biol. lacustre, I (1906), p. 372, f. 51.
Evans in Proc. R. Phys. Soc. Edinb. XVII (1907), table 1.
Heinis in Zool. Anzeig. XXXIII (1907), p. 714; in Arch. Hydrobiol. V (1910), p. 110; in Rev. Suisse Zool. XIX (1911), p. 256.
Brown in Naturalist, 1910, p. 93; in Jrn. Linn. Soc., Zool. XXX, 1910, pp. 362, 367, pl. 1, f. 13; in Brit. Assoc. Handb. Sheffield (1911), pp. 500, 501; in Ann. Scott. Nat. Hist. 1911, pp. 229, 230; in Naturalist, 1912, p. 181; in Scott. Natur. 1912, p. 112; 1913, pp. 208, 210.
Hopkinson in Irish Natur. 1910, p. 3.
Wailes & Penard in Proc. R. Irish Acad. XXXI, LXV (1911), pp. 15, 60, 61, 62.
Wailes in Scott. Natur. 1912, p. 60; in Jrn. Linn. Soc., Zool. XXXII (1912), pp. 126, 152; in Naturalist, 1913, p. 147; in Murray's Nat. Hist. Bolivia and Peru (1913), p. 35.

Trinema constricta

Certes in Mission scient. Cap Horn, VI, Prot. (1889), p. 18, f. 2.

Test sub-circular or oviform, unsymmetrically compressed; transverse section elliptical; aperture circular or oval, ventral, sub-terminal, oblique; plasma colourless, granular, partly filling the test; nucleus containing one or more nucleoles, placed posteriorly; one or two contractile vesicles usually present; pseudopodia attenuate, straight, radiating, simple or sparsely branched, several usually present.

Length 23–65 μ; breadth 16–40 μ; aperture 5–16 μ; thickness 12–20 μ; nucleus 6–12 μ in diameter.

Habitat.—Mosses and sphagnum.

Generally distributed.

Although not so numerously represented, this species is as widely distributed as *Trinema lineare;* it may always be expected in any gathering of moss or sphagnum. The length usually varies between 30 and 45 μ; above 50 μ individuals are rare. From Inishbofin, Galway, one was obtained 87 μ in length and 40 μ in breadth (similar in shape to fig. 6).

From *Trinema enchelys* it is distinguished by the character of the plates forming the test.

A spined form, var. *spicata* Penard, occurs in Australasia but has not been recorded from elsewhere.

2. **Corythion pulchellum** Penard.

(Plate XLVIII, figs. 19–22.)

? Euglypha minima
PERTY Kennt. kleinst. Lebensf. (1852), p. 187, pl. viii, f. 20.
Corythion pulchellum
PENARD in Mém. Soc. Genève, XXXI, i, II (1890), p. 189, pl. ix, ff. 27–36; in Jahrb. nassau. Ver. Naturk. XLIII (1890), p. 72; in Amer. Natur. XXV (1891), p. 1081; Faune Rhiz. Léman (1902), pp. 532–533, 4 figs.; in Arch. Protist. II (1903), p. 272; Sarcodinés in Cat. Invert. Suisse (1905), p. 111; in Arch. Protist. IX (1909), p. 265.
AVERINTZEFF in Trudui S.-Peterb. Obshch. XXXVI, II (1906), p. 315.
SCHOUTEDEN in Ann. Biol. lacustre, I (1906), p. 372.
HEINIS in Arch. Hydrobiol. V (1910), p. 111.
BROWN in Ann. Scott. Nat. Hist. 1911, pp. 229, 230; in Naturalist, 1912, p. 112; in Scott. Natur. 1912, p. 181; 1913, pp. 208, 210.
WAILES & PENARD in Proc. R. Irish Acad. XXXI, LXV (1911), pp. 15, 60, 61, 62.
WAILES in Scott. Natur. 1912, p. 60; in Jrn. Linn. Soc., Zool. XXXII (1912), p. 126; in Naturalist, 1913, p. 147.
Chorythion pulchellum
AVERINTZEFF in Zool. Anzeig. XXXI (1907), p. 311.

Test small, hyaline, in broad view oviform, moderately compressed, truncate at the anterior extremity; in narrow view rounded posteriorly and tapering sharply towards the aperture; transverse section oval; aperture oblique, narrowly lenticular; plasma clear, colourless, with few granules; nucleus containing a single nucleole placed posteriorly; two or three contractile vesicles usually present; pseudopodia unknown.

Length 26–35 μ; breadth 15–20 μ; aperture 7–10 μ; by 3–4 μ in width; thickness about two thirds the breadth.

Habitat.—Mosses and sphagnum.

Never very numerous, *C. pulchellum* is widely distributed. The test is so transparent that it is easily overlooked and the small plates of which it is formed are difficult to distinguish without special preparation.

In this species, as also in the preceding, a small filament is sometimes observed situated near the aperture; it is always comparatively short, of a tough nature, and appears as if it might be used for attaching the test to some object.

From Mount Coulough, Kerry, an individual was obtained 58 μ in length and 37 μ in breadth, but this size is abnormally large. In North America individuals occur up to 42 μ in length. The form of the aperture distinguishes it from *C. dubium*; it does not resemble any other species.

England.—Durham; Westmorland; N. & W. Yorkshire; Derbyshire; Shropshire; Bedfordshire; Hertfordshire; Devonshire.

Scotland.—St. Kilda (Outer Hebrides), Inverness-shire, Elginshire, Perthshire, Isle of May (Fifeshire), Argyllshire, Bass Rock, and Ayrshire (*Brown*).

Ireland.—Armagh; Mayo and the islands off Clew Bay; Galway; Wicklow; Kerry.

Family 3. Gromiina.

Test membranous, usually flexible, smooth or covered with extraneous particles; pseudopodia long, branching, straight or irregularly dendroid, frequently anastomosing; one or more nuclei; contractile vesicles one or more.

The genera included in the family Gromiina may be divided into two groups; one consisting of *Lecythium*, *Pseudodifflugia*, *Diaphoropodon*, *Clypeolina*, *Frenzelina*, and *Gromia*, is intermediate in character between the Euglyphina and the true *Gromiæ* in the other group. These genera possess pseudopodia which are filose, usually branching, but not anastomosing in a true sense, although occasionally some of the filaments may coalesce; but the ectoplasm is of a comparatively firm character and does not possess the digestive functions which the reticulated pseudopodia of the *Gromiæ* proper are able to perform, an ability doubtless due to the rapidly circulating currents which traverse the pseudopodal reticulum in all directions.

The Rhizopoda with reticulated pseudopodia differ only from monothalamous Foraminifera in being

freshwater and not marine, and their affinities can only be clearly seen in a classification which includes both freshwater and marine forms. Authorities usually have confined themselves to one group, *e.g.* Rhumbler (1904) omits the filose Rhizopoda, Averintzeff (1906) deals only with freshwater forms, and in general works by such authors as Ray Lankester and Calkins some of the genera are either not included or not given a definite position.

In the following list of genera the forms intermediate between the Euglyphina and the Gromiina are placed in a new sub-family, the Pseudo-gromiinæ.

Family 3. Gromiina.

Sub-family Pseudo-gromiinæ s.-f. nov.

Pseudopodia filose, arising directly from the plasma.

Genus (1) *Lecythium.*
„ (2) *Pseudodifflugia.*
„ (3) *Diaphoropodon.*
„ (4) *Clypeolina.*
„ (5) *Frenzelina.*
„ (6) *Gromia.*

Sub-family Allogromiinæ Rhumbler.

Pseudopodia reticulate, arising from a peduncle.

Genus (1) *Microgromia.* Freshwater.
„ (2) *Lieberkuehnia.* Freshwater and marine.
„ (3) *Allogromia.* Freshwater and marine.
„ (4) *Diplogromia.* Freshwater.
„ (5) *Shepeardella.* Marine.
„ (6) *Rhynchogromia.* Freshwater and marine.
„ (7) *Rhynchosaccus.* Marine (parasitic).
„ (8) *Hyalopus.* Marine.

In the Pseudo-gromiinæ the normal method of multiplication is by division; in the Allogromiinæ sporulation is probably the normal method, although in *Microgromia* a division of the plasma within the test takes place, and simple division may occur in other genera.

The *Microgromiæ* are intermediate in character between the two sub-families; the pseudopodia arise from a peduncle but are filose in the case of solitary individuals and reticulate when colonies are formed.

Synopsis of the British Freshwater Genera.

Sub-family Pseudo-gromiinæ Wailes.

Pseudopodia filose, arising directly from the plasma.

Test spherical or pyriform, flexible, smooth; aperture flexible. 41. *Lecythium.*

Test ovoid, usually rigid, encrusted with foreign particles. 42. *Pseudodifflugia.*

Test ovoid, flexible, encrusted with foreign particles and furnished with numerous hair-like cils. 43. *Diaphoropodon.*

Test formed of two valves enclosing a membranous sac. 44. *Clypeolina.*

Sub-family Allogromiinæ Rhumbler.

Pseudopodia reticulate, arising from a peduncle or raphe.

Test small, pyriform, smooth; often in colonies; nucleus single. 45. *Microgromia.*

Test ovoid or pyriform, supple, usually smooth, aperture lateral; one or more nuclei. 46. *Lieberkuehnia.*

Test oval, moderately rigid, smooth, aperture terminal; one or more nuclei. 47. *Allogromia.*

Test cylindrical, usually rigid, often large, encrusted with foreign particles; one or more nuclei. 48. *Rhynchogromia.*

Sub-family Pseudo-gromiinæ.

Genus 41. **LECYTHIUM** Hertwig and Lesser, 1874.

Arcella Ehrenberg (pars) Infusionsth. (1838), p. 124.
Gromia Schlumberger (pars) in Ann. Sci. nat. (3) III (1845), p. 255.

Corycia Dujardin (pars) in Ann. Sci. nat. (3) XVIII (1852), p. 240. (Pre-occupied in Lepidoptera, Hühn, 1816.)
Pamphagus Bailey in Amer. Jrn. Sci. XV (1853), p. 341. (Pre-occupied in Orthoptera, Thunberg, 1812.)
Difflugia Schneider (pars) in Archiv. Anat. Physiol. XXI (1854), pp. 204–207.
? *Plagiophrys* Claparède & Lachmann (pars) Études Inf. et Rhiz. I, 2 (1859), p. 453.
Lecythium Hertwig & Lesser in Arch. mikr. Anat. X (1874), Suppl., pp. 117–118.
? *Platoun* Schulze in Arch. mikr. Anat. XI (1875), pp. 115–116.
Chlamydophrys Cienkowsky in Arch. mikr. Anat. XII, 1 (1875), p. 39.
Troglodytes Gabriel in Morph. Jahrb. I (1876), p. 536. (Pre-occupied in Aves, Viellot, 1806.)
Phonergates Buck in Zeits. wiss. Zool. XXX (1878), p. 20. (Pre-occupied in Hemiptera, Stäl, 1853.)
Baileya Averintzeff, communicated by Schouteden in Ann. Biol. lacustre, I (1906), p. 382; *cf.* Zool. Anzeig. XXXI (1907), p. 246.
Trinema Penard (pars) in Mém. Soc. Genève, XXXI, i, ii (1890), p. 186.

Test consisting of a thin, flexible, homogeneous envelope, colourless or translucent, without adherent particles; aperture terminal, elastic; plasma colourless, granular, completely filling the test; nucleus large, placed posteriorly; pseudopodia numerous, long, branching, delicate, not anastomosing.

Synopsis of the British Species.

Envelope hyaline, spherical or pyriform; plasma clear and colourless with large distinct nucleus. (1) *L. hyalinum.*

Envelope yellow, pyriform; lenticular or arcuate in transverse section; aperture small, terminal, pliable. (2) *L. mutabile.*

Envelope spherical or pyriform, not compressed; aperture pliable, elastic; plasma granular, often containing numerous large diatoms, etc. (3) *L. granulatum.*

Envelope pyriform, moderately compressed; furnished with short curved spines. (4) *L. spinosum.*

A study of the literature relating to this genus, first named *Pamphagus* by Bailey, has led the assistant author of the present work to the conclusion that the name which should be applied to it is *Lecythium*. That *Pamphagus* was pre-occupied was detected by Averintzeff as stated by Schouteden in his annotated abstract in French* of Averintzeff's Russian memoir of 1906 on the testaceous freshwater Rhizopoda (Conchulina), in which Averintzeff had used the name *Pamphagus*. Later in the same year, however, he sent to the 'Zoologischer Anzeiger' a paper in which he proposed for *Pamphagus* the name *Baileya*, but although received by the Editor of that journal in October, 1906, it was not printed until February, 1907, Schouteden thus being the first to publish the name. Had no other name been applied to any species of the genus this would have been very appropriate, but between 1853, when Bailey named it, and 1906, when Schouteden published a name in his honour, several generic names had been given to one or other species now included in the genus, and it is necessary to consider them.

We may at once dismiss three names used before 1853 : *Arcella* by Ehrenberg, *Gromia* by Schlumberger, and *Corycia* by Dujardin, each founded for species which do not belong to this genus, and the last one cited being pre-occupied. A difficulty arises with the next name to be mentioned, *Plagiophrys*. It was founded by Claparède and Lachmann for a genus which they describe as "Actinophyrens non cuirassés, munis de nombreux pseudopodes, qui naissent en faisceau d'un seul et même point de la surface du corps. . . . Ces pseudopodes laissent voir à leur surface la circulation de granules caracteristique, qui est toutefois fort lente." This is clearly not a definition of the present genus, but how a rhizopod without any test could

* The passage is as follows:—"M. Awerintzew a proposé dans le *Zoolog. Anzeiger* le nom *Baileya* pour le genre *Pamphagus*, ce dernier nom étant préoccupé (Insectes)." This was published in the 'Annales de Biologie lacustre' in December, 1906.

always emit its pseudopodia from one and the same point on its surface is a puzzle which Archer endeavoured to unravel without coming to a definite conclusion, except that the statement must have been made in error owing to the extreme thinness of the pellicle which renders it almost invisible. Possibly, however, Claparède & Lachmann knew of this pellicle but did not consider it to be of a sufficiently protective nature to serve as a "cuirass." Two species were included in his genus, *P. cylindrica* and *P. sphærica*. They do not, however, belong to the same genus, the first being considered by Penard to be most probably a *Diaphoropodon*, and the second appearing to be identical with "*Gromia hyalina*," as Ehrenberg's species was then known. In view of this uncertainty and of the fact that the definition of the genus *Plagiophrys*, so far as regards this species, is incorrect, we cannot well adopt for it Claparède & Lachmann's name, which should be relegated to the first of the two species which they describe, namely *P. cylindrica*.

The next name, *Lecythium*, was proposed by Hertwig & Lesser in 1874, and the only species which they include in it is *L. hyalinum*. They give references to former descriptions of the species, and there cannot be any doubt as to its identity. The generic name *Lecythium* is therefore here adopted.

Although it is unnecessary to pursue the matter further it may be of interest to point out that *Platoum*, the next name which has been considered a synonym, is of uncertain application; that it was almost immediately followed by *Chlamydophrys*, which would be the name to adopt should *Lecythium* not stand, and that, even should it fail, we need not fear having to use either of the two uncouth names next proposed, *Troglodytes* and *Phonergates*, as both are pre-occupied, *Baileya* being the next available name on this somewhat long list.

1. **Lecythium hyalinum** (Ehrenberg) Hertwig & Lesser.

(Plate XLIV, figs. 9 and 10; Pl. XLIX, figs. 1–5; and Pl. LI, figs 1–7.)

Arcella hyalina
EHRENBERG Infusionsth. (1838), p. 134, pl. ix, f. 8; in Abh. Akad. Berlin, 1841 (1842), p. 444, pl. i, f. 31; *op. cit.* 1871 (1872), pp. 235, 244, 264.
FRESENIUS in Abh. senckenb. Ges. II (1858), pp. 219–223, pl. xii, ff. 1–24.
Gromia hyalina
SCHLUMBERGER in Ann. Sci. nat. (3) III (1845), p. 255.
GRIFFITH & HENFREY Microg. Dict. (1855), p. 299; ed. 4 (1883), p. 366.
EYFERTH Einfach. Lebensf., ed. 2 (1885), p. 52, pl. iii, f. 39.
CHAPMAN Foraminifera (1902), p. 70.
Difflugia hyalina
SCHNEIDER in Arch. Anat. XXI (1854), p. 204, pl. ix, ff. 16–24.
? Plagiophrys sphærica
CLAPARÈDE & LACHMANN Études Inf. et Rhiz. I, 2 (1859), p. 454, pl. xxii, f. 2.
LACHMANN in Verh. Ver. Rheinl. XVI (1859), Sitzber., p. 61.
ARCHER in Qrt. Jrn. Micr. Sci. (N. S.) XI (1871), pp. 146–151, pl. vii, ff. 11–16; *op. cit.* (N. S.) XVI (1876), pp. 343–344; in Proc. Dublin Micr. Club, II, 2 (1873), pp. 82–86, pl. iv, ff. 11–16; *op. cit.* III, 2 (1878), p. 134.
EYFERTH Einfach. Lebensf. (1878), p. 34.
CUNEO in Boll. Scient. XII (1890), p. 142.
Arcella Homœochlamys hyalina
EHRENBERG in Abh. Akad. Berlin, 1871 (1872), p. 244.
Lecythium hyalinum
HERTWIG & LESSER in Arch. mikr. Anat. X (1874), Suppl., pp. 117–118, 241–242, pl. iii, f. 8.
ARCHER in Qrt. Jrn. Micr. Sci. (N. S.) XVII (1877), pp. 197–198, pl. xiii, ff. 1, 2; in Proc. Dublin Micr. Club, III, 3 (1880), p. 267, pl. x, ff. 1, 2.
BUCK in Zeits. wiss. Zool. XXX (1877), pp. 21, 45.
GRUBER in Zeits. wiss. Zool. XXXVI (1881), p. 123, pl. iv, ff. 27–29; in Ber. nat. Ges. Freiberg, VI (1890), p. 4, pl. v, ff. 6, 7.
LANESSAN Traité Zool., Prot. (1882), p. 67.
BLOCHMANN Mikr. Thier. Süsswass. (1886), p. 15.
ENTZ Stud. Protist. I (1888), p. 371.
MAGGI in Rend R. Ist. Lomb. (2) XXI (1888), p. 305; in Arch. Ital. Biol. X (1888), p. 187.
PENARD in Rev. Suisse Zool. VII, 1 (1899), p. 101.
FOREL Le Léman, III (1904), p. 138.
PRANDTL in Arch. Protist. IX (1907), p. 13.
Chlamydophrys stercorea
CIENKOWSKI in Arch. mikr. Anat. XII, 1 (1875), pp. 39–43, pls. vii–viii, ff. 73–89.

Archer in Qrt. Jrn. Micr. Sci. (n. s.) XVII (1877), pp. 198–199, pl. xiii, f. 3; in Jrn. Dublin Micr. Club, III, 3 (1880), pp. 267–268, pl. x, f. 3.
Vejdovský in Sitzb. böhm. Ges. Wiss. 1880 (1881), p. 136.
Taránek in Sitzb. böhm. Ges. Wiss. 1881, pp. 224, 233.
Entz Stud. Protist. I (1888), pp. 139, 172.
Delage & Hérouard Traité Zool. concrète, I (1896), p. 81, f. 75.
Hartog in Cambr. Nat. Hist. I (1906), p. 57; in Encycl. Brit., ed. 11, XXIII (1911), pp. 247–248.
Prandtl in Arch. Protist. IX (1907), p. 13.
Doflein Lehrb. Protozoenk., ed. 3 (1911), pp. 614, 627, 628, 630, ff. 543, 559–561.

Platoun stercoreum

Buetschli in Bronn's Thierreichs, I, 1 (1880), pl. iii, f. 17 *a–c*.
Blochmann Mikr. Thierw. Süsswass. (1886), p. 15; ed. 2 (1895), p. 19.
Delage & Hérouard Traité Zool. concrète, I (1896), p. 115, f. 150.
Parker & Haswell Text-book Zool. I (1897), p. 51, f. 33; ed. 2 (1910), p. 51, f. 34.
Prowazek in Arb. Zool. Inst. Wien, Bd. XI (1900), p. 207, pl. i, f, 11.
Averintzeff in Arch. Protist. VIII (1905), p. 117; in Trudui S.-Peterb. Obshch. XXXVI, ii (1906), p. 92.
Schmidt in Arch. Protist. XXIX (1913), p. 222.

Troglodytes zoster

Gabriel in Morph. Jahrb. I (1876), pp. 536–572, pl. xx.
Archer in Qrt. Jrn. Micr. Sci. (n. s.) XVI (1876), pp. 331–334, pl. xxi. ff. 1–7 (after Gabriel); in Proc. Dublin Micr. Club, III, 3 (1880), pp. 285–289, pl. ix, ff. 1–7.

Phonerogates vorax

Buck in Zeits. wiss. Zool. III (1878), p. 20.

Pamphagus hyalinus

Leidy Freshw. Rhiz. N. Amer. (1879), pp. 194–196, pl. xxxiii, ff. 13–17.
Hitchcock Synops. Freshw. Rhiz. (1881), p. 32.
Taránek in Sitzb. böhm. Ges. Wiss. 1881, p. 224, 233.
Blanc in Bull. Soc. Vaud. (2) XX (1885), p. 288; in Ann. Nat. Hist. (5) XV (1885), p. 288.
Forel Faune Lacs Suisses (1885), p. 131; Lac Léman, ed. 2 (1886), p. 60; in Boll. Scient. IX (1887), p. 90; Le Léman, III (1904), pp. 135, 137.
Penard in Mém. Soc. Genève, XXXI, ii, i (1890), pp. 170–171, pl. viii, ff. 9–25; in Jahrb. nassau. Ver. Naturk. XLIII (1890), p. 71; in Rev. Suisse Zool. VII (1899), pp. 13, 101; *op. cit.* IX (1901), p. 238; Faune Rhiz. Léman (1902), pp. 432–434, 3 figs.; Sarcodinés in Cat. Invert. Suisse (1905), p. 87.
Lord in Sci. Gossip, XXVII (1891), pp. 244–245, ff. 198–201; *op. cit.* XXVIII (1892), p. 129; in Trans. Manch. Micr. Soc. 1891 (1892), p. 56; *op. cit.* 1903 (1904), pp. 76–78, pl. iii, f. 1; 1904 (1905), p. 56.
Cash in Trans. Manch. Micr. Soc. 1891 (1892), p. 52.
Blochmann Mikr. Thierw. Süsswass., ed. 2 (1895), p. 19.
Eyferth Einfach. Lebensf., ed. 3 (1900), p. 270.
Jennings in Bull. U. S. Fish Comm. XIX (1901), pp. 111, 113.
West in Jrn. Linn. Soc., Zool. XXVIII (1901), pp. 330–331; *op. cit.* XXIX (1903), p. 116.
Zacharias in Forschbr. Plön, IX (1902), pp. 19, 21–22, p. 1, ff. 1–7; *op. cit.* X (1903), p. 268.

