

Freshwater Rhizopoda from North and South America.

By G. H. WAILES, F.L.S.

(PLATE 15.)

[Read 19th June, 1913.]

UNITED STATES.

DURING the year 1912 I was able to augment the records of Rhizopoda from the Eastern United States, described in a paper read before this Society in April 1912 *, by collections from the following localities :—

NEW JERSEY.—The Palisades on the west bank of the Hudson River from opposite Yonkers for about 5 miles southward ; gatherings from pools, moss, and sphagnum. This district dries up almost completely during the summer, but 99 species and varieties were recorded, including *Diffugia oviformis*, *D. rubescens*, *Nebela caudata*, *N. tenella*, *Euglypha crenulata*, *E. alveolata* var. *cirrata*, and *Cryptodiffugia eboracensis*, besides others noticed at greater length below.

Englewood and Leonia ; gatherings from pools, ditches, etc., and a large swamp forming part of the Hackensack Meadows : from this district 41 species were obtained, including *Nebela dentistoma* var. *lacustris*, *Euglypha alveolata* var. *cirrata*, and *Pseudodiffugia fulva*.

Princeton ; squeezings from water-plants and sediment from Carnegie Lake, sphagnum from a marsh about one mile north of the lake, and gatherings from a pond near Rahway : 57 species were obtained, including *Diffugia oblonga* var. *cornuta*, *D. oviformis*, *D. rubescens*, *D. urceolata*, *Nebela scutellata*, *Euglypha alveolata* var. *cirrata*, and *Pseudodiffugia gracilis*.

NEW YORK STATE.—West Point on the Hudson ; gatherings from a lake and small marsh, from which 28 species were obtained, including *Bullinula indica*, *Euglypha rotunda*, and *Pseudodiffugia fulva*.

Baldwin, Long Island ; gatherings from a large pond having sphagnum and *Drosera rotundifolia* growing on the margin : 39 species were recorded, including *Pseudodiffugia Archeri* and *P. gracilis* ; *Diffugia rubescens* and *Cyphoderia trochus* var. *amphoralis* were particularly numerous.

VIRGINIA.—Ocean View near Norfolk ; two gatherings of water-plants and some sediment collected by E. Solomonsky : from these 44 species were

* Journ. Linn. Soc., Zool. xxxii. (1912) pp. 121–161.

obtained, including *Diffugia oviformis*, *D. tuberculata* and var. *minor*, only one species of *Nebela*—*N. barbata*, *Euglypha alveolata* var. *cirrata*, *E. armata*, *E. crenulata*, *E. rotunda*, and *Pseudodiffugia gracilis*. Especially numerous was a handsome form of *Centropyxis aculeata* var. *discoides*, about 200 μ in diameter, having a brown test with usually three spines.

The above localities and a further examination of previous collections added 24 species and varieties to the 161 previously recorded, including three new species and one new variety. Short notes on these additional records are added.

Sub-Class RHIZOPODA.

Order AMŒBINA.

Family LOBOSA.

AMŒBA PILOSA, *Cash*.

Linn. Soc. Journ., Zool. xxix. (1904) p. 219. pl. 26. fig. 8.

Cash & Hopkinson, Brit. Freshw. Rhiz., Ray Soc., i. (1905) p. 62, pl. 4. figs. 1-5.

Two individuals of this species were obtained in Van Cortlandt Park, N.Y.; when inactive they were about 50 μ in diameter and covered with fine cils 6 μ in length; the endoplasm was loaded with various kinds of granules, including green and yellow bodies; two rather small contractile vacuoles were visible near the periphery, but the nucleus could not be distinguished. When in movement the ectoplasm flowed in short lobular expansions, the surfaces of which became immediately covered with the fine cils. Whilst under observation one individual rejected all the granular inclusions, leaving a finely granular grey plasma which completely dispersed immediately on becoming dry.

AMŒBA PROTEUS var. GRANULOSA, *Cash*.

Cash & Hopkinson, Brit. Freshw. Rhiz., Ray Soc., i. (1905) p. 48, pl. 1. fig. 3; pl. 3. fig. 2.

Amœba proteus pars, Leidy (6), p. 30, pl. 1. fig. 4.

Occurs on the Palisades, N.J. One individual measured 600 μ in length and about 90 μ in breadth, when active.

AMŒBA VILLOSA, *Wallich*.

Leidy (6), p. 62, pl. 2. figs. 14-16; pl. 8. figs. 1-16.

Not uncommon on the Palisades. Albany, N.Y. (*De Tarr*).

Family VAMPYRELLIDA.

VAMPYRELLA LATERITIA (*Fresen.*), *Leidy*.

Leidy (6), p. 253, pl. 45. figs. 10-16.

Vampyrella spirogyræ, Cienk. in Arch. mikr. Anat. i. (1865) p. 218, pls. 12, 13. figs. 44-65.