Averintzeff in Trudui S.-Peterb. Obshch. XXXVI, II (1906), pp. 81, 266–267.
Schouteden in Ann. Biol. lacustre, I (1906), pp. 361, 362.
Evans in Proc. R. Phys. Soc. Edinb. XVII (1907), table 1.
Hoogenraad in Tidjs. Nederl. Dierk. Ver. (2) X (1908), pp. 414–415, 424.
Landacre in Proc. Ohio Acad. IV (1908), p. 428.
Brown in Naturalist, 1910, p. 93; in Brit. Assoc. Handb. Sheffield (1910), p. 501.
Hopkinson in Irish Natur. 1810, pp. 3, 4.
Wailes & Penard in Proc. R. Irish Acad. XXXI, LXV (1911), p. 18.
Wailes in Scott. Natur. 1912, p. 60; in Trans. Liverp. Biol. Soc. XXVI (1912), p. 20; in Jrn. Linn. Soc., Zool. XXXII (1912), p. 126; in Naturalist, 1913, p. 148.
Schmidt in Arch. Protist. XXIX (1913), p. 219.

Corycia stercorea

Vejdovský Thier. Org. Brunnenw. Prag (1882), pp. 37–38, pl. i, f. 21 *a–d*.
Moniez in Rev. biol. nord France, I (1888), pp. 85–86.
Kemna in Mém. Soc. malac. Belg. XXXIX (1905), p. 96.

Platoun (Chlamydophrys) stercoreum

Lanessan Traité Zool., Prot. (1882), pp. 65–66.

Envelope supple, colourless, transparent, homogeneous; usually spheroidal; aperture circular with a short neck subject to dilation or contraction; plasma clear, colourless, sparsely granular, containing refringent granules; nucleus large, hyaline, usually containing a central nucleole; a single contractile vesicle occasionally visible near the aperture; pseudopodia numerous, radiating, filose or flattened, sometimes branched.

Diameter 30–45 μ; small individuals, about 20 μ in diameter, are sometimes seen.

Habitat.—Submerged sphagnum, moss, and aquatic vegetation. Not uncommon.

England.—Isle of Man; N. and W. Yorkshire; Carrington Moor, Cheshire (*Cash*); Bedfordshire; Buckinghamshire; Gloucestershire (*West*); Isle of Wight; Cornwall.

Wales.—Llyn Idwal (*West*) and Moel Siabod (*Hopk.* coll.), Carnarvonshire.

Scotland.—Shetlands; Hebrides! (*West*); Perthshire (*Cash*); Skye (*West*); Midlothian (*Cash*).

Ireland.—Clare Island, Mayo; Inishbofin, Galway;

Wicklow (*Archer; Hopk.*); Kerry; West of Ireland (*Archer*).

The plasma is generally very clear; it contains numerous bright granules and small vacuoles, but food-particles, when present, are always few in number; the nucleus is large and distinct, it may occasionally contain more than one nucleole. When deprived of fresh air or water the plasma exudes, forming a clear spherical globule around the aperture.

Small groups of two or three individuals often occur, but never colonies as in *Microgromia socialis*.

The filose pseudopodia often arise from a portion of the plasma which is spread around the exterior of the aperture.

The small examples sometimes seen may represent immature individuals, the supple test perhaps allowing for a natural increase in size. From Thirsk in Yorkshire an individual was obtained having a heart-shaped test and possessing two nuclei; this was probably a double or twin test and not a case of division.

2. **Lecythium mutabile** (Bailey) Hopk.

(Plate LI, figs. 8 and 9.)

Corycia

Dujardin in Ann. Sci. nat. (3) XVIII (1852), p. 240.
Claparède & Lachmann Études Inf. et Rhiz. I, 2 (1859), p. 453.
Pritchard Hist. Infus., ed. 4 (1861), p. 550.
Leidy in Proc. Acad. Philad. 1874 (1875), p. 227; *op. cit.* 1878, p. 172.

Pamphagus mutabilis

Bailey in Amer. Jrn. Sci. (2) XV (1853), pp. 341–347, 40 figs.; in Qrt. Jrn. Micr. Sci. I (1853), pp. 295–299.
Greene Protozoa (1858, 1863, and 1871), p. 8.
Archer in Qrt. Journ. Micr. Sci. (N. s.) XI (1871), p. 101; *op. cit.* (N. s.) XII (1872), pp. 195, 423; in Proc. Dublin Micr. Club, II, 1 (1873), pp. 27–28, 121; *op. cit.* II, 2 (1874), p. 153.
Leidy in Proc. Acad. Philad. 1878, p. 172; Freshw. Rhiz. N. Amer. (1879), pp. 191–194, pl. xxxiii, ff. 1–9.
Parona in Boll. Scient. II (1880), pp. 47, 48.
Hitchcock Synops. Freshw. Rhiz. (1881), p. 32.
Taránek in Sitzb. böhm. Ges. Wiss. 1881, pp. 224, 233.
Blochmann Mikr. Thierw. Süsswass., ed. 2 (1895), p. 19, pl. i, f. 27.

Maggi in Rend. R. Ist. Lomb. (2) XXI (1888), p. 301.
Penard in Mém. Soc. Genève. XXXI, i, ii (1890), pp. 171–172, pl. viii, ff. 26–32; in Jahrb. nassau. Ver. Naturk. XLIII (1890), p. 71; in Rev. Suisse Zool. VII, i (1899), p. 101; Faune Rhiz. Léman (1902), pp. 438–440, 5 figs.; in Arch. Protist. II (1903), p. 266; Sarcodinés grands Lacs (1905), p. 115.
Schewiakoff in Mém. Acad. St. Pétersb. (7) XLI (1893), viii, p. 98.
Schaudinn in Deutsch-Ost-Africa, IV, xvii (1897), p. 10.
Eyferth Einfach. Lebensf., ed. 3 (1900), p. 270.
Beardsley in Trans. Amer. Micr. Soc. XXIII (1902), p. 50.
Forel Le Léman, III (1904), p. 137.
Averintzeff in Trudui S.-Peterb. Obshch. XXXVI, ii (1906), pp. 265–266.
Edmondson in Amer. Natur. XL (1906), p. 20, pl. v, f. 32.
Schouteden in Ann. Biol. lacustre, I (1906), p. 361.
Butler in Brit. Assoc. Handb. Dublin (1908), p. 219.
Brown in Naturalist, 1909, p. 107; in Brit. Assoc. Handb. Sheffield (1910), p. 501.
Daday in Deutsch-Ost-Africa, IV, xxiii (1910), p. 10.
Schmidt in Arch. Protist. XXIX (1913), p. 219.
Wailes in Jrn. Linn. Soc., Zool. XXXII (1913), pp. 209, 213.

Pamphagus
Pritchard Hist. Infus., ed. 4 (1861), p. 551.

Corycia dujardini
Gagliardi in Qrt. Jrn. Micr. Sci. (n. s.) XI (1871), p. 80.

Plagiophrys sacciformis
Hertwig & Lesser in Arch. mikr. Anat. X (1874), Suppl., pp. 114–115, pl. iii, f. 3.
Archer in Qrt. Jrn. Micr. Sci. (n. s.) XVII (1877), pp. 122–123, pl. viii, f. 11; in Proc. Dublin Micr. Club, III, 2 (1878), pp. 127–128, 240–241, pl. viii, f. 11.

Plagiophrys scutiformis
Hertwig & Lesser in Arch. mikr. Anat. X (1874), Suppl., pp. 115–117, pl. iii, f. 2.
Archer in Qrt. Jrn. Micr. Sci. (n. s.) XVII (1877), pp. 123–124, pl. viii, f. 10; in Proc. Dubl. Micr. Club, III, 2 (1878), p. 241, pl. viii, f. 10.
Penard in Mém. Soc. Genève, XXXI, ii, i (1890), p. 172, pl. viii, ff. 33–35.
Hoogenraad in Tijds. Nederl. Dierk. Ver. (2) X (1908), pp. 416–417; in Ann. Biol. lacustre, III (1908), pp. 255–256.

Euglypha sacciformis
Archer in Qrt. Jrn. Micr. Sci. (n. s.) XVII (1877), p. 115; in Proc. Dublin Micr. Club, III, 2 (1878), pp. 248–249.

Gromia (Plagiophrys) scutiformis
Buetschli in Bronn's Thierreichs, I, 1 (1880), pl. iii. f. 18.

Corycia mutabilis
Vejdovský in Sitzb. böhm. Ges. Wiss. 1880 (1881), p. 137.

Gromia mutabilis
Blochmann Mikr. Thierw. Süsswass. (1886), p. 15, pl. i, f. 35.
Lauterborn in Zeits. wiss. Zool. LIX (1895), p. 541.
Kofoid in Bull. Michigan Fish Comm. VI (1896), Appx. ii, pp. 78, 84.

Gromia (Pamphagus) mutabilis
Averintzeff in Trudui S.-Peterb. Obshch. XXXVI, ii (1906), p. 96.

Baileya mutabilis
Averintzeff in Zool. Anzeig. XXXI (1907), p. 246.

Test ovoid or pyriform, membranous, flexible, colourless or yellow; fundus rounded or pointed; transverse section oval, lenticular, or arcuate; aperture terminal, small, supple, and elastic; plasma colourless, granular, completely filling the test, often containing many food-particles; nucleus large and granular or containing a small number of nucleoles; one or two contractile vesicles and numerous vacuoles generally present; pseudopodia numerous, long, radiating, branched or simple, extremely fine.

Length 20–70 μ; mature individuals usually 45–60 μ; breadth about half the length; thickness variable.

Habitat.—Submerged sphagnum and aquatic vegetation.

England.—Sheffield district, W. Yorkshire (*Brown*); Cheshire (*Cash*); Epping Forest, Essex (*Scourfield*).

Ireland.—W. Galway, Westmeath, and Tipperary (*Archer*).

Owing no doubt to the difficulty of identifying it when not active and to the fact that it is extremely local in occurrence, the records of this species in the British Isles are very few. It may be looked for amongst filamentous algæ, where, entangled among their mucous investment, perhaps a number of individuals will be found together. When replete with food-particles it is of a more or less dark brown colour.

It is probably widely distributed in the British Isles.

3. **Lecythium granulatum** (Schulze) Hopk.

(Plate XLIV, fig. 11; Pl. L, figs. 1 and 2.)

Gromia granulata
Schulze in Arch. mikr. Anat. XI (1875), pp. 117–118, pl. vii, ff. 5, 6.
Archer in Qrt. Jrn. Micr. Sci. (n. s.) XVI, p. 343; in Proc. Dublin Micr. Club, III, 2 (1878), p. 134.
Pamphagus curvus
Leidy Freshw. Rhiz. N. Amer. (1879), p. 196, pl. xxxiii, ff. 11, 12.
West in Jrn. Linn. Soc., Zool. XXVIII (1901), p. 331, pl. xxix, f. 27.
Forel Le Léman, III (1904), p. 137.

Pamphagus granulatus

Penard Faune Rhiz. Léman (1902), pp. 435–437, 9 figs.; Sarcodinés grands Lacs (1905), pp. 108, 117; Sarcodinés in Cat. Invert. Suisse (1905), p. 87; in Rev. Suisse Zool. XX (1912), pp. 18–22, pl. ii, ff. 16, 17.

Averintzeff in Trudui S.-Peterb. Obshch. XXXVI, II (1906), pp. 267–268.

Schouteden in Ann. Biol. lacustre, I (1906), pp. 361, 362.

Hoogenraad in Tijds. Neederl. Dierk. Ver. (2) X (1908), pp. 415–416, 424; in Ann. Biol. lacustre, III (1908), p. 255.

Brown in Ann. Scott. Nat. Hist. 1911, p. 229; in Naturalist, 1912, p. 181.

Wailes & Penard in Proc. R. Irish Acad. XXXI, LXV (1911), p. 18.

Wailes in Scott. Natur. 1912, p. 60.

Envelope spheroidal or pyriform, membranous, hyaline, supple; often distorted by the ingestion of large diatoms; aperture terminal, normally circular but capable of taking various forms; plasma colourless, completely filling the test, containing large refringent globules and smaller granules; nucleus large, granular, placed posteriorly; one large contractile vesicle and several vacuoles usually present; pseudopodia long, radiating, simple or branched.

Length 40–140 μ or more; breadth about half the length.

Habitat.—Aquatic vegetation.

England.—Derbyshire (*Brown*); Devonshire.

Wales.—Snowdon, Carnarvonshire, 3000 feet (*West*).

Scotland.—Outer Hebrides; Glen Shee, Perthshire (*Brown*).

Ireland.—Clare Island, Mayo; ? Wicklow (*Archer*).

The normal form of the test in this species appears to be ovoid or spheroidal, but its habit of distending itself with a large number of diatoms or filamentous and other Algæ (*Spirogyra*, *Desmidium*, etc.) distorts the membranous test into various shapes, usually elongated and more or less pointed at the posterior end. Small and compact aggregations of diatoms have been noted by many observers and were generally regarded as "cysts" and as having some connection with their life-history. Penard * has no doubt that

* 'Revue Suisse de Zool.,' *loc. cit. supra.*

these aggregations of diatoms are held together by the transparent cuticles of *Lecythium granulatum*, the enclosed plasma having decayed away or even being still present and living but escaping observation (*vide* Pl. XLIV, fig. 11); he also raises the question as to whether the diatoms live in symbiotic relationship with the *Lecythium* or are retained in a living state to serve as food as need may arise.

Both conjugation and longitudinal division have been observed to take place in this species.

L. avidum Leidy is very similar and may be a large form or variety of this species, it measures 148–220 μ in length. *L. curvum* Leidy appears to be identical with this species.

4. **Lecythium spinosum** (Penard) Hopk.

(Plate L, figs. 3–6.)

Trinema spinosum
PENARD in Mém. Soc. Genève, XXXI, i, II (1890), pp. 186–187, pl. x, ff. 72–74.
Pamphagus armatus
LAUTERBORN in Zool. Anzieg. XXIX (1901), p. 54; in Zeits. wiss. Zool. XC (1908), p. 647, pl. xli, f. 3.
PENARD (*? = Trinema spinosum*) Faune Rhiz. Léman (1902), pp. 577–578, f. 12 (p. 572).
SCHOUTEDEN in Ann. Biol. lacustre, I (1906), pp. 360, 361.

Test membranous, ovoid or pyriform, unsymmetrically compressed, furnished with short curved spines; aperture sub-terminal, oblique; nucleus granular, placed posteriorly; plasma filling the test, pseudopodia numerous, simple or branched.

Length 45–70 μ; breadth about half the length.

Habitat.—Aquatic vegetation. Rare.

ENGLAND.—Wansted Park, Epping Forest, Essex (*Scourfield*).

The figures on Plate L are from sketches supplied by Mr. Scourfield, who adds the following description :—"Tests armed with spines, the contents yellowish-green with highly-refringent globules; pseudopodia

long and fine, sometimes waving almost like flagellæ, twisted and knotted when withdrawn towards the mouth. Test with irregular outline."

The English individuals above described are very similar to those from Switzerland figured by Penard (1890) as *Trinema spinosum* which are considered by Lauterborn to be distinct from his *Pamphagus armatus;* but, considering the flexibility of the envelope in this genus, the variation in form is not more than frequently occurs in other species of the genus, and the possession of spines on a membranous test is of such rare occurrence that unless further differences are found to exist it seems inadvisable to consider these unsymmetrical tests as even varieties. Indeed there can really be no doubt as to the identity of this species with Penard's *Trinema spinosum;* and his specific name is therefore retained although he appears to have accepted that of Lauterborn.

Genus 42. **PSEUDODIFFLUGIA** Schlumberger, 1845.

Pseudodifflugia Schlumberger in Ann. Sci. nat. (3) III (1845), p. 256.
Pleurophrys Claparède & Lachmann Études Inf. et Rhiz. I, 2 (1859), p. 454.
Difflugia Ehrenberg (pars) in Abh. Akad. Berlin, 1871 (1872), p. 264.
Plagiophrys Penard in Mém. Soc. Genève XXXI, i, II (1890), p. 173.

Test ovoid, chitinous, usually rigid, covered with extraneous particles; transverse section circular or elliptical; aperture terminal; plasma grey or colourless, granular; nucleus single, placed posteriorly; a single contractile vesicle usually present; pseudopodia filose, long, straight or branched, not anastomosing.

This genus is closely allied to *Lecythium*, but is distinguished by a more rigid envelope covered with extraneous particles. In the species *P. horrida* and

P. compressa the tests have a considerable range of form and the aperture is certainly flexible; the former has a peculiar and characteristic test and is also remarkable as containing, according to Penard, numbers of a parasitic bacillus in the plasma. Further investigations are desirable to ascertain if these are invariably present.

P. fulva and *P. fascicularis* are stable forms usually easily identified; the test of *P. gracilis*, however, is found in a wide range of forms to which at present exact limits can hardly be ascribed, but they cannot well include the form described by Schulze as *P. lageniformis*.*

Synopsis of the British Species.

Test of medium size, sub-spherical or ovoid, not compressed; covered with fine quartz grains. (1) *P. gracilis.*

Test small, pyriform, not compressed; usually having a few large adherent quartz grains. (2) *P. fulva.*

Test of medium size, dark in colour, slightly compressed; usually covered thickly with diatom valves. (3) *P. horrida.*

Test variable in size, pyriform, not compressed; aperture bordered by a collar. (4) *P. fascicularis.*

Test moderately large, smooth, not compressed, covered by a thick layer of small silicious particles. (5) *P. archeri.*

Test ovoid, of medium size, compressed; aperture flexible, oval or linear. (6) *P. compressa.*

1. **Pseudodifflugia gracilis** Schlumberger.

(Plate L, figs. 6–9, and Pl. LI, figs. 10 and 11.)

Pseudodifflugia gracilis

Schlumberger in Ann. Sci. nat. (3) III (1845), p. 254.

Leidy (pars) Freshw. Rhiz. N. Amer. (1879), pp. 198–201, pl. xxxiii, ff. 18–20 (? 21–24, 26, 27); in Proc. Acad. Philad. 1879, p. 163.

Hitchcock Synops. Freshw. Rhiz. (1881), p. 33.

Taránek in Sitzb. böhm. Ges. Wiss. 1881, pp. 224, 233.

Tarr in Rep. N. York State Mus. XXXV (1884), p. 167.

Blochmann (pars) Mikr. Thierw. Süsswass. (1886), p. 14, pl. i, f. 32; ed. 2 (1895), p. 18, pl. i, f. 25.

* 'Archiv f. mikros. Anat.' XI, p. 125, pl. vii, ff. 6–8.

LORD in Sci. Gossip, 1891, p. 245, f. 202; *op. cit.* 1892, p. 129; in Trans. Manch. Micr. Soc. 1891 (1892), p. 56.
PERRY in Proc. Amer. Soc. Micr. XII (1891), p. 95.
CASH in Trans. Manch. Micr. Soc. 1891 (1892), p. 52.
DADAY in Termész. Füzetec, VI (1892), p. 27, etc.; in Deutsch-Ost-Africa, IV, XXIII (1910), p. 11.
SCHEWIAKOFF in Mém. Acad. St. Pétersb. (7) XLI (1893), VIII, p. 98.
ENTZ in Math. Termész. értes. XV (1897), pp. 173, 178; in Math. nat. Ber. Ungarn, XV (1899), pp. 184, 188.
SCHAUDINN in Deutsch-Ost-Africa, IV, XVII (1897), p. 11.
AVERINTZEFF in Trudui S.-Peterb. Obshch. XXX, I (1900), p. 240; *op. cit.* (pars) XXXVI, II (1906), pp. 276–277.
EYFERTH Einfach. Lebensf., ed. 3 (1900), p. 271.
WEST in Jrn. Linn, Soc, Zool. XXVIII (1901), p. 330.
PENARD Faune Rhiz. Léman (1902), pp. 449–450, 4 figs.; in Arch. Protist. II (1903), p. 264; Sarcodinés in Cat. Invert. Suisse (1905), pp. 90–91.
ZSCHOKKE in Arch. Hydrobiol. I (1905), p. 4.
SCHOUTEDEN (pars) in Ann. Biol. lacustre, I (1906), p. 364.
HOPKINSON in Irish Natur. 1910, pp. 3, 4.
WAILES & PENARD in Proc. R. Irish Acad. XXXI, LXV (1911), p. 19.
WAILES in Scott. Natur. 1912, p. 61; in Jrn. Linn. Soc., Zool. XXXII (1912), p. 126; *loc. cit.* (1913), p. 213; in Naturalist, 1913, p. 148.
SCHMIDT in Arch. Protist. XXIX (1913), p. 220.

Pleurophrys sphærica

CLAPARÈDE & LACHMANN Études Inf. et Rhiz. I, 2 (1859), p. 455, pl. xxii, f. 3.
ARCHER ? in Qrt. Jrn. Micr. Sci. (N. S.) IX (1869), pl. xx, f. 1; *op. cit.* (N. S.) X (1870), pp. 77–20, 121; (N. S.) XVI (1876), p. 343; in Proc. Dubl. Micr. Club, I, 5 (1872), pp. 352–354, 389, pl. xiii, f. 1.
HERTWIG & LESSER in Arch. mikr. Anat. X (1874), Suppl., p. 135, pl. iii, f. 4.
SCHULZE in Arch. mikr. Anat. XI (1875), p. 122.
MAGGI in Rend. R. Ist. Lomb. (2) IX (1876), p. 543; in Atti Soc. Ital. XXI (1879), p. 319.
EYFERTH Einfach. Lebensf., ed. 2 (1885), p. 52.
FOREL Le Léman, III (1902), p. 173.
BUTLER in Brit. Assoc. Handb. Dublin (1908), p. 219.

Pleurophrys amphitremoides

ARCHER in Qrt. Jrn. Micr. Sci. (N. S.) X (1870), pp. 20, 121, pl. xx, f. 2; in Proc. Dubl. Micr. Club, I, 5 (1872), pp. 355, 389, pl. xiii, f. 2.
SCHULZE in Arch. mikr. Anat. XI (1875), pp. 123–124, pl. vii, f. 1.
ALLMAN in Jrn. Linn. Soc. XIII (1877), pp. 407–408.
PENARD in Mém. Soc. Genève, XXXI, i, II (1890), p. 170, pl. vii, ff. 115–117; pl. viii, ff. 1–8; in Rev. Suisse Zool. IX (1901), p. 238.

Difflugia gracilis

EHRENBERG in Abh. Akad. Berlin, 1871 (1872), p. 264.

Pleurophrys angulata

MERESCHKOVSKY in Trudui S.-Peterb. Obshch. VIII (1878), p. 192, pl. ix, f. 14; in Arch. mikr. Anat. XVI (1879), pp. 192–193, pl. x, ff. 14, 14*a*.

Pseudodifflugia amphitremoides

BUETSCHLI in Bronn's Thierreichs, I, 1 (1880), pl. iii, f. 14.

Penard in Mém. Soc. Genève, XXXI, i, II (1890), p. 170, pl. vii, ff. 115–117; pl. viii, ff. 1–7; in Jahrb. nassau. Ver. Naturk. XLIII (1890), p. 71.
Rhumbler in Zeits. wiss. Zool. LXI (1895), p. 95.
Delage & Hérouard Traité Zool. concrète, I (1896), p. 115, f. 151.

Plagiophrys gracilis
Penard in Mém. Soc. Genève, XXXI, i, II (1890), p. 173, pl. viii, ff. 43-45; in Rev. Suisse Zool. VII (1899), p. 60, pl. vii, f. 37.
Thiébaud & Favre in Ann. Biol. lacustre, I (1906), pp. 68, 76.

Pseudodifflugia hemisphærica
Penard in Amer. Natur. XXV (1891), p. 1083.

Difflugia urceolata
Francé (pars) in Res. Erforsch. Balatons. II, I (1897), p. 7.

Test light brown or yellowish in colour, broadly ovoid or sub-spherical; covered with fine quartz-grains; not compressed; aperture circular, terminal, devoid of neck; nucleus placed posteriorly; a small contractile vesicle sometimes discernible; pseudopodia long, filose, straight or forked.

Length 30–55 μ; aperture 10–20 μ.

Habitat.—Aquatic vegetation.

England.—N. Yorkshire; Cheshire (*Cash*); Shropshire; Bedfordshire; Essex (*Scourfield*); Buckinghamshire; Isle of Wight; Devonshire; Cornwall.

Wales.—Llyn Bochlwyd and Capel Curig, Carnarvonshire (*West*).

Scotland.—Shetlands; Outer Hebrides; Inverness-shire (*Brown*).

Ireland.—Clare Island, Mayo; Wicklow (*Archer*).

Between the limits of length (20–65 μ) indicated by Penard are a number of forms which show considerable variation in colour, relative size of aperture, and the character of the adherent foreign particles as well as in the appearance of the pseudopodia. The larger sub-spherical forms appear to be rare in the British Isles, the type usually found being broadly ovoid and of rather small size (30–40 μ in length).

This species is distinguished from *P. fulva* by its larger size and the usually comparatively smooth exterior of its test; the character of the pseudopodia and colour of the test distinguish it from species belonging to the genera *Difflugia* and *Phryganella*.

The illustration by Archer in the 'Quart. Journ. Micros. Sci.,' vol. ix, Pl. xx, fig. 1 (*Pleurophrys ? sphærica*) probably represents *Pseudodifflugia Archeri* as it measures 110 μ in length.

2. **Pseudodifflugia fulva** (Archer) Penard.

(Plate L, figs. 10–13; Pl. LI, fig. 12.)

Pleurophrys fulva

Archer in Qrt. Jrn. Micr. Sci. (n. s.) X (1870), pp. 20, 122, pl. xx, f. 3; *op. cit.* (n. s.) XIII (1873), p. 437; in Proc. Dubl. Micr. Club, I, 5 (1872), pp. 355, 390, pl. xiii, f. 3; *op. cit.* II, 3 (1875), p. 285.

Schulze in Arch. mikr. Anat. XI (1875), pp. 124–125, pl. vii, ff. 2, 3.

Pseudodifflugia fulva

Penard in Rev. Suisse Zool. IX (1901), p. 238; Faune Rhiz. Léman (1902), pp. 451–452, 5 figs.; Sarcodinés in Cat. Invert. Suisse (1905), p. 91.

Hopkinson in Irish Natur. 1910, pp. 3, 4.

Wailes in Scott. Natur. 1912, p. 61; in Jrn. Linn. Soc., Zool. XXXII (1912), p. 126; in Naturalist, 1913, p. 140.

Schmidt in Arch. Protist. XXIX (1913), pp. 219–220, pl. v, ff. 17–20.

Test light brown or yellow in colour, small, pyriform, not compressed, covered with extraneous particles, usually including a few large quartz-grains; aperture circular, terminal, devoid of neck; nucleus placed posteriorly, containing a single nucleole; a single contractile vesicle usually present; plasma not entirely filling the test; pseudopodia long, attenuate, numerous, straight or branched.

Length 15–30 μ; diameter 12–20 μ; aperture 6–12 μ.

Habitat.—Aquatic vegetation.

England.—N. Yorkshire; Rutlandshire; Buckinghamshire; Hampshire; Isle of Wight; Devonshire; Cornwall; Scilly Isles.

Scotland.—Outer Hebrides.

Ireland.—Clare Island and Caher Island, Mayo; Inishbofin, Galway; Wicklow (*Archer*).

Probably distributed generally in the British Isles, but owing to its small size this species is easily overlooked. Penard gives 15 to 23 μ as the usual limits of length; Archer's figure measures about 30 μ; in the

British Isles the length usually varies from 20 to 26 μ. Colourless tests occasionally occur.

3. **Pseudodifflugia horrida** Penard.

(Plate LII, figs. 1–4.)

Pseudodifflugia horrida
PENARD Faune Rhiz. Léman (1902), pp. 452–453, 5 figs.; Sarcodinés grands Lacs (1905), pp. 115, 596, 604–606, 3 figs.; Sarcodinés in Cat. Invert. Suisse (1905), p. 91.
MURRAY in Proc. R. Soc. Edinb. XXV (1905), p. 615.
WAILES & PENARD in Proc. R. Irish Acad. XXXI, LXV (1911), p. 19.

Test of medium size, dark grey or brown in colour, opaque, oviform, slightly compressed, flexible, especially around the aperture; covered with a rough coating of foreign particles and projecting diatom-frustules; aperture terminal, of variable shape; the plasma clear, granular, with few inclusions, entirely filling the test; nucleus small, with a single large nucleole; one or two contractile vesicles usually present; pseudopodia long, attenuate, straight.

Length 35–60 μ; breadth about three-quarters of the length; aperture about half of the breadth; thickness about nine tenths of the breadth.

Habitat.—Aquatic vegetation.

ENGLAND.—Cheshire (*Cash*).
SCOTLAND.—Loch Ness, Inverness-shire (*Penard*).
IRELAND.—Inishbofin, Galway.

Penard noticed that the individuals found in Loch Ness were infested with large numbers of bacteria of very small diameter and about 20 μ in length, similar to, but much more numerous than, those found in the Swiss members of this species; in addition to these bacteria the majority of the Loch Ness individuals contained parasites in appearance like degenerate *Peranema* (Duj.) but wanting the flagellum; they were 15 to 20 μ in length; their life-history is unknown. Similar parasites are found in the Heliozoon *Raphidiophrys viridis*. Ciliates are often seen in the

tests of Rhizopoda, but may be only intruders in most cases and not truly parasitical.

The plasma of *P. horrida* can only be examined by expelling it from the test, which is covered by a confused mass of diatoms, grains, and silicious plates; the colour as a whole varies from brown to nearly black; the aperture appears flexible and may be found entirely closed or widely distended; its outline is usually very indistinct. The pseudopodia are rarely observed.

4. **Pseudodifflugia fascicularis** Penard.

(Plate LII, figs. 5–8.)

? Pseudodifflugia amphora
Leidy Freshw. Rhiz. N. Amer. (1879), p. 201, pl. xxx, f. 28.
Pseudodifflugia fascicularis
Penard Faune Rhiz. Léman (1902), pp. 453–455, 5 figs.; Sarcodinés in Cat. Invert. Suisse (1905), p. 92.
Averintzeff in Trudui S.-Peterb. Obshch. XXXVI, II (1906), p. 275.
Schouteden in Ann. Biol. lacustre, I (1906), p. 364, f. 34.
Wailes & Penard in Proc. R. Irish Acad. XXXI, LXV (1911), p. 19.
Wailes in Scott. Natur. 1912, pp. 61, 64; in Jrn. Linn. Soc., Zool. XXXII (1913), pp. 209, 213; in Naturalist, 1913, p. 148.

Test variable in size, pyriform, yellowish in colour, not compressed, covered with relatively-large quartz-grains, or occasionally diatom-frustules; aperture circular, terminal, larger in diameter than the neck and surrounded by a collar of variously-sized grains; nucleus large, containing numerous nucleoles; plasma limpid, granular, partly filling the test; pseudopodia numerous, long, attenuate, straight or forked.

Length 23–40 μ; diameter two thirds to three quarters of the length; aperture about half of the diameter.

Habitat.—Aquatic vegetation.

England.—Bedfordshire.

Scotland.—Outer Hebrides.

Ireland.—Clare Island and Achill Island, Mayo; Inishbofin, Galway; Kerry.

British individuals usually vary from 25 to 35 μ in

length; few larger than this were recorded; Penard gives 17 to 71 μ as the limits of length, remarking that individuals over 50 μ are rare.

Small individuals sometimes occur with comparatively-smooth tests, and the collar may be a well-defined beading around the aperture.

The enlarged aperture with its collar of quartz-grains renders this species easily recognizable among the *Pseudodifflugiæ*. The test resembles that of *Cryptodifflugia sacculus* Pen. (length 20 to 40 μ) from which species, however, it is distinguished by the longer neck and more prominent collar around the aperture. When active it is easily identified by the character of the pseudopodia.

5. **Pseudodifflugia archeri** Penard.

(Plate XLVIII, fig. 23; and fig. 154 in text.)

Pseudodifflugia amphora
PENARD (pars) in Rev. Suisse Zool. VII (1899), pp. 80–82, pl. viii. ff. 1–5.
Pseudodifflugia archeri
PENARD in Rev. Suisse Zool. IX (1901), pp. 231. 234, 238; Faune Rhiz. Léman (1902), pp. 456–458, 4 figs.; Sarcodinés grands Lacs (1905), pp. 57–59, 110, 115, 119, 125, 2 figs. on p. 58; Sarcodinés in Cat. Invert. Suisse (1905), p. 92; in Rev. Suisse Zool. XVI (1908), pp. 462, 466.
AVERINTZEFF in Trudui S.-Peterb. Obshch. XXXVI, II (1906), pp. 278–279.
MONTI in Ann. Biol. lacustre, I (1906), pp. 130, 166.
SCHOUTEDÉN in Ann. Biol. lacustre, I (1906), p. 364, f. 35.
DOFLEIN in Sitzb. Ges. Morph. München, XXIII (1908), pp. 118–122, ff. 2–5.
WAILES & PENARD in Proc. R. Irish Acad. XXXI, LXV (1911), p. 19.
WAILES in Jrn. Linn. Soc., Zool. XXXII (1912), p. 126.

Test moderately large, of a dark colour, oviform, covered with several layers of silicious grains; transverse section circular or broadly oval; aperture terminal, circular; plasma grey, granular, often containing numerous small crystals; nucleus placed posteriorly, large, granular, containing several nucleoles; several contractile vesicles and many vacuoles usually present; pseudopodia long, numerous, straight or forked.

Length 55–110 μ (Penard gives 50–170 μ as the limits of length and 80–100 μ as the usual size).

Habitat.—Deep lakes and aquatic vegetation.

England.—Shrewsbury, Shropshire; Devonshire; Cornwall.

Wales.—Bodelwyddan, Flintshire.

Ireland.—Clare Island and Roonah, Mayo.

The test is characterized by its thick covering of amorphous silicious particles arranged like a mosaic in the cementing medium, each small particle being isolated from its neighbours.

Fig. 154.—*Pseudodifflugia archeri.* × 200.

The crystals found in the plasma are considered by Penard to consist of some organic compound; owing to the opacity of the test the contents are not visible unless the specimen is immersed in oil of cloves or Canada balsam. The plasma and contractile vesicles, etc., cannot be studied in the living animal unless they happen to be protruded from the aperture.

5. **Pseudodifflugia compressa** (Schulze) Penard.

(Plate LII, figs. 9–11.)

Pleurophrys compressa

Schulze in Arch. mikr. Anat. XI (1875), p. 125, pl. vii, ff. 4, 5.

Archer in Qrt. Jrn. Micr. Sci. (n. s.) VII, p. 204, pl. xiii, ff. 9*a*, 9*b*; in Proc. Dubl. Micr. Club, III, 3 (1880), pp. 273–274, pl. x, ff. 9*a*, 9*b*.

Pseudodifflugia compressa

Penard Faune Rhiz. Léman (1902), pp. 458–459, 2 figs.; Sarcodinés in Cat. Invert. Suisse (1905), p. 93.

Averintzeff in Trudui S.-Peterb. Obshch. XXXVI, ii (1906), p. 275.

Schouteden in Ann. Biol. lacustre, I (1906), pp. 363, 364.

Wailes & Penard in Proc. R. Irish. Acad. XXXI, lxv (1911), p. 19.

Test ovoid, yellowish-brown in colour, compressed, covered with small plates and foreign particles; in narrow side view with rounded fundus and sides tapering towards the aperture; aperture flexible, of variable shape; plasma granular, usually containing food-particles; a contractile vesicle placed anteriorly usually present; pseudopodia numerous, attenuate, radiating, and branched.

Length 55–70 μ; breadth 35–42 μ; thickness 25–30 μ; aperture 12–14 μ.

Habitat.—Sphagnum and aquatic vegetation.

England.—Golf-links, Sandown, Isle of Wight.

Ireland.—Salt marsh ditch, Clare Island, and lake on Inishturk, Mayo.

The limits of this species are difficult to define as the amount of compression of the test and the form of the aperture are subject to considerable variation.

Genus 43. **DIAPHOROPODON** Archer, 1869.

? *Plagiophrys* Claparède & Lachmann (pars) Études Inf. et Rhiz. I, 2 (1859), p. 453.

Diaphoropodon Archer in Qrt. Jrn. Micr. Sci. (n. s.) IX (1869), pp. 394–397. (Diagnosis of genus, *op. cit.* (n. s.) X (1870), p. 123.)

? *Gromia* Blochmann (pars) Mikr. Thierw. Süsswass. (1886), p. 15.

Diaphorodon Penard Sarcodinés in Cat. Invert. Suisse (1905), p. 89.

Test ovoid, membranous, flexible, covered with fine extraneous particles and furnished with a thick covering of fine, hyaline, hair-like cils; pseudopodia long, filose, branching, not anastomosing.

In general appearance and specific characters this genus, containing a single species, is similar to the genus *Pseudodifflugia*, but is distinguished by the presence of fine hair-like cils thickly covering the test; these are so fine and transparent that they have the appearance (under low powers) of a hyaline investment

or fringe, and were thought by Archer to be pseudopodia or prolongations of the ectoplasm; chiefly for this reason he placed *D. mobile* in a separate genus. The cils, however, are of a rigid nature very similar to those of *Nebela barbata* and *Lecythium bathybioticum*; there is therefore no more reason for separating this species from the genus *Pseudodifflugia* than for removing the above species from their respective genera.

1. **Diaphoropodon mobile** Archer.

(Plate LIII, figs. 1–4, and Pl. LIV, figs. 1 and 2.)

? Plagiophrys cylindrica
Claparède & Lachmann Études Inf. et Rhiz. I, 2 (1859), pp. 453–454, pl. xxii, f. 1.
Rhumbler in Arch. Protist. III (1903), p. 200, f. 15.
Eyferth Einfach. Lebensf. (1878), p. 34.
Diaphoropodon mobile
Archer in Qrt. Jrn. Micr. Sci. (n. s.) IX (1869), pp. 394–397, pl. xx, f. 6; *op. cit.* (n. s.) X (1870), p. 123; (n. s.) XII (1872), p. 194; in Proc. Dubl. Micr. Club, I, 5 (1872), pp. 349–352, 391, pl. xiii, f. 6; *op. cit.* II, 1 (1873), pp. 108, 120.
Allman in Jrn. Linn. Soc. XIII (1877), p. 408.
Buetschli in Bronn's Thierreichs, I, 1 (1880), pl. iv, f. 1.
Lanessan Protozoa (1882), pp. 72–73, f. 61.
Lankester in Encycl. Brit., ed. 9, XIX (1885), p. 845, f. ix (12); in Zool. Art. contrib. Encycl. Brit. (1891), p. 16, f. ix (12).
Brady in Jrn. R. Micr. Soc. 1887, p. 877.
Blochmann Mikr. Thierw. Süsswass., ed. 2 (1895), p. 18.
Delage & Hérouard Traité Zool. concrète (1896), p. 115, f. 152.
Penard in Rev. Suisse Zool. IX (1901), p. 237; *op. cit.* XIII (1905), p. 602; Faune Rhiz. Léman (1902), pp. 444–448, 2 figs.
Chapman Foraminifera (1902), p. 70, pl. i, f. d.
Averintzeff in Trudui S.-Peterb. Obshch. XXXVI, ii (1906), p. 271.
Schouteden in Ann. Biol. lacustre, I (1906), p. 363, f. 31.
Butler in Brit. Assoc. Handb. Dublin (1908), p. 219.
Hopkinson in Irish Natur. 1910, p. 3.
Hartog in Encycl. Brit., ed. 11, XXIII (1911), p. 248, f. 7 (11).
Wailes & Penard in Proc. R. Irish Acad. XXXI, lxv (1911), pp. 15, 60, 61.
Wailes in Scott. Natur. 1912, p. 60; in Jrn. Linn. Soc., Zool. XXXII (1913), p. 209.
? Gromia cylindrica
Blochmann Mikr. Thierw. Süsswass. (1886), p. 15.
Diaphorodon mobile
Penard Sarcodinés in Cat. Invert. Suisse (1905), p. 90.

Test membranous, flexible, brown in colour, covered with a variety of extraneous particles, translucent,

usually more or less ovoid, the surface covered with numerous, short, hyaline, hair-like cils; the aperture terminal, of varying shape; the plasma grey, granular, not completely filling the test; nucleus large, granular, placed posteriorly; one or two contractile vesicles, placed anteriorly; pseudopodia long, numerous, branching, but not anastomosing.

Length 60–113 μ; diameter about two thirds of the length; cils 8–10 μ in length.

Habitat.—Aquatic vegetation.

England.—Isle of Wight; Devonshire; Cornwall.
Wales.—Dolgoth, Merionethshire (*Cash*).
Scotland.—Dumfriesshire.
Ireland.—Armagh; Clare Island, Mayo; W. Galway, Wicklow, and Kerry (*Archer*).

Owing to the flexibility of the membrane the test is somewhat variable in shape; it is usually ovoid with the aperture at the smaller end, but occasionally it is found at the larger end; sometimes the test is of nearly equal width for a portion of its length. The hair-like cils with which it is thickly covered are rigid and apparently of a chitinous nature; being colourless and extremely fine they easily escape observation.

Large oil-like globules can often be discerned in the plasma; they are readily stained by carmine. In the larger individuals the nucleus is from 20 to 23 μ in diameter. Occasionally quartz-grains and diatom-frustules are included in the foreign matter with which the test is coated. Penard states that in some instances he was unable to perceive the hyaline cils which usually cover the test; these cils are unaffected by alcohol or dilute sulphuric acid; they become invisible in glycerine and Canada balsam. Double tests are occasionally found.

The long pseudopodia with secondary tuft-like branchings depicted by Archer were only observed by him in individuals when first seen; they were quickly

retracted and he never saw them formed a second time; they have not been noticed by subsequent observers. The pseudopodia are usually attenuate, and are radiating, and simple or forked.

Genus 44. **CLYPEOLINA** Penard, 1901.

Clypeolina Penard in Rev. Suisse Zool. IX (1901), p. 237.

Test ovoid, compressed, formed of a double envelope; the outer covering consisting of two separate chitinous valves covered with small scales and silicious particles; the inner covering consisting of a membranous sac; pseudopodia long, filose, frequently branched.

Penard formed this genus to receive a species similar to a *Pseudodifflugia* but having a well-developed keel around the margin of the test; this keel is formed by the junction of the flattened edges of the two half outer valves forming the test, and it may be slight or even altogether absent. The generic and constant characteristic feature of *C. marginata* is this bivalve test possessed by no other known testaceous Rhizopod. The separate inner membrane and method of division are also peculiar features.

The only known member of the genus, *C. marginata*, has in Great Britain been recorded from a single locality only; no doubt it will be found elsewhere if diligently looked for, but unless carefully examined it is apt to be mistaken for a *Pseudodifflugia*. Like many species belonging to allied genera it may occur in a very limited habitat, *i. e.* a single small pool or ditch in a marsh or a single tussock of sphagnum may contain numerous individuals of a particular species whilst in adjoining and similar situations none are to be found; it is also by no means certain that they will be found in the same places during successive years.

1. **Clypeolina marginata** Penard.

(Plate LIII, figs. 5 and 6.)

Clypeolina marginata

Penard in Rev. Suisse Zool. IX (1901), p. 237; Faune Rhiz. Léman (1902), pp. 459–461, 4 figs.; Sarcodinés grands Lacs (1905), pp. 59–61, 109, 7 figs.; Sarcodinés in Cat. Invert. Suisse (1905), p. 93; in Arch. Protist. VIII (1906), pp. 66–85, 10 figs.; in Rev. Suisse Zool. XVI (1908), p. 465.

Averintzeff in Trudui S.-Peterb. Obshch. XXXVI, II (1906), p. 273.

Schouteden in Ann. Biol. lacustre, I (1906), p. 363, f. 33.

Test ovoid, compressed, consisting of outer and inner envelopes; the outer envelope formed of two equal valves of a chitinous material with an admixture of small scales and silicious grains, yellow or brown in colour and becoming darker with age; the transverse section lenticular; the inner envelope consisting of a thin, flexible, colourless membrane closely investing the plasma; the aperture terminal, wide, linear; the plasma with clear, limpid ectoplasm and pale blue endoplasm containing numerous small globules; nucleus large, ovoid or spherical, placed nearly centrally and containing an irregularly-shaped nucleole; a single large contractile vesicle and numerous vacuoles usually present; pseudopodia numerous, long, filose, straight, often alternately branched.

Length 80–150 μ, but usually 120–135 μ; breadth rather more than half the length.

Habitat.—Aquatic vegetation in lakes and marshes.

England.—Norfolk (*Cash*).

For a detailed study of this species, Penard ('Archiv für Protist.,' 1906) should be consulted; these later researches modify to some extent his description of the genus and species written in 1902. This is the only known Rhizopod provided with a bivalve test, the two valves fitting together like those of a mussel, but without any hinge; multiplication takes place by the division of the internal membrane in a longitudinal direction, and each of the individuals thus formed

appropriates one of the old outer valves and secretes one new valve; thus in any individual the two valves are of different ages. Diatoms are its principal food but small algæ are also ingested. The contractile vesicle pulsates very slowly, having a period of many hours.

Sub-family Allogromiinæ.

This sub-family was founded by Rhumbler in 1903 to include those genera belonging to the Reticulosa, that is having pseudopodia forming a network or reticulum, which up to that time had been included in the family Gromida (Clap. & Lachm., 1859) whose type was *Gromia oviformis* Duj.

Rhumbler's reason for this alteration was that *G. oviformis* (a marine species) is drawn by Dujardin with filose pseudopodia, and cannot therefore be taken as the type for a group of reticulous species.

It is not unlikely that Dujardin failed to see the full development of the pseudopodial reticulum as this is usually formed gradually, a number of filose pseudopodia being first protruded, which branch in various directions, coalescing with one another until an intricate network is eventually formed. This point of view is supported by Grueber's drawings of *Gromia lagenoides* and *G. mollis* as well as Dujardin's of *G. fluvialis* (fig. 157), all of which show very immature reticula, nearly all the pseudopodia being simply filose.

However as Dujardin neither depicted nor described a pseudopodial reticulum for *G. oviformis*, the classification of Rhumbler has been adopted by us.

The following description by Leidy ('Freshw. Rhiz. N. Amer.' p. 279) of *G. terricola** gives an excellent idea of the appearance of the reticulated pseudopodia characteristic of this sub-family:—"Over each and every thread of the pseudopodal net *Gromia* has as

* = *Allogromia fluvialis.*

complete control as if the threads were permanently differentiated limbs acted on by particular muscles, and directed in their movements by nervous agency. Threads dissolve their connection and are withdrawn; new ones are formed and establish other connections; they bend; they contract into a spiral; they occasionally move like the lashing of a whip, and indeed produce almost every conceivable variety of motion. Not unfrequently spindle-like accumulations of protoplasm occur in the course of the pseudopodal threads. Sometimes, through the conjunction and spreading of several of the latter together, islet-like expansions occur, and become the centres of secondary nets.