At West Point, N.Y., and in a pool on the Palisades, N.J., opposite Harlem, this species occurs numerously. Individuals kept under observation fed freely on filaments of *Spirogyra* (cells $30\ \mu$ diam. and $70-80\ \mu$ in length); the contents were abstracted by the animal apparently dissolving an oval aperture, $10-12\ \mu$ in length, in the cell-wall; through this, pseudopodia were thrust and the cell-contents absorbed, then the transverse cell-walls were attacked, and a very small hole, about $2\ \mu$ in diameter, was made in each by the extremity of a pseudopodium which was then used to abstract such of the contents as were within its reach, a portion usually being left. After three adjoining cells had thus been more or less completely emptied, the *Vampyrella* moved along the filament for a distance of 3 or 4 cell-lengths and repeated the process. Whilst feeding, the animals did not increase noticeably in size but became green; this colour, however, soon disappeared, and the normal brick-red colour was resumed.

Frequently accompanying the *Vampyrellæ* were a number, 4 to 8, of small amœboid sporozoa, 6 to $8\ \mu$ in diameter; they appeared to search the *Spirogyra* filament for the large openings made by the *Vampyrella*, through these they entered the empty cells and then searched the end walls for the small perforations that had been made, squeezed themselves through, and fed on such portions of the contents of the cells as had been beyond the reach of the *Vampyrella*. These sporozoa had a well-defined nucleus and small vacuole, whilst within the cells they displayed two or three sharply pointed pseudopodia; they became green and larger after feeding, and frequently some were unable to emerge through the small perforation until the process of digestion had reduced them in size.

Order CONCHULINA.

Family ARCELLIDA.

ARCELLA CURVATA, sp. nov. (Pl. 15. figs. 3 & 4.)

Arcella discoides pars, *Leidy* (6), p. 173, pl. 28. figs. 32-36.

Test of medium size, light brown in colour, circular, the ventral face curved so as to form a portion of a cylindrical surface subtending an angle of $80^{\circ}-100^{\circ}$, the dorsal face forming a dome of moderate height; aperture large, circular, invaginated, bordered by numerous small pores; plasma greyish, granular, usually including many food-particles; the nuclei not

large, about four or five in number ; two or more contractile vesicles usually present ; pseudopodia not observed.

Diameter 120–135 μ ; aperture 48–55 μ ; thickness about one quarter of the diameter.

Distribution.—Norfolk, Virginia ; Jacksonville, Florida (*Leidy*) ; Switzerland (*Penard*).

In the material from Norfolk the curved tests at once attracted attention, and that this is not merely an accidental condition is evidenced by the constant curvature and the absence of any similar tests not curved. The number of the nuclei also distinguishes it from other *Arcellæ*, a subject which is entered upon at greater length in the note on the following species.

No active and only a few living individuals were observed, and further observations as to the number of nuclei and the plasma, etc., are desirable. Penard has observed this species in two localities near Geneva ; at Norfolk it occurs numerously but is perhaps of very local occurrence.

ARCELLA MEGASTOMA, *Penard*, sp. nov. (Pl. 15. figs. 1 & 2.)

A. polypora pars, *Penard* (8), p. 408.

A. polypora pars, *Wailes* (16), p. 130.

A. discoïdes, *Ehrenb.* pars, *Leidy* (6), p. 173, pl. 28. fig. 22.

Test large, circular, compressed, thickness about one quarter to one third of the diameter ; aperture large, circular, invaginated, surrounded by numerous small pores, from 0.4 to more than 0.5 of the diameter of the test in width ; plasma greyish in colour, granular, attached to the test by numerous epodes and containing many food-particles ; nuclei small, numerous, from 40 to 200 in number ; several contractile vesicles usually present ; pseudopodia digitate.

Diameter 190–365 μ ; aperture 100–190 μ .

Distribution.—Van Cortlandt Park, N.Y. ; Split Rock, Lake Boonton, N.J. ; Wyoming (*Leidy*) ; Chili ; Switzerland (*Penard*).

Having received slides containing specimens found near Geneva, kindly sent to me, for comparison with American specimens, by Dr. Penard, he suggested that I should give a description of this species, which he had named provisionally *A. megastoma* ; it is, however, to be hoped that he will supplement it by the results of observations extending over a considerable period.