"The pseudopodal extensions of *Gromia* consist of pale granular protoplasm with coarser and more defined granules. The latter are observed to be in incessant motion along the course of the threads, flowing in opposite directions in all except those of the greatest delicacy. In the larger threads, the granules are immersed and near together; in the smallest threads, they are in single rows, more or less widely separated, and thicker than the threads, so that these appear like strings of minute beads. . . . Besides the granules, minute vacuoles often make their appearance along the course of the pseudopods. Some of these seem to be of the character of contractile vesicles, —starting as mere points, slowly enlarging, and then collapsing."

Genus 45. **MICROGROMIA** Hertwig & Lesser, 1874.

Arcella (pars) Fresenius in Abh. senekenb. nat. Ges. II (1858), p. 219.
Cystophrys (pars) Archer in Qrt. Jrn. Micr. Sci. (n. s.) IX (1869), p. 259.
Gromia (pars) Archer in Qrt. Jrn. Micr. Sci. (n. s.) IX (1869), p. 322.
Microgromia Hertwig & Lesser in Arch. mikr. Anat. X (1874), Suppl., p. 1.

Test small, hyaline, spherical or pyriform, not compressed; aperture circular, terminal; pseudopodia long, straight or branching, filose or anastomosing, usually arising from a peduncle; nucleus single; one contractile vesicle usually present; habit solitary or colonial.

M. socialis and *M. mucicola*, the two species recorded from Great Britain, often occur in colonies or small groups, and in this state may be joined by a pseudopodial reticulum, but when they are solitary the pseudopodia are filose; in either case they arise from a peduncle. *M. elegantula* Penard also possesses a peduncle and filose pseudopodia. *M. levipes* Penard is similar but apparently has no peduncle. The genus is therefore somewhat anomalous and is intermediate in character between the Pseudo-gromiinæ and the Allogromiinæ, and might perhaps with equal propriety be placed in either family.

Synopsis of the British Species.

Test small; often found in large colonies. (1) *M. socialis.*
Test minute; habit usually solitary; when in groups these consist of two or three individuals only.
(2) *M. mucicola.*

1. **Microgromia socialis** (Archer) Hertwig & Lesser.

(Plate LV; Pl. LVI, figs. 1–6.)

Difflugia enchelys
Schneider in Arch. Anat. Physiol. XXI (1854), pl. ix, ff. 17–21. (*Non* Ehrenberg, 1838.)
Arcella hyalina
Fresenius in Abh. senckenb. nat. Ges. II (1858), pp. 219–223, pl. xxii, ff. 1–24. (*Non* Ehrenberg, 1838.)
Gromia socialis
Archer in Qrt. Jrn. Micr. Sci. (n. s.) IX (1869), pp. 322, 390; *op. cit.* (n. s.) X (1870), pp. 22, 124, pl. xx, ff. 7–11; in Proc. Dubl. Micr. Club, I, 5 (1872), pp. 289, 344, 349, 392, pl. xiii, ff. 7–11.
Schulze in Arch. mikr. Anat. XI (1875), pp. 118–122, pl. vi, ff. 21–26.
Gruber in Zeits. wiss. Zool. XXXVI (1881), pp. 115, 123, pl. iv, ff. 21–26.
Lanessan Protozoa (1882), p. 62, ff. 47–50.

Cystophrys haeckeliana
ARCHER in Qrt. Jrn. Micr. Sci. (N. S.) IX (1860), p. 259, pl. xvii, ff. 1, 2; in Proc. Dubl. Micr. Club, I, 4 (1870), p. 201; *op. cit.* I, 5 (1872), pp. 328–336, 380, pl. xi, ff. 1, 2.
Microgromia socialis
HERTWIG & LESSER in Arch. mikr. Anat. X, Suppl. (1874), pp. 1–34, pl. i.
ARCHER in Qrt. Jrn. Micr. Sci. (N. S.) XVI (1876), pp. 343–344; *op. cit.* (N. S.) XVII (1877), pp. 115–121, pl. viii, f. 8; in Proc. Dubl. Micr. Club, III, 2 (1878), pp. 134–135, 233–239, pl. viii, f. 8.
CIENKOWSKY in Arch. mikr. Anat. XII (1876), pp. 34–37, pl. vi, ff. 48–59.
MAGGI in Rend. R. Ist. Lomb. (2) IX (1876), p. 543; in Atti Soc. Ital. XXI (1879), p. 319.
ALLMAN in Jrn. Linn. Soc. XIII (1877), pp. 400–403, f. 6.
CATTANEO in Boll. Scient. I (1879), p. 7.
BUETSCHLI in Bronn's Thierreichs, I, 1 (1880), pl. iii, f. 15 a–d.
GRUBER in Biol. Centralbl. I (1881), p. 457.
PARONA in Arch. Sci. nat. (3) X (1883), p. 238; in Boll. Scient. VI (1884), p. 56.
EYFERTH Einfach. Lebensf., ed. 2 (1885), p. 52, pl. iii, f. 28; ed. 3 (1900), p. 270, pl. ix, f. 18.
LANKESTER in Qrt. Jrn. Micr. Sci. (N. S.) XXV (1885), p. 71.
BLOCHMANN Mikr. Thierw. Süsswass. (1886), p. 15, pl. i, f. 34; ed. 2 (1895), p. 19, pl. i, f. 26.
LUDWIG in Leunis' Synops. Thierk., ed. 3, II (1886), p. 1196, f. 1155.
BRADY in Jrn. R. Micr. Soc. 1887, p. 877.
ENTZ Stud. Protist. I (1888), pp. 138, 171.
DELAGE & HÉROUARD Traité Zool. concrète, I (1896), pp. 113–114, ff. 146–149.
PARKER & HASWELL Text-book Zool. I (1897), p. 50, f. 32; ed. 2 (1910), p. 50, f. 33.
CALKINS Protozoa (1901), pp. 56, 92–93, ff. 24, 51.
CHAPMAN Foraminifera (1902), p. 69, pl. i, f. B.
PENARD Faune Rhiz. Léman (1902), p. 580, f. 76 (p. 572).
ZACHARIAS in Forschb. Plon, X (1903), p. 242; XI (1904), p. 198.
CASH in Jrn. Linn. Soc., Zool. XXIX (1904), pp. 218, 223.
CLAUS & GROBBEN Lehrb. Zool., ed. 7 (1904), p. 229.
HARTOG in Cambridge Nat. Hist. I (1906), pp. 59–60, f. 11.
PRANDTL in Arch. Protist. IX (1907), p. 3.
BUTLER in Brit. Assoc. Handb. Dublin (1908), p. 219.
BROWN in Jrn. Linn. Soc., Zool. XXX (1910), p. 362.
HOPKINSON in Irish Natur. 1910, pp. 3, 4.
SCHMIDT in Arch. Protist. XXIX (1913), p. 222.
Microgromia
HOGG Microscope, ed. 15 (1898), p. 485, pl. xv, f. 3.
Mikrogromia socialis
BUCK in Zeits. wiss. Zool. XXX (1877), pp. 21, 45.
AVERINTZEFF in Trudui S.-Peterb. Obshch. XXXVI, II (1906), pp. 81, 269.
SCHOUTEDEN in Ann. Biol. lacustre, I (1906), p. 362.

Test small, sub-spherical or pyriform, symmetrical, hyaline; without extraneous adhering particles, ter-

minating in a short neck and circular aperture; plasma bluish, granular; nucleus large, with a single nucleole; a single contractile vesicle situated near the aperture usually present; pseudopodia arising from a peduncle, attenuate, branching, anastomosing, often connecting numerous individuals into colonies more or less closely aggregated. Multiplication by longitudinal or transverse division of the plasma and also by the liberation of zoospores.

Diameter 25–35 μ.

Habitat.—Aquatic vegetation.

England.—Cumberland (*Brown*); Epping Forest, Essex (*Cash*).

Ireland.—Calary, Carrig, and Glenmalure, Wicklow (*Archer*).

The peduncle from which the pseudopodia arise is characteristic of all those Gromiina which possess anastomosing pseudopodia; in *M. socialis* it is often short and may consist of little more than a portion of the plasma projecting from the aperture. Multiplication in this species may take place either by longitudinal or by transverse division of the plasma; in the former case the division of the plasma (except the pseudopodia) is completed within the test, the daughter individual emerges in an amœboid state, secretes a test for itself, and may follow an independent existence or remain attached to the parent either by the anastomosing pseudopodia or by helping to form a compact colony. When transverse division of the plasma takes place within the test, as described by Hertwig (1874), the moiety near the fundus of the test becomes a free-swimming flagellated zoospore, the subsequent life-history of which has not been followed out. (See Plate LVI, figs. 1–6.)

The *Cystophrys haeckeliana* of Archer (1869) proved to be merely the closely-aggregated colonial form of *M. socialis*. When it occurs in a solitary form the pseudopodia are of a filose character; when the indi-

viduals are some distance apart they are connected by a pseudopodal reticulum; and when closely aggregated they are immersed in plasma.

(The Epping Forest specimens were found in a bog-pool off Copper Hall Lodge Road, in which also *Pompholyxophrys*, *Acanthocystis*, and *Pamphagus hyalinus* [*Lecythium hyalinum*] occur. The characters presented by a colony of sixteen or eighteen individuals agreed very closely with Archer's description; but in his figure as given in the 'Qrt. Jrn. Micros. Sci.,' 1869, Pl. xxii, the pseudopodal filaments are inadequately represented (*Cash*).)

2. **Microgromia mucicola** Archer.

(Pl. LVI, figs. 7 and 8.)

Microgromia
Archer in Qrt. Jrn. Micr. Sci. (n. s.) XVI (1876), p. 105; in Proc. Dublin Micr. Club, III, 1 (1876), pp. 107–108).
Microgromia mucicola
Archer in Qrt. Jrn. Micr. Sci. (n. s.) XVII (1877), pp. 121–122, 194, 465, pl. viii, f. 9; in Proc. Dubl. Micr. Club, III, 2 (1878), pp. 239–240, 247, pl. viii, f. 9; *op. cit.* III, 3 (1880), p. 283.
Brady in Jrn. R. Micr. Soc. 1887, p. 877.
Butler in Brit. Assoc. Handb. Dublin (1908), p. 219.

Test minute, pyriform, hyaline, without extraneous adherent particles; plasma granular; nucleus single, containing a single nucleole; contractile vacuoles usually present but obscure; pseudopodia arising from a peduncle, branching and anastomosing; habit usually solitary but sometimes occurring in groups of two or at most three individuals.

Length about 10 μ; breadth 6–7 μ.

Habitat.—The mucous investment of Algæ, *e.g.* "*Dictyosphœrium*" and *Cosmocladium*.

Ireland.—Rocky Valley, Bray, Wicklow (*Archer*).

This species is so inert, and the pseudopodia are so seldom displayed and so easily overlooked when displayed, that Archer mistook it at first for an algal spore; for the same reasons and also on account of its

minuteness it has probably been overlooked by other observers. The method of multiplication has not been observed.

Genus 46. **LIEBERKUEHNIA*** Claparède & Lachmann, 1859.

Lieberkuehnia Claparède & Lachmann Étude Inf. et Rhiz. I, 2 (1859), pp. 464–465.
Lieberkühnia Haeckel Rhiz. fin. et ord. (1861), p. 13.

Test membranous, supple, smooth or thinly covered with foreign particles, pyriform, ovoid, or spherical; aperture usually single, lateral or sub-terminal, flexible; nuclei one or more; contractile vesicles numerous; pseudopodia arising from a long peduncle within the test, reticulate, often enveloping the test.

This genus was formed by Claparède & Lachmann to include those Rhizopoda which possess anatomosing pseudopodia arising from an internal peduncle or prolongation of the plasma and a test which is supple and membranous. Two species included in this genus are exclusively marine, one (*L. paludosa*) is exclusively a freshwater form, whilst *L. wageneri* is found in both salt- and fresh-water; that only has been recorded from the British Isles.

In the Allogromiinæ the aperture is usually well marked and readily identified, but in *Lieberkuehnia* it is often obscure and difficult to locate, especially when the animal is in a nearly spherical form; the aperture then usually is merely a narrow slit in the test. The origin of the pseudopodia is also obscure when they are emitted from various parts of the layer of plasma which often more or less completely envelopes the exterior of the test. Individuals having two apertures, one at each pole of the test, sometimes occur.

* This spelling is correct in accordance with Latin orthography. The German modified ü cannot be used in the names of either genera or species.

1. **Lieberkuehnia wageneri** Claparède & Lachmann.

(Plate LVI, fig. 9; and figs. 155 and 156 in text.)

Lieberkuehnia wageneri
Claparède & Lachmann Études Inf. et Rhiz. I, 2 (1859), pp. 465–466, pl. xxiii. (Wrongly "xxiv" on pp. 465 and 482.)
Haeckel in Zeits. wiss. Zool. XV (1865), pp. 344, 363–363 *passim.*
Chapman Foraminifera (1902), p. 69, pl. i, f. a.
Lieberkühnia wageneri
Haeckel Rhiz. fin. et ord. (1861), p. 13.
Carpenter Foraminifera (Ray Soc. 1862), pl. ii, pp. 28–29, 63.
Koelliker Icon. histol. I (1864), p. 26.
Siddall Cat. Brit. Foram. (1879), p. 3; in Qrt. Jrn. Micr. Sci. (n. s.), XX (1880), pp. 141–145, pl. xvi, ff. 8–12 (marine).
Lanessan in Rev. Internat. Sci. VI (1880), p. 10; Protozoa (1882), pp. 58–60, f. 45.
Brady in Jrn. R. Micr. Soc. 1887, p. 876 (marine).
Verworn Protisten-Stud. (1889), pp. 23, 166, 180, pl. iii, f. 11 a–g; pl. v, f. 17 a–d.
Delage & Hérouard Traité Zool. concrète, I (1896), p. 113, f. 144.
Rhumbler in Arch. Protist. III (1903). p. 209, f. 26.
Averintzeff (pars) in Trudui S.-Peterb. Obshch. XXXVI, ii (1906), pp. 126–127.
Schouteden (pars) in Ann. Biol. lacustre, I (1906), p. 375.
Penard in Arch. Protist. VIII (1907), pp. 250–258, ff. 15–52; *op. cit.* IX (1909), p. 265; in Brit. Antarct. Exped. I (1911), pp. 221, 240.
Doflein Lehrb. Protozoenk., ed. 3 (1911), p. 632, f. 563.
Wailes & Penard in Proc. R. Irish Acad. XXXI, lxv (1911), pp. 19, 63.
Lieberkuehnia
Maupas in Compt. rend. Acad. Sci. XCV (1882), pp. 191–194; in Ann. Nat. Hist. (5) X (1882), pp. 410–413.
Lieberkühnia
Verworn Allgem. Physiol., ed. 2 (1897), pp. 157–159, ff. 50, 51.
Calkins Protozoa (1901), p. 284, f. 146 a–e.
Hartog in Cambridge Nat. Hist. I (1906), pp. 60, 61, f. 12.
Gromia lieberkühnia
Hogg Microscope, ed. 15 (1898), p. 485, pl. xv, f. 5.
Lieberkühnia wagneri
Penard Faune Rhiz. Léman (1902), pp. 552-553, 3 figs.; Sarcodinés in Cat. Invert. Suisse (1905), p. 119.
Lieberkühnia fluvialis
Penard in Arch. Protist. XVII (1909), p. 295, f. 1.

Test membranous, ovoid or sub-spherical, transparent, supple, usually devoid of adherent particles; aperture sub-terminal, oblique, flexible; plasma clear, slightly yellow, containing numerous bright, usually oval, granules, nearly filling the test, connected with the aperture by a ribbon-like peduncle or raphe lying

laterally within the test; nuclei numerous, usually 80 to 150 in number, each containing a single

Fig. 155.—*Lieberkuehnia wageneri*, with the pseudopodia depicted half their real length. × 200. (After Claparède & Lachmann, but reduced to one half the size of their figure.)

hemispherical nucleole; contractile vesicles numerous; pseudopodia long, anastomosing, often enveloping the test.

Length 60–160 μ. Nuclei 6 μ in diameter.

Habitat.—On Algæ. Freshwater and marine.

Ireland.—Near the lighthouse, Clare Island, Mayo (*Wailes & Penard*).

When the test assumes a spherical form the aperture is difficult to locate as it becomes a mere slit immersed in the exuding plasma; also the test may be covered by extraneous matter (grains of sand, diatoms, etc.) which adhere to it although they are not incorporated with it. In these circumstances the peduncle or raphe may be indistinguishable, consisting as it does of a fine ribbon-like band within the test

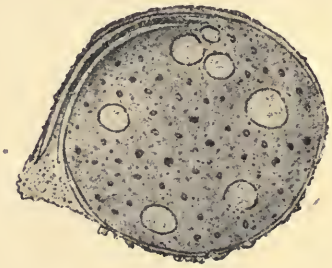

Fig. 156.—*Lieberkuehnia wageneri*, without its pseudopodia. × about 250. (After Penard, as *L. fluvialis*.)

and lying closely to one side of it for about half its length, its aperture end spreading out and forming the origin of a very extensive reticulum. A portion of the plasma often flows around the outside of the test, more or less enveloping it with a coating from which pseudopodia sometimes arise. The numerous nuclei are spherical and each contains a single nucleole lying at one side, shaped like the segment of a sphere, so that in broad view they appear circular and placed centrally in the nucleus, whilst in narrow view they are nearly hemispherical and lie close to one side of it. To see the nuclei it is frequently necessary to crush the test and expel the plasma. In young individuals Penard has found two or three very small nucleoles in each nucleus.

Individuals occur provided with an aperture at each pole, usually having a raphe at either end; Penard records one such in which the raphe appeared to be continuous from one aperture to the other.

Propagation by the test dividing into two or three portions has been observed.

Lieberkuehnia wageneri is easily distinguished from *L. paludosa*, as the latter species is much the larger, being usually from 200 μ to 350 μ in length, has a stout membranous test from 2 μ to 4 μ in thickness, and the nuclei are few in number, often only one, or if more than one then the number is one of the series 2, 4, 8, 16, or 32, and according to Penard never more. It is distinguished from the exclusively marine species *L. gracilis* and *L. bütschli* by these always possessing only a single nucleus.

Genus 47. **ALLOGROMIA** Rhumbler, 1903.

Gromia (*pars*) Dujardin in Ann. Sci. nat. (2) VIII (1837), p. 311.

Allogromia Rhumbler in Arch. Protist. III, 2 (1903), pp. 203–204.

Lieberkühnia (*pars*) Penard in Arch. Protist. IX (1909), p. 295.

Test a thin chitinoid membrane, rather rigid, smooth or slightly coated with extraneous matter, broadly ovoid or spherical; aperture terminal; one or more nuclei; contractile vesicles numerous; pseudopodia numerous, filiform, springing from a short peduncle, branching and anastomosing, with numerous mobile granules.

Rhumbler founded this genus to comprise those species of reticulose testaceous Rhizopoda possessing a single, smooth or nearly smooth, spherical, oval, or ovoid test, a terminal aperture, and a short peduncle bearing reticulated pseudopodia. Its nearest ally is *Lieberkuehnia*, which has a lateral or sub-terminal aperture and a long peduncle bearing the pseudopodia.

Gromia oviformis having been made the type of the genus *Gromia*, as explained above (p. 127), Dujardin's *G. fluvialis*, which has reticulated pseudopodia, should be taken as the type of the genus *Allogromia*. Therefore the original figures of *Gromia fluvialis* are here reproduced (fig. 157). There is no similitude between these and the figure given by Claparède & Lachmann of *Lieberkuehnia wageneri* (see fig. 155, p. 135), nor is there between the descriptions of these species, and they are here treated as distinct, not only specifically but also generically.

The genus *Allogromia* contains six species, of which four are exclusively marine.

Synopsis of the British Species.

Test large, 80–120 μ in length.	(1) *A. fluvialis*.
Test small, about 30 μ in diameter.	(2) *A. stagnalis*.

1. **Allogromia fluvialis** (Dujardin) Rhumbler.

(Figs. 157 and 158.)

Gromia fluvialis

Dujardin in Ann. Sci. nat. (2) VIII (1837), pp. 311–312, pl. ix, f. 2; in Pr.-Verb. Soc. Philom. Paris; 1838, p. 7; in Institut, VI (1838), p. 47.
Gervais in Ann. franç. étrang. Anat. II (1838), pp. 128–129.
Stein Org. Infus. (1859), p. 25.

Gromia fluviatilis

Oken in Isis, 1839, col. 356.
Dujardin Hist. nat. Zooph., Infus. (1841), p. 255, pl. i, f. 17; pl. ii, ff. 1, 2.
Richardson in Micr. Jrn. 1841, pp. 26–27.
Perty Kenntn. kleinst. Lebensf. (1852), p. 188.
Griffiths & Henfrey Microg. Dict. (1855), p. 299, pl. xxiv, f. 15; ed. 4 (1883), p. 366, pl. xxxi, f. 15.
Archer in Qrt. Jrn. Micr. Sci. (n. s.) VI (1866), p. 185; *op. cit.* (n. s.) IX (1869), p. 390; in Proc. Dubl. Micr. Club, I, 2 (1868), p. 51; *op. cit.* II, 2 (1874), p. 129.
Schoch Mikr. Thiere Süsswass.-Aq. I (1868), p. 15, pl. i, f. 5; in Neuj. nat. Ges. Zürich, 1870, pp. 4–6, pl., f. 1.
Eyferth Einfach. Lebensf. (1878), p. 34; *op. cit.*, ed. 2 (1885), p. 52; ed. 3 (1900), p. 270.
Greeff in Sitzb. Ges. Nat. Marberg, 1888, p. 120.
Cuneo in Boll. Scient. XII (1890), p. 142.
Le Dantek in Compt. rend. Acad. Sci. CXIX (1894), p. 1279; in Jrn. R. Micr. Soc. 1895, p. 185; in Bull. sci. France Belg. XXVI (1895), pp. 56–90, ff. 1–7; in Feuille Naturel. (3) XXVI (1895), pp. 57–58.

Calkins Protozoa (1901), p. 285.
Chapman Foraminifera (1902), p. 70.
Penard Faune Rhiz. Léman (1902), pp. 554–556, 3 figs.
Schmidt in Arch. Protist. XXIX (1913, p. 223.

Gromia terricola
Leidy in Proc. Acad. Philad. 1874, p. 88; in Arch. Sci. nat. LII (1875), p. 167; Freshw. Rhiz. N. Amer. (1879), pp. 277–281, pl. xlvii, ff. 1–4.
Lawson in M. Micr. Jrn. XIII (1875), pp. 87–88.
Hitchcock Synops. Freshw. Rhiz. (1881), p. 51.
Blanc in Arch. Sci. nat. (3), XVII (1886), p. 365.
Blochmann Mikr. Thierw. Süsswass. (1886), p. 15; ed. 2 (1895), p. 19, pl. i, f. 28.
Schewiakoff in Mém. Acad. St. Pétersb. (7) XLI, viii (1893), p. 98.

Allogromia fluvialis
Rhumbler in Arch. Protist. III (1903), p. 206, f. 22.
Penard Sarcodinés in Cat. Invert. Suisse (1905), pp. 119–120.

Allogromia fluviatilis
Averintzeff in Trudui S.-Peterb. Obshch. XXXVI, ii (1906), pp. 325–326.
Schouteden in Ann. Biol. lacustre, I (1906), p. 375.
Hartog in Encycl. Brit., ed. 11, XXIII (1911), p. 248, f. 7 (4).

Lieberkühnia fluvialis
Penard (pars) in Arch. Protist. IX (1909), pp. 293–296 (*non* fig.).

Test membranous, spherical or ovoid, transparent, supple, smooth or sparsely covered with silicious particles; plasma slightly yellow, granular, usually containing food-particles, nearly filling the test; aperture not observed; peduncle not observed; nucleus single, large, and granular; contractile vesicles numerous; pseudopodia long, anastomosing, often enveloping the test.

Length usually 80–120 μ, but may vary between 50 and 250 μ.

Habitat.—Aquatic vegetation and mosses.

England.—Brigg, Lincolnshire (*West*).
Ireland.—Connemara (*Archer*).

Individuals found in mosses seem to have tests better protected by extraneous particles than those living amongst Algæ.

Penard's identification* of *Gromia fluvialis* Dujardin with *Gromia terricola* Leidy has been adopted.

* 'Archiv. f. Protist.' VII (1909), pp. 293–296.

Dujardin, in his description of *Gromia fluvialis*, gives no information as to the character of the nucleus or of the aperture, and Leidy ('Freshw. Rhiz. N.

Fig. 157.—*Allogromia fluvialis.* × 200. (After Dujardin.)

Amer.'), in a much more complete account of his *G. terricola*, accompanied by excellent drawings, also omits (owing to lack of specimens) all details of the

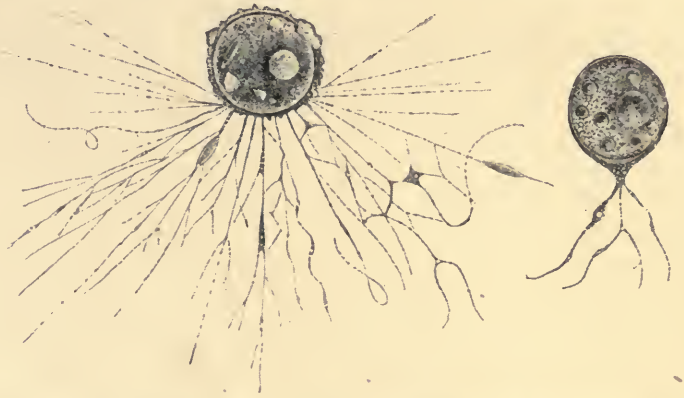

Fig. 158.—*Allogromia fluvialis*, with the pseudopodia fully and only partially extended. × 120. (After Leidy, as *Gromia terricola*, but reduced to three fifths the size of his figures.)

aperture, but he notes the presence of a single nucleus which he describes as large, pale, and granular; the occurrence of numerous "oil globules" in the plasma is also noted by him.

In the only drawing by either of the above authors

which shows a side or an oral view of the test, viz. Leidy, Pl. LVII, fig. 3, a great similarity to *Lieberkuehnia wageneri* is evident, but neither an aperture nor a peduncle is indicated, which is unfortunate, as it is on the characters of these features that the certain identification of the genus to which the species may belong depends.

The large single nucleus described by Leidy precludes us, granting the correctness of his observation, from identifying this species with *L. wageneri*, and it is differentiated from *L. paludosa*, which often has such a nucleus, by its smaller size and thin test.

Further examination of specimens and more definite information as to the generic and specific characteristics of the species are much to be desired.

2. **Allogromia stagnalis** (G. S. West), Hopk.

(Plate LIV, fig. 3.)

Gromia stagnalis

West in Jrn. Linn. Soc., Zool. XXVIII (1901), pp. 331–332, pl. xxix, f. 28.

Averintzeff in Trudui S.-Peterb. Obshch. XXXVI, II (1906), p. 270.

Schouteden in Ann. Biol. lacustre, I (1906), p. 362, f. 58.

Test chitinoid, spherical, smooth, colourless or straw-coloured, very thin and transparent; aperture small, not readily visible; plasma usually green in colour, a large amount exuding from the aperture, flowing all over the exterior of the test, and giving rise to numerous divergent and anastomising pseudopodia; nucleus single, small, often not visible, situated in the posterior region of the plasma.

Diameter 28–32 μ.

Habitat.—Amongst *Lemna minor* in stagnant ditches.

England.—Near Brigg, Lincolnshire.

As we have not seen this species, the above description is adapted from that of Prof. West (*loc. cit.*), who says: "This beautiful Rhizopod occurred in abundance in the sediment collected by washing and squeezing *Lemna minor* and a few species of filamentous algæ."

. . . It "is readily distinguished by its small size, green colour, and habit." And he adds: "The green colour . . . is due to the presence of a more or less diffused 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."

Genus 48. **RHYNCHOGROMIA** Rhumbler, 1894.

Rhynchogromia Rhumbler in Zeits. wiss. Zool. LXVII (1894), p. 590.

Gromia Penard (pars) in Rev. Suisse Zool. VII (1899), pp. 89, 97.

Animal enclosed in a chitinous, rigid or flexible, elongated envelope encrusted with foreign particles; aperture terminal or slightly oblique; plasma finely granular, nearly or quite filling the test; one or more nuclei; one or more contractile vesicles or vacuoles usually present; pseudopodia arising from a peduncle, numerous, branched, anastomosing, often investing the exterior of the test.

The plasma and pseudopodia of the *Rhynchogromiæ* are similar in character to those of the *Lieberkuehniæ*, but the test is usually composed of a considerable thickness of silicious particles, and it is much larger.

Rhynchogromia nigricans is the only species so far recorded from the British Isles.

1. **Rhynchogromia nigricans** (Penard) Rhumbler. (Plate LVI, fig. 10.)

Gromia nigricans

Penard Faune Rhiz. Léman (1902), pp. 568–570, 3 figs.; Sarcodinés grands Lacs (1905), pp. 115, 596.

Murray in Proc. Roy. Soc. Edinb. XXV (1905), p. 605.

Rhynchogromia nigricans
Rhumbler in Arch. Protist. III (1903), p. 213, f. 32.
Penard Sarcodinés in Cat. Invert. Suisse (1905), p. 122.
Averintzeff in Trudui S.-Peterb. Obshch. XXXVI, II (1906), p. 329.
Schouteden in Ann. Biol. lacustre, I (1906), pp. 375, 376.

Test large, elongated, flexible, covered with a thick layer of small extraneous particles; transverse section circular; aperture terminal; plasma completely filling the test, clear, granular, containing numerous inclusions; nucleus usually single (occasionally two or three), containing numerous nucleoles; pseudopodia numerous, anastomosing, arising from a peduncle.

Length 220 μ or more, sometimes attaining 400 μ.

Habitat.—Submerged mosses and lakes.

Scotland.—Loch Ness, Inverness-shire; depth 300–400 feet (*Penard*).

This species is distinguished from *Rhynchogromia linearis* Penard by its more robust form and the character of the test; from *R. squamosa* Penard by the characters of the nucleus and of the test. The peduncle is obscure and difficult to distinguish. As first described by Penard the test was of a blackish colour, but specimens found subsequently had a brownish tinge; no information is available as to the exact colour of the individuals, four in number, found in Loch Ness; they were observed in a living state.

Family 4. Amphistomina.

Test spherical or oval, consisting of a chitinous membrane either smooth or encrusted with adherent particles, furnished with two apertures situated at opposite poles; nucleus single, placed centrally; pseudopodia filose, radiating, straight or branched, but not anastomosing.

The genus *Diplophrys*, although placed in the same family, beyond possessing two apertures in the test, has no affinity with the genus *Amphitrema*.

In the genus *Micrometes* (Cienkovsky), belonging to the allied family Polystomina, the test may have from three to six apertures, but up to the present time it has not been recorded from the British Isles.

Synopsis of the British Genera.

Test very small, spherical, hyaline, smooth; plasma containing a coloured globule; when young often in colonies. 1. *Diplophrys.*

Test of medium size, oval, smooth or encrusted with foreign matter; plasma usually containing algæ living in symbiotic relationship. 2. *Amphitrema.*

Genus 49. **DIPLOPHRYS** Barker, 1868.

Diplophrys Barker in Qrt. Jrn. Micr. Sci. (n. s.) VIII (1868), p. 123.
Cystophrys Archer in Qrt. Jrn. Micr. Sci. (n. s.) IX (1869), p. 265.
Elæorhanis Greeff in Arch. mikr. Anat. XI (1875), p. 23.

Body spherical, with a thin, hyaline, homogeneous envelope provided with two apertures; plasma colourless, transparent, granular; nucleus single; several pulsating vesicles usually present; pseudopodia filamentous, radiating.

This genus contains only one species, which inhabits fresh water.

1. **Diplophrys archeri** Barker.

(Plate XLIV, figs. 12 and 13; Pl. LVI, fig. 11.)

Diplophrys archeri
Barker in Qrt. Jrn. Micr. Sci. (n. s.) VIII (1868), p. 123; in Proc. Dubl. Micr. Club, I, 3 (1869), p. 178.
Hertwig & Lesser in Arch. mikr. Anat. X (1874), Suppl., p. 139, pl. iii, f. 9.
Greeff in Arch. mikr. Anat. XI (1875), p. 15, pl. i, ff. 11–13.
Schulze in Arch. mikr. Anat. XI (1875), p. 127, ff. 10–15.
Allman in Jrn. Linn. Soc. XIII (1877), pp. 408, 409, f. 8.
Buck in Zeits. wiss. Zool. XXX (1877), p. 34.

Leidy Freshw. Rhiz. N. Amer. (1879), pp. 256–258.
Buetschli in Bronn's Thierreichs, I, 1 (1880), pl. iv, f. 2 a, b.
Hitchcock Synops. Freshw. Rhiz. (1881), p. 47.
Taránek in Sitzb. böhm. Ges. Wiss. 1881, pp. 224, 235.
Lankester in Encycl. Brit., ed. 9, XIX (1885), p. 845, ff. ix, 1; in Zool. Art. contrib. Encycl. Brit. (1891), p. 16, f. ix, 1.
Blochmann Mikr. Thierw. Süsswass. (1886), p. 15, pl. i, f. 36; ed. 2 (1895), p. 20, pl. ii, f. 29.
Ludwig in Leunis' Synops. Thierk., ed. 3, II (1886), p. 1169, f. 1153.
Penard in Jahrb. nassau. Ver. Naturk. XLII (1889), p. 144; *op. cit.* XLIII (1890), p. 72; in Mém. Soc. Genève, XXXI, ii, 1 (1890), p. 189, pl. xi, ff. 37–63; Faune Rhiz. Léman (1902), pp. 540–543, 2 figs.; Sarcodinés grands Lacs (1905), pp. 108–117; Sarcodinés in Cat. Invert. Suisse (1905), p. 114.
Lord in Trans. Manch. Micr. Soc. 1891 (1892), p. 56.
Zopf Beitr. nieder. Organism. (1892), p. 46.
Certes in Bull. Soc. zool. France, XVIII (1893), p. 114.
Schewiakoff in Mém. Acad. St. Pétersb. (7) XLI (1893), viii, p. 98.
Zacharias in Forschb. Plon, I (1893), p. 3; *op. cit.* II (1894), p. 57; V (1897), p. 113; in Zool. Anzeig. XXII (1899), pp. 50, 51; in Biol. Centralbl. XIX (1899), p. 144.
Delage & Hérouard Traité Zool. concrète, I (1896), p. 116, f. 163.
Francé in Res. Erforsch. Balatons. II, 1 (1897), p. 11.
Schaudinn in Deutsch-Ost-Africa, IV, xvii (1897), p. 11.
Eyferth Einfach. Lebensf., ed. 3 (1900), p. 271.
Godet in Bull. Soc. Neuchâtel, XXVIII (1901), p. 78.
West in Jrn. Linn. Soc., Zool. XXVIII (1901), p. 332; *op. cit.* XXIX (1903), p. 116.
Scharff in Irish Natur. XI (1902), p. 26.
Hoogenraad in Tijds. Nederl. Dierk. Ver. (2) X (1908), pp. 417–419, 424; in Ann. Biol. lacustre, III (1908), p. 256.
Brown in Naturalist, 1909, p. 108; in Brit. Assoc. Handb. Sheffield (1910), p. 501; in Ann. Scott. Nat. Hist. 1911, p. 229.
Daday in Deutsch-Ost-Africa, IV, xxiii (1910), p. 11.
Hopkinson in Irish Natur. (1910), pp. 3, 4.
Hartog in Encycl. Brit., ed. 11, XXIII (1911), p. 248, f. 7 (1).
Wailes & Penard in Proc. R. Irish Acad. XXXI, lxv (1911), p. 59.
Wailes in Jrn. Linn. Soc., Zool. XXXII (1913), p. 209.

Habit colonial or solitary; body spherical, invested with a delicate hyaline membrane provided with two apertures situated at or near two opposite poles; plasma colourless, transparent, finely granular, filling the envelope except near the two apertures; nucleus single, containing a single nucleole; several pulsating vesicles usually present; one large, or two or three small, coloured, oil-like globules always present; pseudopodia extremely attenuate, radiating, straight or dichotomously branched, emanating from each aperture; reproduction by fission or tetrad division.

Diameter 8–20 μ; free embryos 4–8 μ in diameter; embryos in colonies 2–4 μ in diameter.

Habitat.—Submerged vegetation.

England.—Sheffield District, W. Yorkshire (*Brown*).

Ireland.—Lough Gatny, Donegal (*West*); Calary and Carrig (*Archer*); Wicklow (*Barker*).

The embryos or young individuals are frequently aggregated into colonies which form circular masses about 30–60 μ or more in diameter, from the periphery of which slender pseudopodia radiate. These colonies have amœboid movements and may divide; when this takes place the two portions separate until they are connected only by one or two individuals and the very fine elastic filament or filaments, emanating from their apertures, upon which they appear to be threaded like beads. When these break the outlying cells are retracted into the portion to which they remain attached. These embryos are about 4 μ in diameter and are colourless and transparent except for one *dark* spot in each.

The exact position of *D. archeri* amongst the Rhizopoda is doubtful; it has no affinity with the genus *Amphitrema* beyond possessing two apertures to the test, but it has affinities with the Reticulosa. It is doubtful if *Diplophrys stercorea* (Cienk.), found on horse-dung, has any real relationship with *D. archeri*.

Penard ('Faune Rhiz. Leman,' 1902) discusses the peculiarities of this species, and his observations may be thus briefly summed up. The plasma never contains any food-particles; the pseudopodia differ from those of other Rhizopoda in that they are stiff and rigid when extended and the animal progresses without any visible movement in them; the envelope appears to be of a substance resembling that of a vegetable cell rather than that of a Rhizopod; the oil-like globules enclosed in the plasma, which may be pale blue, yellow, or brownish in colour, and are present even in the embryos, recall the characteristics of a chromatophore or of the oil-globules contained in certain plants.

The phenomena of multiplication by tetrad division are entirely exceptional among the Rhizopoda.

The colonies of embryos are very similar to those reputed to belong to the Heliozoon *Elæorhanis cincta* Greeff, which however measure about 7 μ in diameter and contain *yellow* oil-like globules. Archer's *Cystophrys oculea* ('Qrt. Jrn. Micr. Sci.,' vol. ix (1869), Pl. XX, fig. 3) may possibly represent this organism.

Genus 50. **AMPHITREMA** Archer, 1869.

Amphitrema Archer in Qrt. Jrn. Micr. Sci. (n. s.) IX (1869), p. 397.

Ditrema Archer in Qrt. Jrn. Micr. Sci. (n. s.) XVIII (1877), p. 103.

Test ovoid, symmetrical, compressed, composed of a transparent membrane with or without adherent extraneous particles; provided with a small aperture at each extremity; plasma colourless, granular, usually containing living *Zoochlorella*-cells; nucleus single, placed centrally; one or two contractile vesicles usually present; pseudopodia filose, straight, sparsely branched, radiating.

Archer created the genus *Ditrema* to include *D. flavum*, a species which is similar to those of the genus *Amphitrema* except that the test is devoid of extraneous adherent particles; this seems an insufficient reason for not including in a single genus species which are so closely related.

A. rhenianum Lauterborn does not properly belong to this genus.*

Synopsis of the British Species.

Test brown, devoid of adherent particles. (1) *A. flavum.*

Test colourless, covered with foreign particles; apertures furnished with external collars. (2) *A. wrightianum.*

Test colourless, covered with foreign particles; apertures without collars. (3) *A. stenostoma.*

* Penard, 'Revue Suisse Zool.,' vol. xix, 1911.

1. **Amphitrema flavum** (Archer) Penard.

(Plate LVII, figs. 1–5.)

Ditrema flavum

ARCHER in Qrt. Jrn. Micr. Sci. (N.S.) XVII (1877), pp. 336–337, pl. xxi, f. 9 (see also p. 103); in Proc. Dubl. Micr. Club, III, 3 (1880), pp. 291–292, pl. ix, f. 9 (see also pp. 131–132).

TARÁNEK in Sitzb. böhm. Ges. Wiss. 1881, pp. 224, 235.

BLOCHMANN Mikr. Thierw. Süsswass. (1886), p. 16; ed. 2 (1895), p. 20.

AVERINTZEFF in Trudui S.-Peterb. Obshch. XXX, I (1900), p. 240; *op. cit.* XXXI, I (1901), p. 324; XXXVI, II (1906), pp. 95, 105, 318.

SCHOUTEDEN in Ann. Biol. lacustre, I (1906), p. 373.

BROWN in Ann. Scott. Nat. Hist. 1911, p. 229.

Amphitrema flavum

PENARD Faune Rhiz. Léman (1902), pp. 534–537, 8 figs.; Sarcodinés in Cat. Invert. Suisse (1905), p. 112.

EVANS in Proc. R. Phys. Soc. Edinb. XVII (1907), table 1.

HEINIS in Arch. Hydrobiol. V (1910), p. 111.

WAILES & PENARD in Proc. R. Irish Acad. XXXI, LXV (1911), pp. 14, 20, 61, 62.

WAILES in Scott. Natur. 1912, p. 60; in Jrn. Linn. Soc., Zool. XXXII (1912), pp. 126, 153; in Naturalist, 1913, p. 148.

SCHMIDT in Arch. Protist. XXIX (1913), p. 222.

Test composed of a thick, chitinous, brown, homogeneous envelope; in broad view with nearly parallel sides and rounded ends; in narrow view elliptic; end views oval, each with a central small oval aperture; plasma colourless, granular, not completely filling the test, usually loaded with *Zoochlorella*-cells living in symbiotic relationship; nucleus single, placed centrally, containing a single large nucleole, or two or three small ones; one to three contractile vesicles usually present, also frequently several vacuoles; pseudopodia filose, straight, radiating, usually few in number.

Length 45–77 μ; breadth 23–45 μ; thickness 15–25 μ; aperture 3·5–6·5 μ in broadest diameter; nucleus about 12 μ in diameter; nucleoles 3–4 μ in diameter. The breadth varies from two fifths to two thirds of the length; the thickness is usually about half the breadth.

Habitat.—Sphagnum.

Essentially a sphagnum-inhabiting species, *Amphitrema flavum* is widely distributed over the British Isles and is frequently found in large numbers, espe-

cially in upland districts. The average size of British individuals (55–70 μ in length) appears to be greater than that of the Swiss (45–55 μ: Penard), but in the United States the size is about the same as in the British Isles.

A noticeable peculiarity of this species is the apparent tendency of individuals to divide into halves transversely (*vide* Penard, 'Faune Rhiz. Léman'). At Leckby Carr near York, where this species occurs numerously, many individuals as shown in Plate LVI, fig. 4, were seen, but in no case had the division proceeded beyond the depicted stage.

In Mayo this species was found by Penard containing spherical blue-green algæ (4 μ dia.) which were not *Chlorella vulgaris* (Beyerinck), the species usually found living symbiotically with Rhizopoda.

2. **Amphitrema wrightianum** Archer.

(Plate LVII, figs. 6–8.)

(Allied to *Actinophrys* or *Acineta*
Brightwell Fauna Infus. E. Norfolk (1848), p. 24, pl. xi, f. 3.)
Amphitrema wrightianum
Archer in Qrt. Jrn. Micr. Sci. (N. S.) IX (1869), p. 397, pl. xx, ff. 4, 5; *op. cit.* (N. S.) X (1870), pp. 20–21, 122, pl. xx, ff. 4, 5; (N. S.) XVI (1876), p. 341; in Proc. Dubl. Micr. Club, I, 5 (1872), pp. 355–356, 390–391, pl. xiii, ff. 4, 5; *op. cit.* III, 2 (1878), p. 132.
Buetschli in Bronn's Thierreichs, I, 1 (1880), pl. iv, f. 3.
Lankester in Encycl. Brit., ed. 9, XIX (1885), p. 16, f. ix (11); in Zool. Art. contrib. Encycl. Brit. (1891), p. 16, f. ix (11).
Blochmann Mikr. Thierw. Süsswass. (1886), p. 16; ed. 2 (1895), p. 20.
Delage & Hérouard Traité Zool. concrète, I (1896), p. 116, f. 154.
West in Jrn. Linn. Soc., Zool. XXVIII (1901), p. 332.
Chapman Foraminifera (1902), p. 71, pl. i, f. F.
Penard Faune Rhiz. Léman (1902), pp. 539–540, 3 figs.; Sarcodinés in Cat. Invert. Suisse (1905), p. 113.
Averintzeff in Truduï S.-Peterb. Obshch. XXXVI, II (1906), p. 95, pl. ii, f. 37; pp. 320–321; in Ann. Biol. lacustre, I (1906), p. 324.
Schouteden in Ann. Biol. lacustre, I (1906), p. 373.
Evans in Proc. R. Phys. Soc. Edinb. XVII (1907), table 1.
Heinis in Arch. Hydrobiol. V (1907), p. 111.
Hopkinson in Irish Natur. 1910, p. 3.
Brown in Jrn. Linn. Soc., Zool. XXXII (1911), p. 84.
Hartog in Encycl. Brit., ed. 11, XXIII (1911), p. 248, f. 7 (10).
Wailes & Penard in Proc. R. Irish Acad. XXXI, LXV (1911), pp. 14, 20, 61.

Wailes in Scott. Natur. 1912, p. 60; in Jrn. Linn. Soc., Zool. XXXII (1912), pp. 126, 153; in Naturalist, 1913, p. 148.
Schmidt in Arch. Protist. XXIX (1913), pp. 222, 226.
Amphitrema wrightiana
Averintzeff in Arch. Protist. VIII (1906), p. 118.
Butler in Brit. Assoc. Handb. Dublin (1908), p. 218.

Test composed of a fine membranous envelope, elliptical, compressed, covered with plates or extraneous particles; in narrow side view oblong or elongate-oval; transverse section oval; apertures small, oval, placed centrally at each end and provided with short tube-like external collars; plasma colourless, granular, not completely filling the test, usually containing *Chlorella*-cells living symbiotically; nucleus large, containing several nucleoles, placed centrally; a single contractile vesicle usually present; pseudopodia attenuated, straight, sparsely branched, and radiating.

Length 61–95 μ; breadth 43–64 μ; thickness from one half to three fifths of the breadth; aperture 6–10 μ in width; length of collar 3–4 μ.

Habitat.—Sphagnum.

England.—Westmorland; N. Yorkshire; Norfolk (*Brightwell*); Hampshire; Isle of Wight; Devonshire; Cornwall.

Wales.—Carnarvonshire and Merionethshire (*Cash*).

Scotland.—Shetland Islands; Perthshire (*Cash, Brown*); Midlothian (*Cash*); Dumfriesshire; Wigtownshire (*Brown*).

Ireland.—Clare Island and mainland, Mayo; Westmeath, Galway, Co. Dublin, Wicklow, and Kerry! (*Archer*).

Although not nearly so plentiful as *A. flavum*, this species is often associated with it; the particles which thickly encrust the membranous test usually consist of silicious grains and diatom-frustules; they are often so thickly aggregated around the apertures that the projecting collars are discerned with difficulty; the extremities of the collars are often slightly expanded.

The nucleus, unless it be artificially coloured, is difficult to distinguish on account of the opacity of the test and the number of green *Chorella*-cells contained in the plasma. The tufts of pseudopodia extending from the two apertures are usually unequal in the size and number of filaments.

In the peat deposits of Clare Island, Mayo, several tests were found of which the broad and narrow side views are shown in Pl. LVII, fig. 8. The extraneous grains of silica, diatoms, etc., which no doubt were originally attached to them, have, during the thousands of years which have elapsed since they were occupied by the living animal, become detached, the membranous coverings alone being left.

3. **Amphitrema stenostoma** Nuesslin.

(Plate LVII, figs. 9 and 10, and fig. 159 in text.)

Amphitrema stenostoma

Nuesslin in Zeits. wiss. Zool. XL (1884), p. 717, pl. xxxvi, ff. 7–14.
Blochmann Mikr. Thierw. Süsswass. (1886), p. 16, pl. ii, f. 37; ed. 2 (1895), p. 20, pl. ii, f. 30.
Penard Faune Rhiz. Léman (1902), pp. 527–538, 3 figs.; Sarcodinés in Cat. Invert. Suisse (1905), p. 112; in Brit. Antarct. Exped. I (1911), pp. 220, 223.
Cash in Jrn. Linn. Soc., Zool. XXIX (1904), p. 219.
Averintzeff in Trudui S.-Peterb. Obshch. XXXVI, ii (1906), p. 321.
Schouteden in Ann. Biol. lacustre, I (1906), p. 373.
Evans in Proc. R. Phys. Soc. Edinb. XVII (1907), table 1.
Hopkinson in Irish Natur. 1910, p. 3.
Brown in Ann. Scott. Nat. Hist. 1911, p. 229; in Jrn. Linn. Soc., Zool. XXXII (1911), p. 84; in Naturalist, 1912, pp. 181, 182; in Scott. Natur. 1913, p. 187.
Wailes & Penard in Proc. R. Irish Acad. XXXI, lxv (1911), pp. 14, 20, 61.
Wailes in Scott. Natur. 1912, p. 60; in Jrn. Linn. Soc., Zool. XXXII (1912), pp. 126, 153; in Naturalist, 1913, p. 187.

Test similar to that of the preceding species but more closely covered with grains of quartz and various extraneous particles; the apertures destitute of any collar, usually surrounded by numerous particles and collections of reserve materials; nucleus, plasma, and pseudopodia similar to those of the preceding species.

Length 55–97 μ; breadth 31–74 μ; thickness 23–34 μ.

Habitat.—Sphagnum.

England. — N. and W. Yorkshire; Derbyshire (*Brown*); Shropshire; Buckinghamshire; Isle of Wight; Devonshire.

Wales.—Cader Idris and Criccieth (*Cash*), Llyn Crafnant and Moel Siabod (*Hopk.*), Llyn Llydaw (*West*), Carnarvonshire; Towyn, Merionethshire (*Cash*).

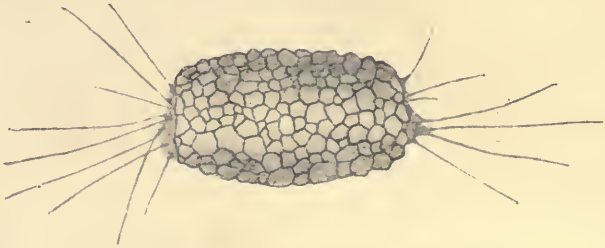

Fig. 159.—*Amphitrema stenostoma.* × 520. An abnormal form from Llyn Llydaw, Snowdon. (*G. S. West.*)

Scotland. — Shetlands; Sutherlandshire; Outer Hebrides; Aberdeenshire (*Brown*); Perthshire (*Cash*, *Brown*); Midlothian (*Cash*); Dumfriesshire; Kirkcudbrightshire and Wigtownshire (*Brown*).

Ireland.—Clare Island and Inishturk, Clew Bay, and mainland, Mayo; Wicklow (*Hopk.*); Kerry.

The length varies usually between 55 and 65 μ and is less on an average than that of *A. wrightianum*, but individuals found at Goathland, N. Yorks, and near Scourie, Sutherland (coll. by W. West) measured 97 μ.

The test varies in colour from nearly colourless to dark brown, owing to the attached particles.

This species is perhaps rather less rare than *A. wrightianum*, with which it is frequently associated.

INDEX

OF SPECIES, ETC., DESCRIBED IN VOL. III.*

Synonyms in italics.

* The figures in heavy type indicate the pages on which they are described; in light type, synonyms and incidental references.

ADLARD AND SON, IMPR., LONDON AND DORKING.

EXPLANATIONS OF THE PLATES.

Plate 33

PLATE XXXIII.

FIGS.

1, 2. *Euglypha scutigera* Penard. (p. 7) Fig. 1.—× 500. Fig. 2.—After West. × 500.

3. *E. acanthophora* var. *brevispina* Penard. (p. 8) After Cash. × 400.

4. *E. acanthophora* var. *flexuosa* Penard. (p. 12) × 600.

5. *E. acanthophora* var. *brevispina* Penard. (p. 13) × 400.

6, 7. *E. tuberculata* Duj. (p. 13) Lateral and vertical views. × 400.

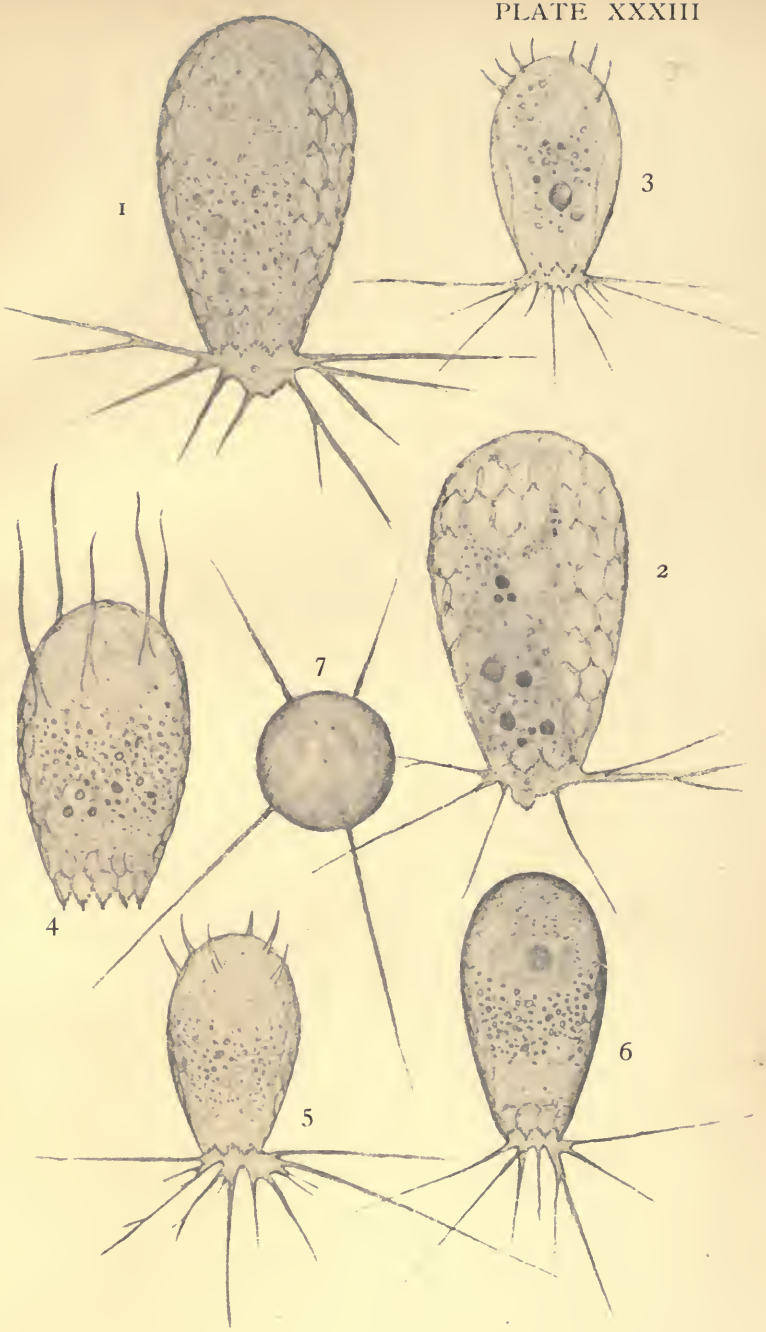
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PLATE XXXIV.

FIGS.

1, 2. *Euglypha cristata* Leidy. (p. 19) Lateral and vertical views. × 500.

3. *E. brachiata* Leidy. (p. 24) Lateral view. × 500.

4. *E. bryophila* Brown. (p. 25) × 1000.

5. *E. mucronata* Leidy. (p. 22) × 500. Fig. 5*a*.—Aperture scale. × 1000.

6–8. *E. filifera* Penard. (p. 26) × 500.

9. *E. rotunda* Wailes. (p. 31) Broad lateral view. × 1000.

10–12. *E. lævis* Perty. (p. 32) Broad, narrow, and oral views. × 700.

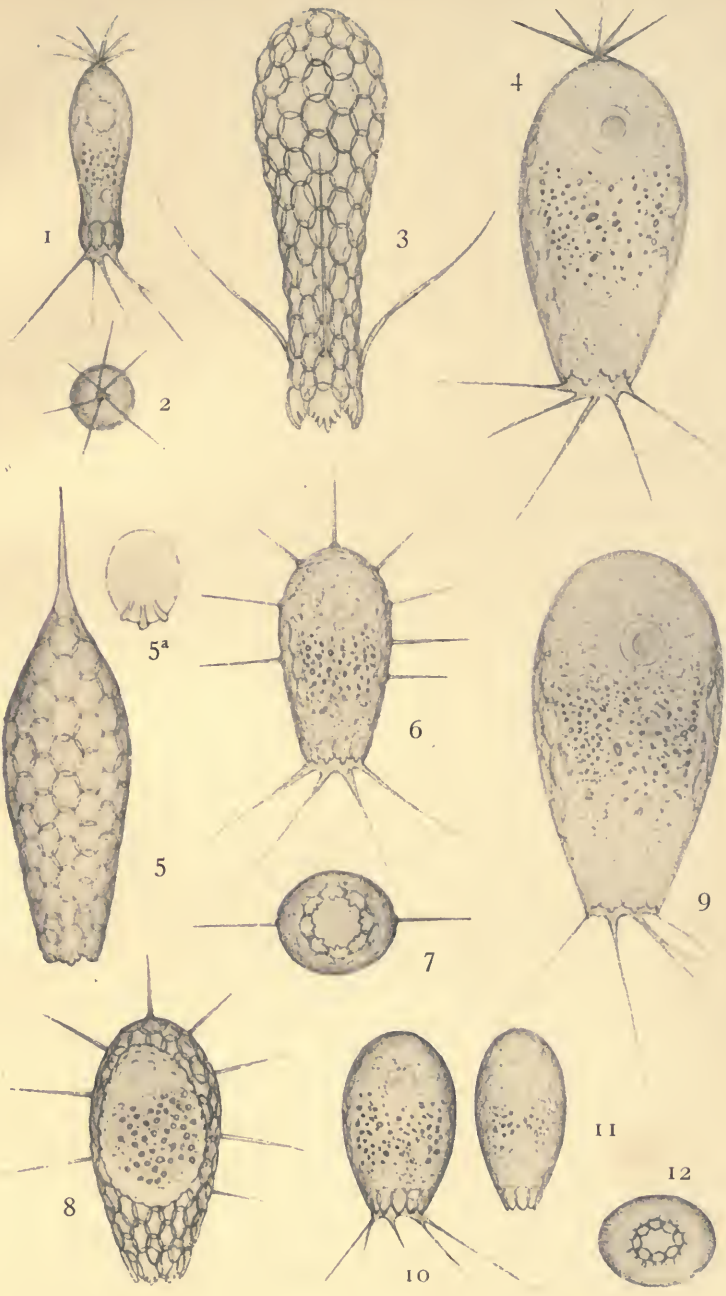
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Plate 35

PLATE XXXV.

FIGS.

1. *Euglypha scutigera* Penard. (p. 7) × 450.
2. *E. acanthophora* (Ehrenb.) Perty. (p. 8) × 450.
3. *E. tuberculata* var. *minor* Taránek. (p. 17) × 1000.
4, 5. *E. tuberculata* Duj. (p. 13) Lateral and oral views. × 600.
6. *E. cristata* Leidy. (p. 19) × 600.
7. *E. cristata* var. *major* Wailes. (p. 20) × 600.
8. *E. cristata* Leidy. (p. 19) × 600.
9, 10. *E. bryophila* Brown. (p. 25) × 600.
11. *E. brachiata* Leidy. (p. 24) × 600.
12, 13. *E. filifera* Penard. (p. 26) × 600.
14–15. *E. rotunda* Wailes. (p. 31) Broad, narrow, and oral views. × 600.

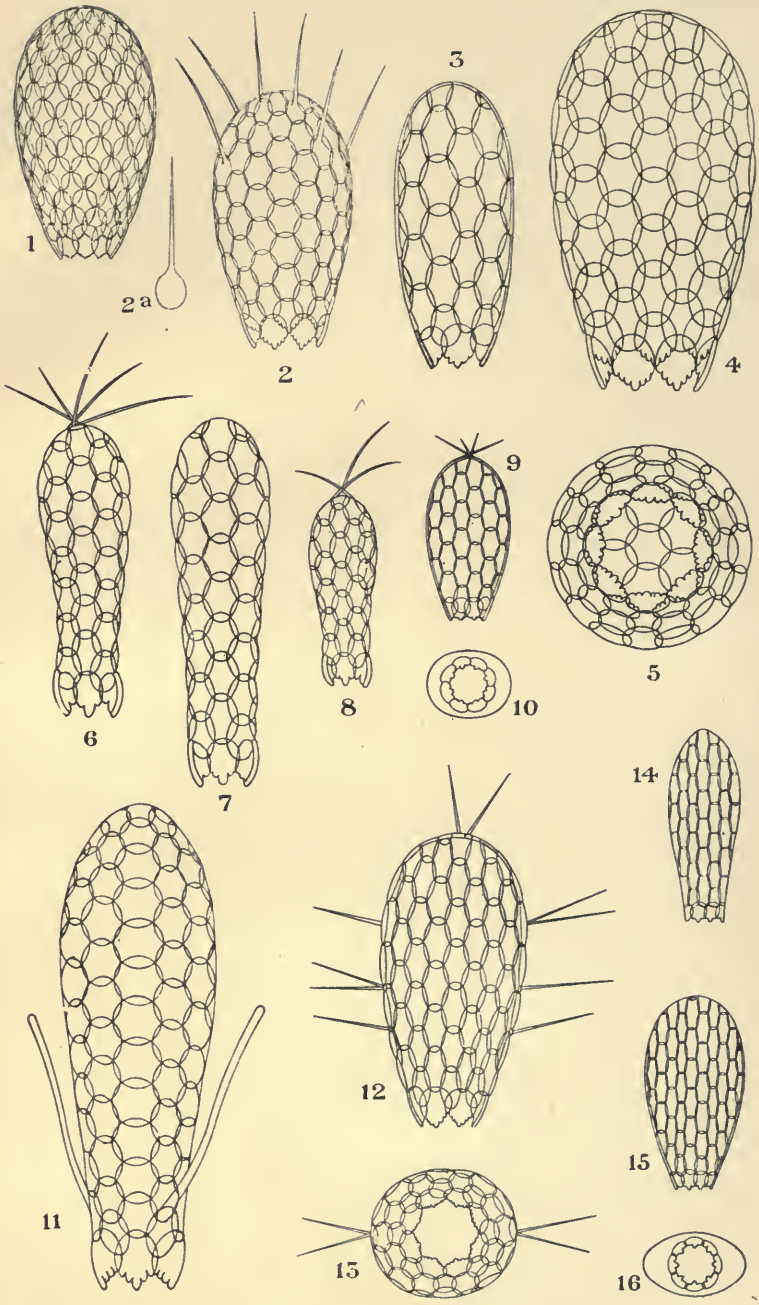
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Plate 36

PLATE XXXVI.

FIGS.

1–3. *Euglypha strigosa* (Ehrenb.) Leidy. (p. 28) Broad, narrow, and oral views. × 600.

4. *E. strigosa* forma *glabra* Wailes. (p. 30) × 600.

5. *E. strigosa* forma *heterospina* Penard. (p. 30) × 600.

6. *E. strigosa* var. *muscorum* Wailes. (p. 31) × 800.

7–13. *E. denticulata* Brown. (p. 41) Fig. 7.—Broad view of active individual. × 750. Figs. 8, 9.—Broad and narrow views. × 550. Fig. 10.—Detail of aperture. × 1000. Fig. 11.—Portion of test. × 1000. Fig. 12.—Broad view of active individual. × 350. Fig. 13.—Broad view of an active individual of an irregular form not infrequent in drier situations. × 600. After Brown.


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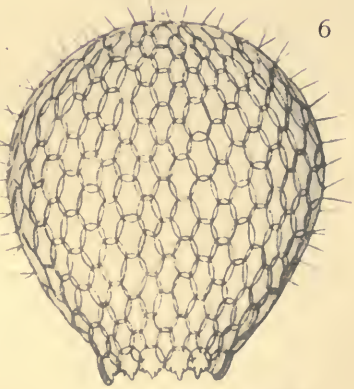
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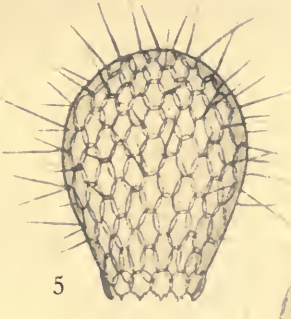
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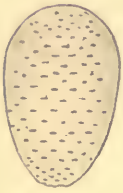
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PLATE XXXVII.

Figs.

1, 2. *Euglypha ciliata* (Ehrenb.) Leidy. (p. 34) Broad and narrow views of an active individual. × 500. After Cash.

3. *E. ciliata* forma *heterospina* Wailes. (p. 37) × 500. After Cash.


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Plate 38

PLATE XXXVIII.

FIGS.

1–3. *Euglypha ciliata* (Ehrenb.) Leidy. (p. 34) Broad, narrow, and oral views. × 500.

4–5. *E. ciliata* forma *glabra* Wailes. (p. 37) Broad and vertical views. × 500.

6. *E. ciliata* forma *heterospina* Wailes. (p. 37) × 500.

7–9. *E. compressa* Carter. (p. 38) Broad, narrow, and oral views. × 500.

10. *E. compressa* forma *glabra* Wailes. (p. 41) × 500.

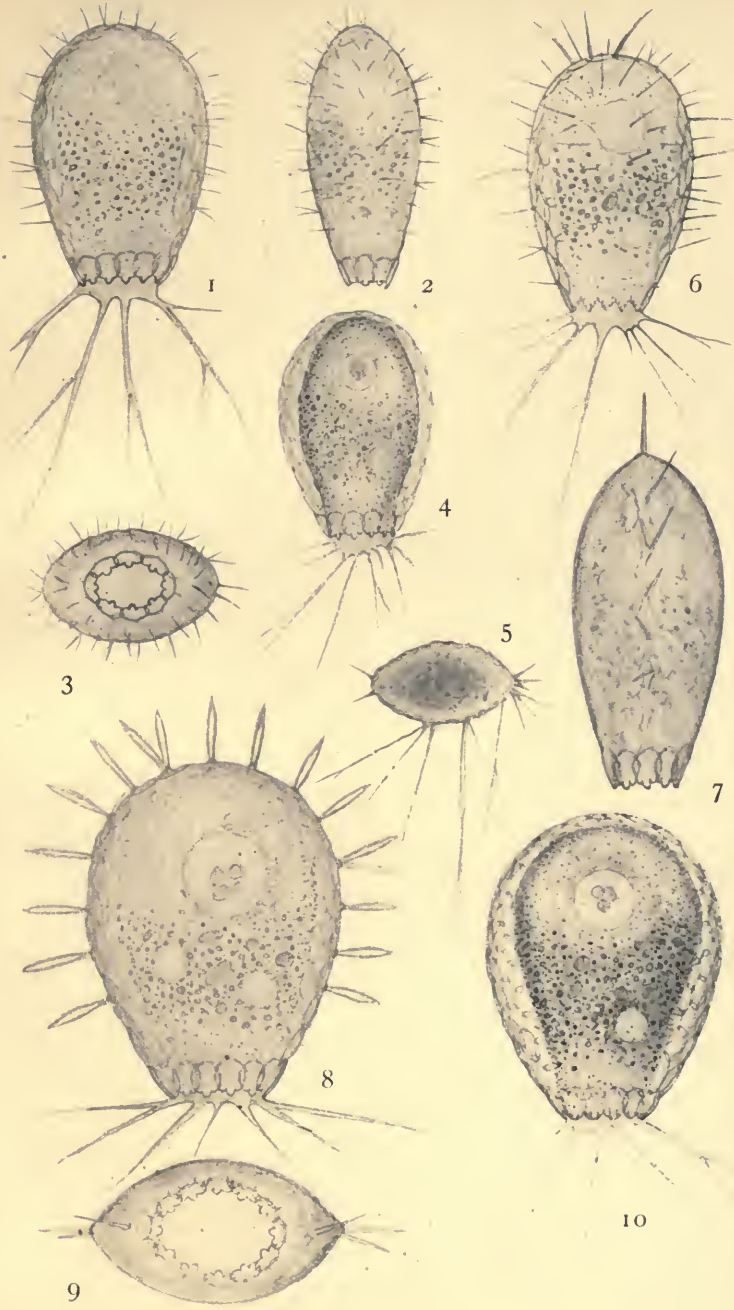
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Plate 39

PLATE XXXIX.

Figs.

1–3. *Euglypha strigosa* (Ehrenb.) Leidy. (p. 28) Broad, narrow, and oral views. × 600.

4. *E. strigosa* forma *glabra* Wailes. (p. 30) × 600.

5–7. *E. lævis* Perty. (p. 32) Broad, narrow, and oral views. × 750.

8–11. *E. ciliata* forma *glabra* Wailes. (p. 37) Broad and narrow lateral views. Figs. 8, 9.— × 600. Figs. 10, 11.— × 450.

12–15. *E. compressa* Carter. (p. 38) Figs. 12, 13.—Broad and narrow lateral views. Fig. 14.—Aperture showing the scales in the foreground in full view. Fig. 15.—Oral view. All × 500.

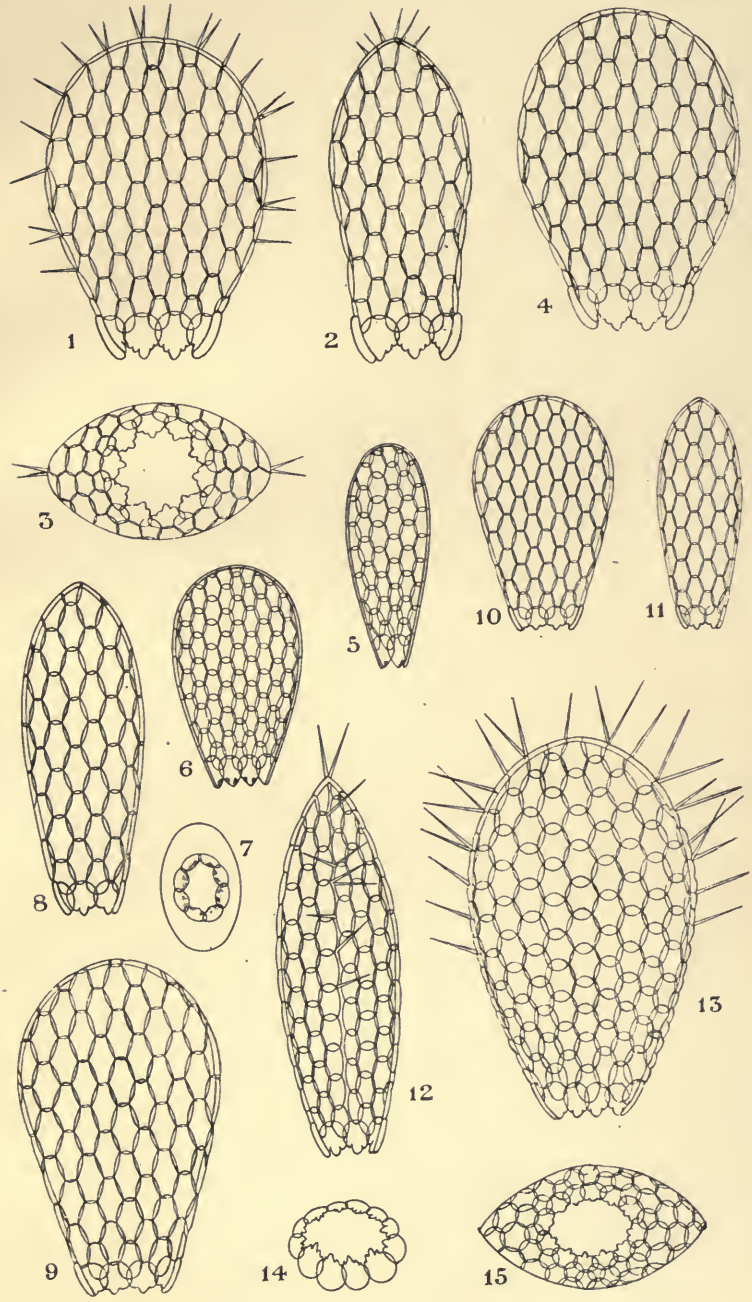
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PLATE XL.

FIGS.

1–6. *Placocista spinosa* (Carter) Leidy. (p. 43) Fig. 1.—Broad view. × 300. Figs. 2–4.—Broad, narrow, and vertical views. × 300. Figs. 5, 6.—Outlines of tests showing extremes of variation of form from the normal. × 150.

7–9. *P. jurassica* Penard. (p. 46) Broad, narrow, and oral views. × 500.

10. *P. lens* Penard. (p. 47) Broad view. × 500.

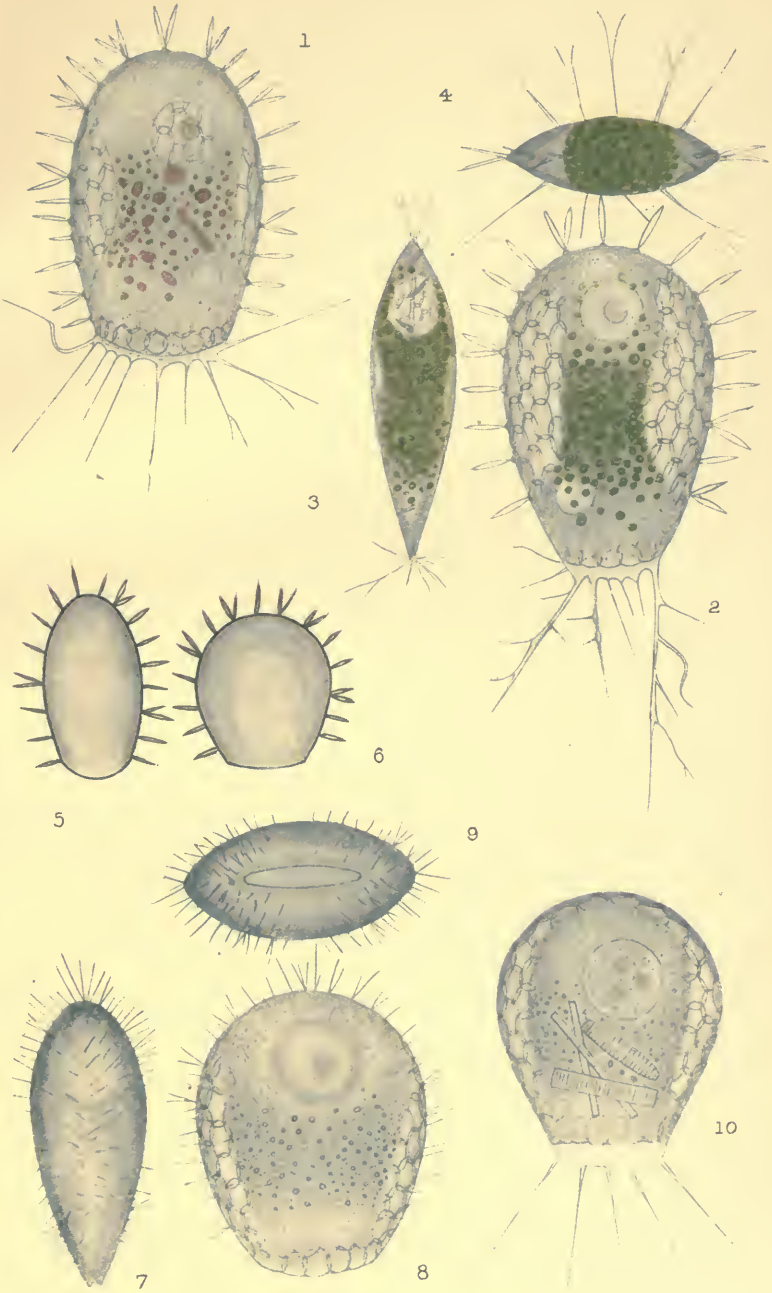
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Plate 41

PLATE XLI.

FIGS.

1–4. *Assulina seminulum* (Ehrenb.) Leidy. (p. 54) Figs. 1–3.—Broad, narrow, and oral views. × 600. Fig. 4.—Broad view of an abnormally large individual from Goathland, Yorkshire. × 300.

5. *A. seminulum* var. *scandinavica* Penard. (p. 54) × 300.

6–9. *A. muscorum* Greeff. (p. 55) Fig. 6.—Broad view. × 800. Figs. 7–9.—Broad, narrow, and oral views. × 500.

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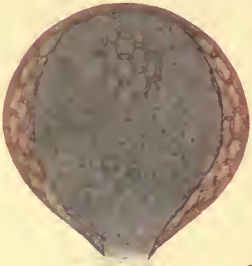

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Plate 42

PLATE XLII.

FIGS.

1. *Placocista jurassica* Penard. (p. 46) × 500. After Cash.

2–13. *Sphenoderia lenta* Schlumb. (p. 57) Figs. 2, 3.—Lateral and oral views. Figs. 4, 5.—Lateral views showing broad and narrow views of the aperture. Figs. 6–8.—After Cash. Figs. 9, 10.—Lateral views showing broad and narrow views of the aperture. Figs. 11–13.—After West. All × 600.

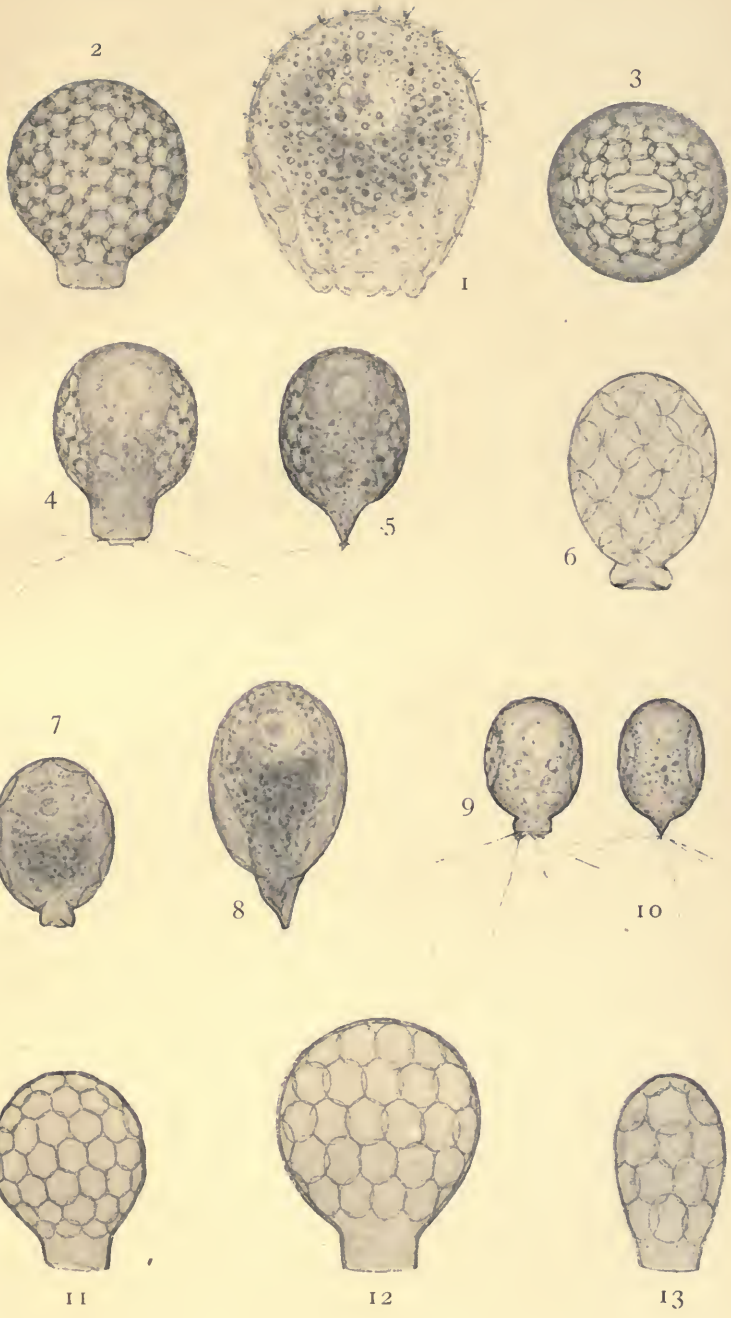
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Plate 43

PLATE XLIII.

FIGS.

1. *Assulina seminulum* var. *scandinavica* Penard. (p. 54) × 300.

2–6. *A. muscorum* Greeff. (p. 55) Fig. 2.— × 800. Fig. 3. —Portion of test. × 1200. Figs. 4–6.—Broad and vertical views of active individuals. After Cash. × 500.

7–10. *Sphenoderia fissirostris* Penard. (p. 60) Fig. 7.—An active individual. Figs. 8–10.—Empty tests. × 600.

11–13. *S. macrolepis* Leidy. (p. 62) Figs. 11–12.—Broad and narrow views of empty test. Fig. 13.—Broad view of active individual. × 500.

14, 15. *S. dentata* Penard. (p. 63) × 600.

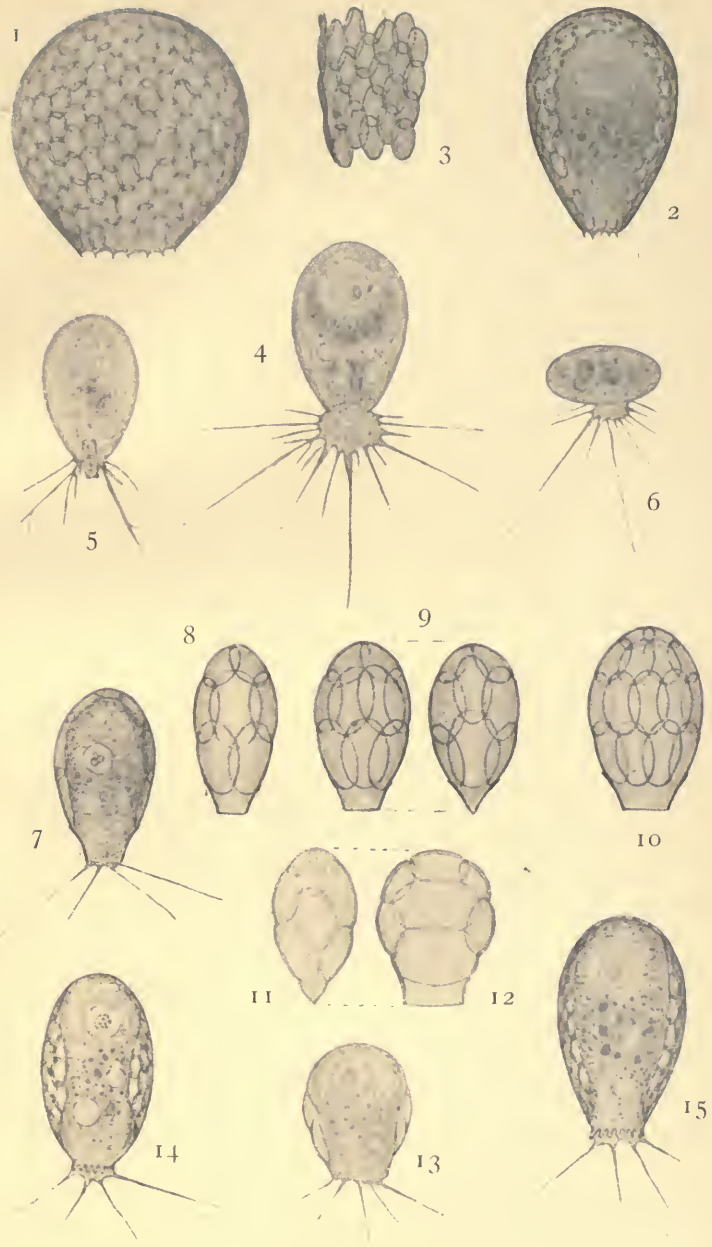
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Plate 44

PLATE XLIV.

FIGS.

1–4. *Paulinella chromatophora* Lauterborn. (p. 66) Figs. 1, 2.—Side view and transverse section of an active individual. × 1500. Fig. 3.—Process of division. × 1500. Fig. 4.—Nucleus. × 2000. All after Lauterborn.

5, 6. *P. chromatophora* var. *pulchella* (G. S. West) Wailes. (p. 67) Oral and side views. After West. × 750.

7, 8. *P. chromatophora* Lauterborn. (p. 66) Side and oral views. After Brown. × 1200.

9, 10. *Lecythium hyalinum* Hertwig & Lesser. (p. 104) Fig. 9.—Solitary active individual. Fig. 10.—Appearance of same when deprived of air. × 500.

11. *L. granulatum* (Schulze) Hopk. (p. 111) Individual distended by ingested diatoms; from a specimen stained and mounted by Dr. Penard. × 300.

12, 13. *Diplophrys archeri* Barker. (p. 144) Fig. 12.—Active solitary individual. Fig. 13.—Process of tetrad division. After Hertwig & Lesser. × 1000.

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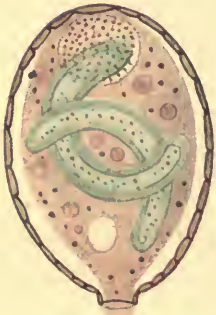

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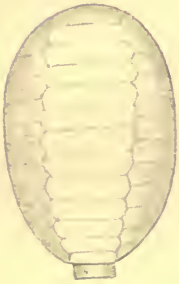

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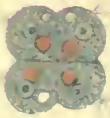

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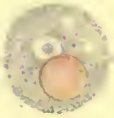

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Plate 45

PLATE XLV.

FIGS.

1. *Cyphoderia trochus* var. *palustris* Penard. (p. 81) After Cash. × 300.

2–6. *C. ampulla* (Ehrenb.) Leidy. (p. 70) Fig. 3.—An encysted individual. Figs. 2 and 5.—Side and oral views of active individuals. Fig. 4.—Oral view of an abnormally shaped individual. Fig. 6.—Two individuals in conjunction. All after Cash. × 300.


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PLATE XLVI.

FIGS.

1. *Cyphoderia ampulla* (Ehrenb.) Leidy. (p. 70) Active individual. × 400.
2. *C. ampulla* var. *vitræa* Wailes. (p. 76) Empty test. × 400.
3. *C. ampulla* (Ehrenb.) Leidy. (p. 70) After West. × 500.
4. *C. ampulla* var. *papillata* Wailes. (p. 77) Empty test. × 300.

5, 6. *C. ampulla* var. *major* Penard. (p. 78) Fig. 5.—Portion of test showing arrangement of markings; recorded only from Oldstead, Yorkshire. × 2000. Fig. 6.—Active individual. × 300.

7–9. *Campascus minutus* Penard. (p. 84) Oral, end, and lateral views of an active individual. × 500.

PLATE XLVI

Plate 47

PLATE XLVII.

FIGS.

1–10. *Trinema enchelys* (Ehrenb.) Leidy. (p. 86) Fig. 1.—Side view of active individual. Figs. 2, 3.—Side and oral views of an empty test. Fig. 4.—Dorsal view of an active individual. Figs. 5, 6.—Dorsal views of active individuals. After Cash. Fig. 7.—Conjugation of two individuals. Fig. 8.—Side view of a test having lateral compression. Figs. 9, 10.—Oral and side views of an empty test. All × 500.

11–21. *T. lineare* Penard. (p. 91) Figs. 11–15.—Outlines of tests. Fig. 16.—Abnormal test with evaginated aperture. Figs. 17–21.—Active individuals. All × 500.

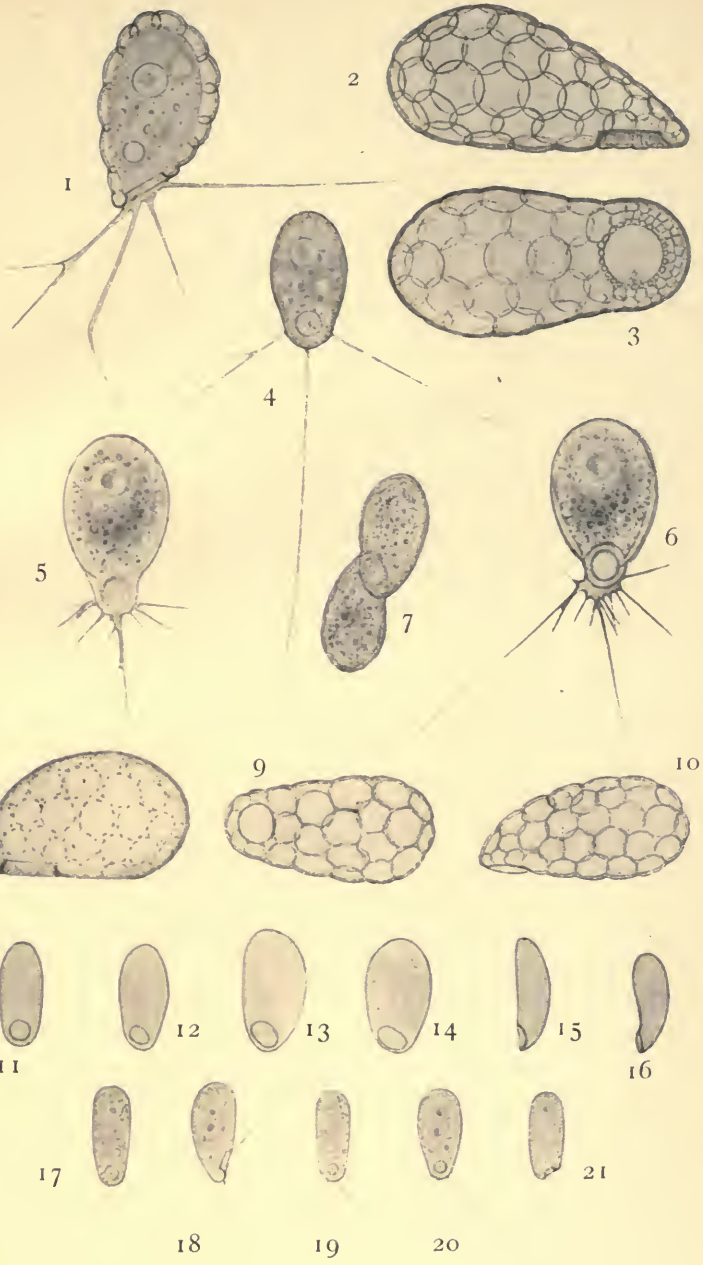
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Plate 48

PLATE XLVIII.

FIGS.

1–3. *Trinema enchelys* var. *galeata* Penard. (p. 91) Oral, side, and end views of empty test. × 600.

4, 5. *T. complanatum* Penard. (p. 94) Oral and side views of an empty test. × 600.

6–18. *Corythion dubium* Taránek. (p. 96) Fig. 6.—An empty test of unusually elongated form. Figs. 7, 8.—End and oral views of empty test. Figs. 9–11.—Oral, end view, and section of a test. Fig. 12.—Dorsal view of same in living state, its aperture being in the normal horizontal position. Figs. 13–18.—Empty tests of various forms. All × 500.

19–22. *C. pulchellum* Penard. (p. 98) Figs. 19, 20.—Broad and narrow views of a living individual. Figs. 21, 22.—Two examples in broad view. The pseudopodia have not been observed. × 500.

23. *Pseudodifflugia archeri* Penard. (p. 120) Lateral view of active individual. × 400.

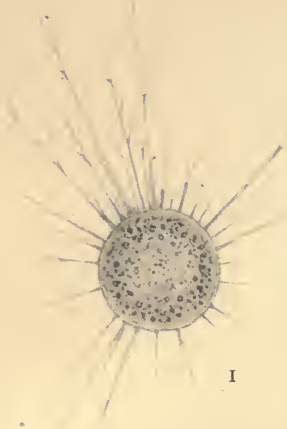
PLATE XLVIII

Plate 49

PLATE XLIX.

FIGS.

1–5. *Lecythium hyalinum* Hertwig & Lesser. (p. 104) Figs. 1–2.—Solitary active individuals. Figs. 3–5. —Associations of two individuals. All after Cash. × 500.



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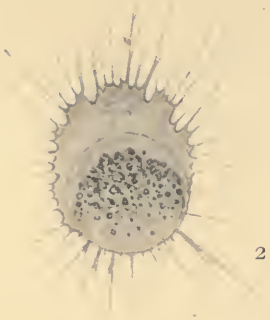

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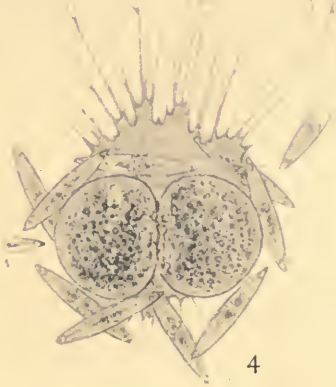

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Plate 50

PLATE L.

Figs.

1, 2. *Lecythium granulatum* (Schultz) Hopk. (p. 110) After West. × 500.

3, 4. *L. spinosum* (Penard) Hopk. (p. 112) After Scourfield. × 350.

6–9. *Pseudodifflugia gracilis* Schlumberger. (p. 114) Figs. 6–8.—Side views of active individuals. Fig. 9.—Oral view. × 500.

10–13. *P. fulva* Archer. (p. 117) Figs. 10, 12, 13.—Side and vertical views of active individuals. Fig. 11.—Side view of colourless test such as occasionally occurs. × 500.


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Plate 51

PLATE LI.

FIGS.

1–7. *Lecythium hyalinum* Hertwig & Lesser. (p. 105) Active solitary individuals; the protrusion of plasma as shown in Fig. 7 is due to want of air. After Cash. × 500.

8, 9. *L. mutabile* (Bailey) Hopk. (p. 108) Side and vertical views of an active individual. After Cash. × 500.

10, 11. *Pseudodifflugia gracilis* Schlumberger. (p. 114) Side and vertical views of active individuals. After Cash. × 500.

12. *P. fulva* Archer. (p. 117) After Cash. × 500.

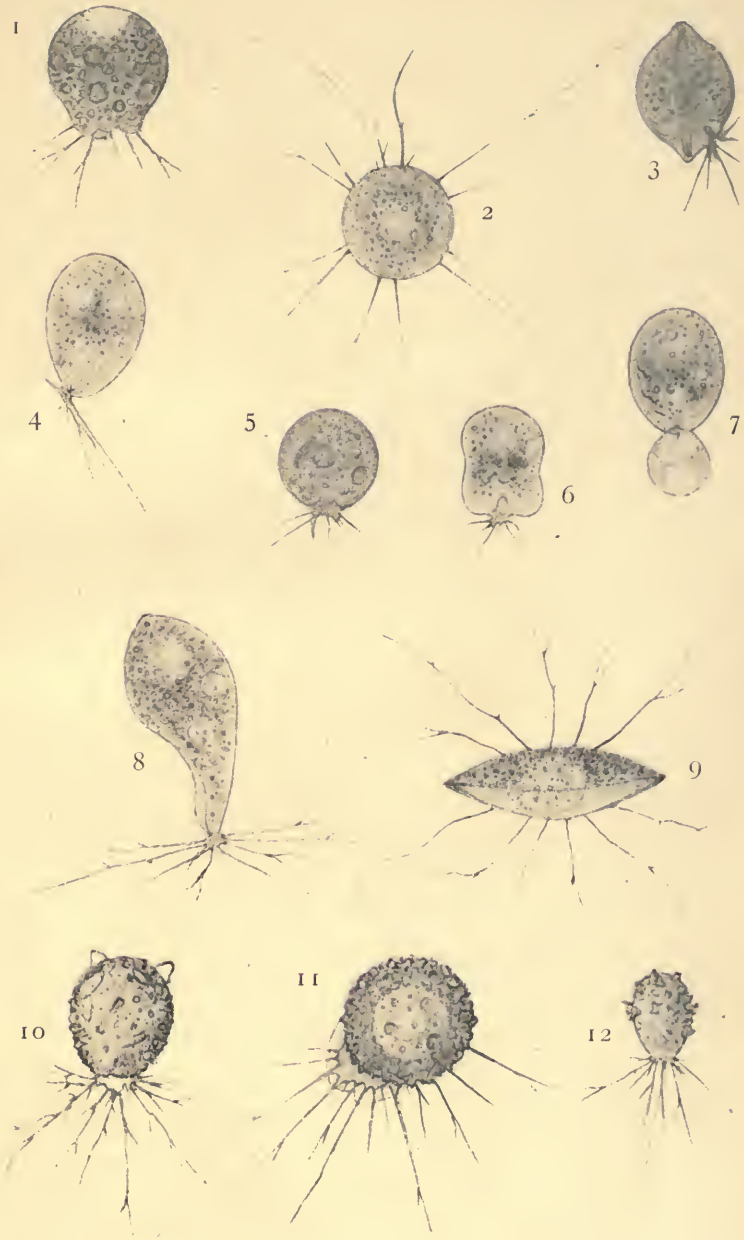
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Plate 52

PLATE LII.

Figs.

1–4. *Pseudodifflugia horrida* Penard. (p. 118) Side and oral views of two examples from Inishboffin, Galway. × 500.

5–8. *P. fascicularis* Penard. (p. 119) Fig. 5.—Side view. Figs. 6 and 8.—Side and vertical views of an active individual. Fig. 7.—Side view of a smooth test such as sometimes occurs. All × 600.

9–11. *P. compressa* F. E. Schulze. (p. 121) Broad, vertical, and narrow views of an active individual. × 500.


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Plate 53

PLATE LIII.

FIGS.

1–4. *Diaphoropodon mobile* Archer. (p. 123) Fig. 1.—Side view of active individual. × 400. Figs. 2–3. —Oral and side views of another with an abnormally pointed fundus. × 400. Fig. 4.—Process of division, from a specimen mounted by Dr. Penard. The spines are not visible in Canada balsam. × 200.

5–6. *Clypeolina marginata* Penard. (p. 126) Side and vertical views. × 500.

7. *Amphitrema stenostoma* Nüsslin. (p. 151) An individual of unusual form and colour. After West. × 300.

PLATE LIII

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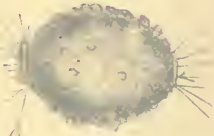

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Plate 54

PLATE LIV.

Figs.

1, 2. *Diaphoropodon mobile* Archer. (p. 123) Fig. 1.—An active individual with pseudopodia as usually observed. Fig. 2.—Another showing fully developed pseudopodia as observed by Archer shortly after capture. After Archer (fig. 1 as *Pleurophrys ? sphærica*). × 300.

3. *Allogromia stagnalis* G. S. West (Hopk.). (p. 141) After West. × 500.

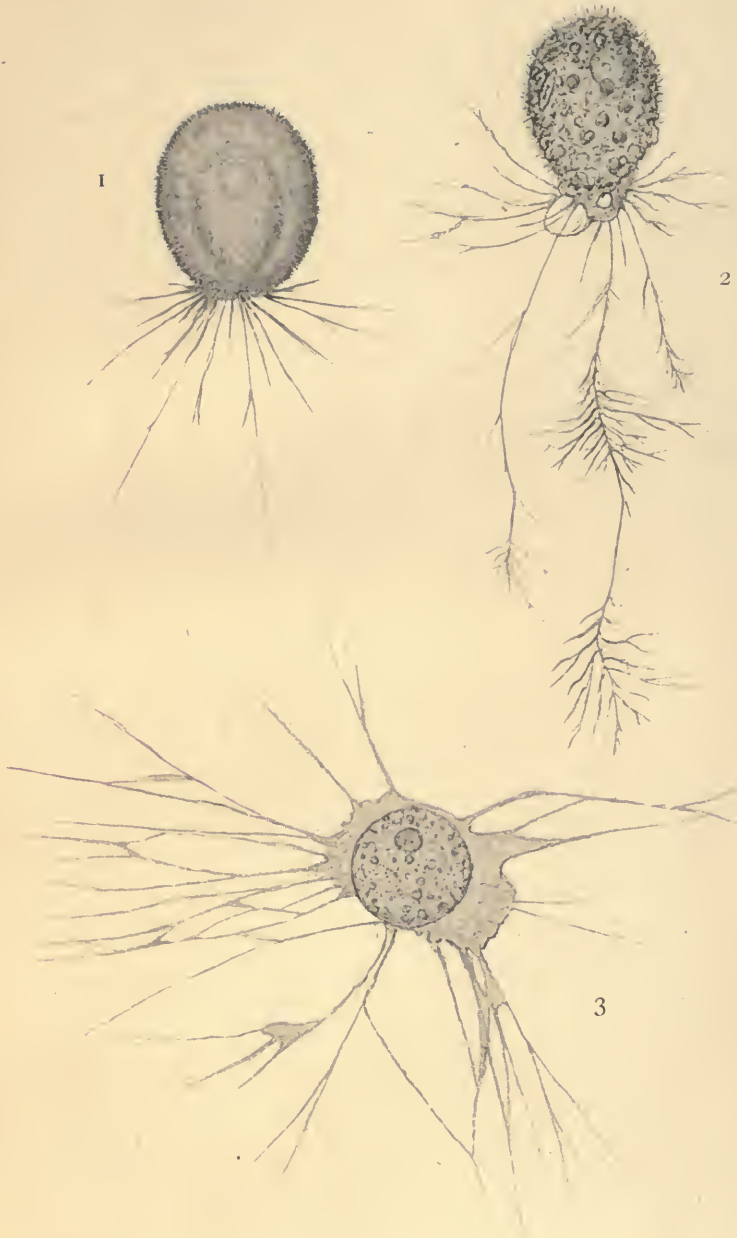
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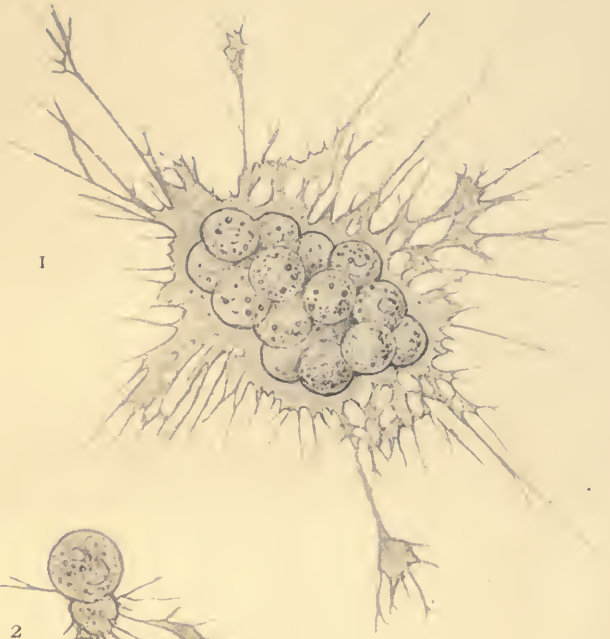
Plate 55

PLATE LV.

FIGS.

1–5. *Microgromia socialis* Hertwig & Lesser. (p. 129) Fig. 1.—A colony. × 250. Figs. 2, 3.—Solitary individuals. × 300. Fig. 4.—Association of two. × 300. Fig. 5.—Association of three. × 250. After Cash.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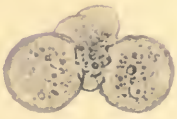
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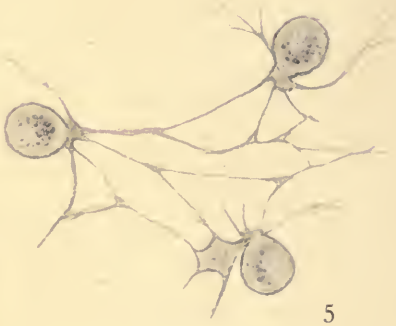
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PLATE LVI.

FIGS.

1–6. *Microgromia socialis* Hertwig & Lesser. (p. 129) Fig. 1.—Individual dividing *transversely*. Fig. 2.—The *upper* moiety escaping from the test. Fig. 3.—Its modification into a zoospore. Fig. 4.—The zoospore. Fig. 5.—A young active individual after leaving a colony. Fig. 6.—The same at rest. After Hertwig & Lesser. × 400. (These were copied by Archer in his illus. in Q.J.M.S., 1877, Pl. VIII.)

7, 8. *M. mucicola* Archer. (p. 132) After Archer. × 800. (Q.J.M.S., 1877, Pl. VIII, fig. 9.)

9. *Lieberkuehnia wageneri* Clap. & Lach. (p. 134) Active individual with the pseudopodia not fully extended. × 300.

10. *Rhyncogromia nigricans* (Penard) Rhumbl. (p. 142) × 300.

11. *Diplophrys Archeri* Barker. (p. 144) A colony of young individuals about to divide into two small colonies. × 1000.

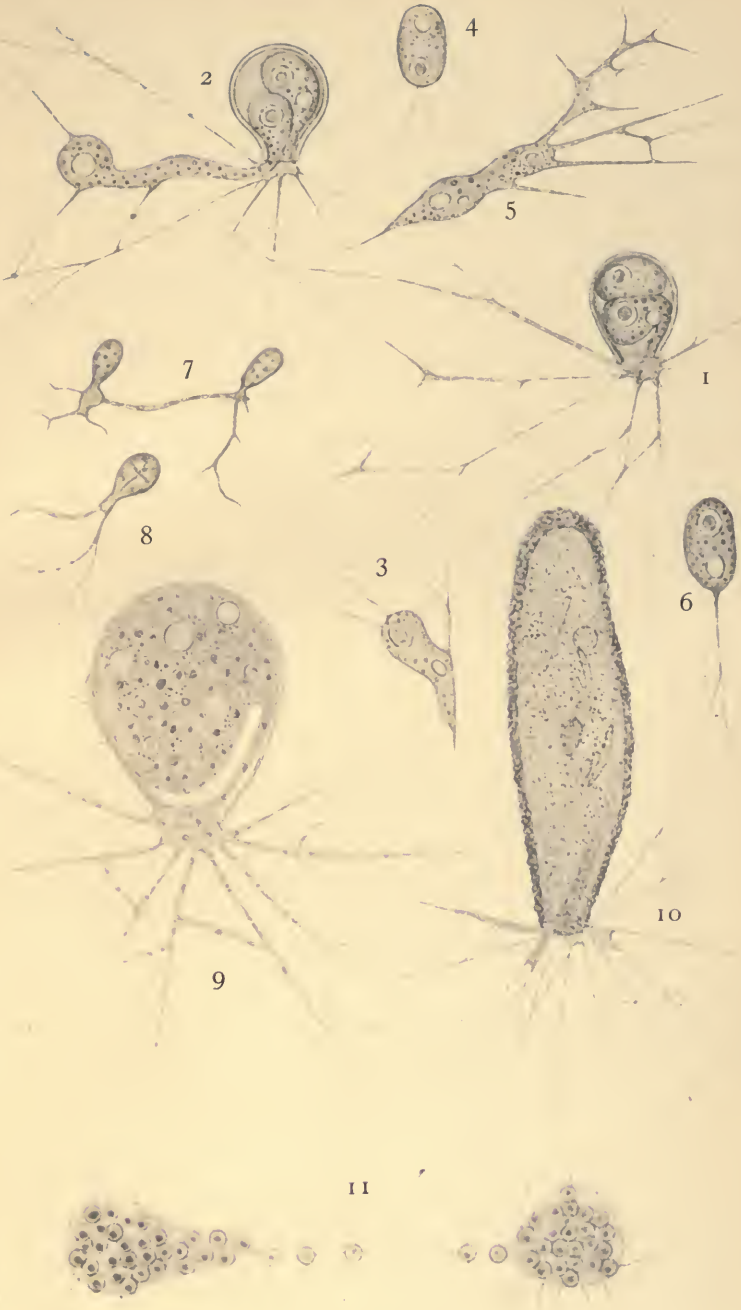
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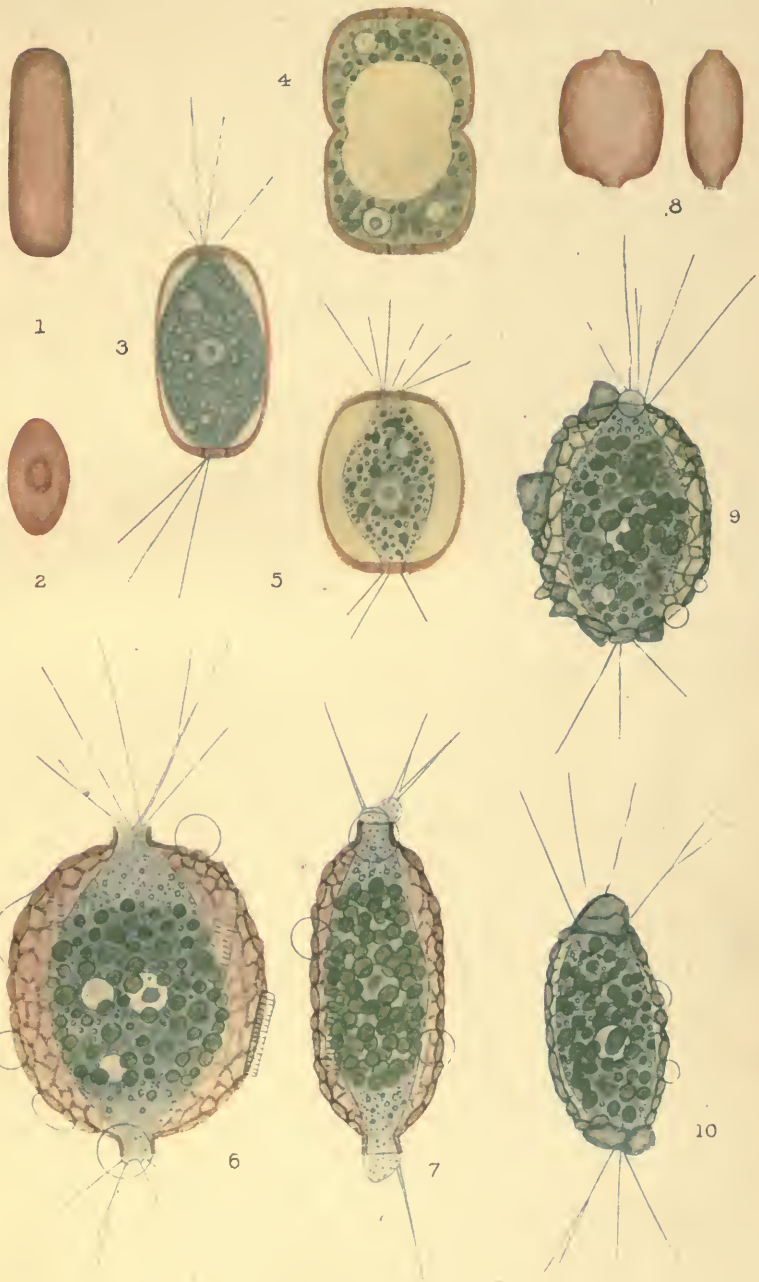
PLATE LVII.

Figs.

1–5. *Amphitrema flavum* (Archer) Penard. (p. 148) Figs. 1–3.—Narrow, oral, and broad views. Fig. 4.—Broad view of an individual containing zoochlorellæ with a transverse constriction as if a process of division were taking place; further stages have not been observed. Fig. 5.—Active individual containing zoochlorellæ; a broad short form which might possibly be derived from a process of division as suggested by Fig. 4. All × 500.

6–8. *A. wrightianum* Archer. (p. 149) Figs. 6–7.—Broad and narrow views. × 500. Fig. 8.—Broad and narrow views of a test from the peat deposit on Clare Island, Mayo; the covering of silicious particles, etc., having probably fallen off owing to decay. × 250.

9, 10. *A. stenostoma* Nüsslin. (p. 151) Broad and narrow views of an active individual. × 500.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Morris, Capel; *Brookfield, Binstead Road, Ryde, I.W.*

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Wimereux, Station Zoologique de; *Wimereux, Pas de Calais, France.*

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October, 1915.

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For the Sixty-first Year, 1904.

82. A Monograph of the British Desmidiaceæ. By W. and G. S. West. Vol. I. xxxvi + 224 + 64 pp., 32 plates. 8vo. 1904.

83. The British Tunicata. By the late Joshua Alder and the late Albany Hancock. Edited by John Hopkinson. Vol. I. With a History of the Work by Canon A. M. Norman. xvi + 146 + 42 pp., 20 plates, and frontispiece. 8vo. 1905.

For the Sixty-second Year, 1905.

84. A Monograph of the British Desmidiaceæ. By W. and G. S. West. Vol. II. x + 206 + 64 pp., 32 plates. (xxxiii–lxiv). 8vo. 1905.

85. The British Freshwater Rhizopoda and Heliozoa. By James Cash, assisted by John Hopkinson. Vol. I. The Rhizopoda, Part I. x + 150 + 32 pp., 16 plates. 8vo. 1905.

For the Sixty-third Year, 1906.

86. The British Tunicata. By the late Joshua Alder and the late Albany Hancock. Edited by John Hopkinson. Vol. II. With Lives of the Authors by Canon Norman and Dennis Embleton. xxviii + 164 + 62 pp., 30 plates (xxi–l), and frontispiece. 8vo. 1907.

For the Sixty-fourth Year, 1907.

87. A Monograph of the British Marine Annelids. By William Carmichael McIntosh. Vol. II, Part I. Polychæta. Nephthydidæ to Syllidæ. viii + 232 + 46 pp., 22 plates (xliii–l, lvii-lxx). Folio. 1908.

For the Sixty-fifth Year, 1908.

88. A Monograph of the British Desmidiaceæ. By W. and G. S. West. Vol. III. xvi + 274 + 62 pp., 31 plates (lxv–xcv). 8vo. 1908.

For the Sixty-fifth Year, 1908.

89. The British Freshwater Rhizopoda and Heliozoa. By the late JAMES CASH, assisted by JOHN HOPKINSON. Vol. II. The Rhizopoda, Part II. xviii + 168 + 32 pp., 16 plates (xvii–xxxii), and frontispiece. 8vo. 1909.

For the Sixty-sixth Year, 1909.

90. The British Nudibranchiate Mollusca. By the late JOSHUA ALDER and the late ALBANY HANCOCK. Part 8 (supplementary). Text by Sir CHARLES ELIOT. viii + 198 + 18 pp., 8 plates. Folio. 1910.

For the Sixty-seventh Year, 1910.

91. A Monograph of the British Marine Annelids. By WILLIAM CARMICHAEL MCINTOSH. Vol. II, Part 2. Polychæta. Syllidæ to Ariciidæ. vii + 292 (233–524) + 46 pp., 23 plates (li–lvi, lxxi–lxxxvii). Folio. 1910.

For the Sixty-eighth Year, 1911.

92. A Monograph of the British Desmidiaceæ. By W. and G. S. WEST. Vol. IV. xiv + 194 + 66 pp., 33 plates (xcvi–cxxviii). 8vo. 1912.

93. The British Tunicata. By the late JOSHUA ALDER and the late ALBANY HANCOCK. Edited by JOHN HOPKINSON. Vol. III. xii + 114 + 34 pp., 16 plates (li–lxvi), and frontispiece. 8vo. 1912.

For the Sixty-ninth Year, 1912.

94. A Bibliography of the Tunicata. By JOHN HOPKINSON. xii + 288 pp. 8vo. 1913.

95. The British Parasitic Copepoda. By THOMAS SCOTT and ANDREW SCOTT. Vol. I (Copepoda parasitic on Fishes, Part I). xii + 256 pp., 2 plates. 8vo. 1913.

For the Seventieth Year, 1913.

96. The British Parasitic Copepoda. By THOMAS and ANDREW SCOTT. Vol. II (Copepoda parasitic on Fishes, Part II). xii + 144 pp., 72 plates. 8vo. 1913.

For the Seventy-first Year, 1914.

97. A Monograph of the British Marine Annelids. By WILLIAM CARMICHAEL MCINTOSH. Vol. III. Part I.—Text. Polychæta. Opheliidæ to Ammocharidæ. viii + 368 pp. Folio. 1915.

For the Seventy-second Year, 1915.

98. The British Freshwater Rhizopoda and Heliozoa. By James Cash and George Herbert Wailes, assisted by John Hopkinson. Vol. III. The Rhizopoda, Part III. By G. H. Wailes. xxiv + 156 + 52 pp., 25 plates, and frontispiece. 8vo. 1915.

99. The Principles of Plant-Teratology. By W. C. Worsdell. Vol. I. Text and 25 plates. 8vo. 1915.

In Course of Publication.

The British Desmidiaceæ. By W. West and Prof. G. S. West.

The British Freshwater Rhizopoda and Heliozoa. By the late James Cash and (after Vol. II) G. H. Wailes.

The British Marine Annelids. By Prof. W. C. McIntosh. (Vol. III, part 2, plates, for 1916.)

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