All species of *Arcellæ* have normally two nuclei only, except *A. polypora*, *A. megastoma*, and *A. curvata* ; the first two belong to what may be called the *A. discoïdes* group, having tests more or less similar to that species but possessing more than two nuclei : *A. discoïdes*, however, has been recorded by several observers with more than two nuclei (8. p. 408), for example *Leidy* (6), Pl. 28. fig. 28, shows a test 180 μ in diameter with three nuclei, but others may have escaped observation, and in other respects it conforms to *A. polypora* ;

but until a sufficient number of observations have been recorded to clear up this question it would perhaps be advisable to regard *A. polypora*, Penard, as a variety of *A. discoides*, Ehrenberg. The following table shows the relationship of these species with *approximate* limits of size :—

	Diameter.	Aperture.	Height.	No. of nuclei.
<i>Arcella discoides</i> , Ehrenberg	80-150 μ	·3 dia.	1/5 to 1/3 dia.	2 normally
„ <i>polypora</i> , Penard	100-200 μ	·3-·4 dia.	1/4 to 1/3 „	8-20
„ <i>megastoma</i> , Penard, sp. nov.	190-365 μ	·4-·55 dia.	1/4 to 1/3 „	40-200
„ <i>curvata</i> , sp. nov.	120-135 μ	·4 dia.	1/4 dia.	4 or 5

Information is required regarding the development of the young of the above species and the number of nuclei present at various stages of their growth. It is possible that the nuclei increase in number by division during the development of an individual. The structure of the tests and the pores around the apertures appear to vary in the *A. discoides* group within a wide range, the limits of which cannot at present be accurately defined.

ARCELLA VULGARIS, *Ehrenberg*. (Pl. 15. fig. 5.)

An unusual form of this species was found which has acute basal angles, as shown in fig. 5.

Diameter 100-136 μ ; height $\frac{1}{3}$ to $\frac{1}{2}$ the diameter.

Distribution.—Princeton, N.J. ; Norfolk, Va.

Family DIFFLUGINA.

DIFFLUGIA BICORNIS, *Penard*, in *Mém. Soc. Genève*, xxxi. 1890, no. 2, p. 141, pl. 4. figs. 12-14. (Pl. 15. figs. 10 & 11.)

D. bicuspidata, Rhumbler, *Zeitschr. f. wiss. Zool.* lii. (1891) p. 546, pl. 32. fig. 60.

D. elegans pars, *Penard* (8), p. 237, fig. 10.

? *D. acuminata* pars, *Leidy* (6), p. 109, pl. 12. figs. 24-27.

The majority of the tests observed were furnished with two horns, but three- and rarely four-horned tests also occur ; the two- and three-horned forms are symmetrical, but the fourth horn appears as if interpolated on the latter form (fig. 11).

Length, without horns, 70-80 μ ; breadth of test 60-65 μ ; horns 20-30 μ in length.

Distribution.—Good Ground, Long Island ; Palisades and Princeton, N.J. ; Asbury Park, N.J.

The tests figured by Leidy (figs. 24–27) have smaller and less divergent horns than those seen by me but are of about the same size, his figs. 28 and 29 are much larger (about $200\ \mu$ in length).

This species is much smaller than either *D. corona* or *D. urceolata*, has fewer horns, and the circular aperture is devoid of any lip. The plasma often contains zoochlorella cells.

DIFFLUGIA LANCEOLATA, Penard.

D. pyriformis pars, Leidy (6), p. 98, pl. 10. fig. 17.

Occurs on the Palisades, N.J., about $140\ \mu$ in length.

DIFFLUGIA OLLIFORMIS, Lagerheim. (Pl. 15. fig. 12.)

In Förh. Geol. Fören. Stockholm, xxiii. (1901) p. 512, figs. 1–5.

The test of this *Diffugia* resembles that of *D. subæqualis*, Penard (Revue Suisse), but is rarely so large, is less truncate and much more variable in size. The colour of the test is brown, with an aperture bordered by a collar usually smooth but occasionally composed of small grains loosely aggregated.

Length $80\text{--}87\ \mu$; diameter $70\text{--}78\ \mu$; collar $36\text{--}42\ \mu$.

Distribution.—Carnegie Lake, Princeton, N.J.

In the 'Scottish Naturalist,' March 1912, p. 63, this species was recorded doubtfully by me as *D. subæqualis*. The limits of size in Great Britain are:—length $50\text{--}84\ \mu$, diameter $45\text{--}80\ \mu$, collar $30\text{--}60\ \mu$. A small variety about $30\ \mu$ in length also occurs in Yorkshire (Lagerheim, figs. 4 & 5).

DIFFLUGIA URCEOLATA var. *AMPHORA*, Leidy.

Leidy (6), pl. 14. figs. 3, 4, 8; pl. 16. fig. 34.

D. amphora, Leidy, Proc. Acad. Nat. Sci. Philad. 1874, p. 79.

This variety is distinct from *D. amphora*, Penard (Faune Rhiz. Léman, 1902), which is distinguished by a recess around the base of the neck, and the collar having in side view a wavy outline, and by the expression of the polygonal aperture. *D. amphoralis*, Hopkinson, is a much smaller species.

Length $190\text{--}200\ \mu$ (Leidy $200\text{--}600\ \mu$); diameter $125\text{--}128\ \mu$; aperture $58\text{--}60\ \mu$. Similar to Leidy's fig. 8, pl. 14.

Distribution.—Van Cortlandt Park, N.Y.

Family NEBELINA.

NEBELA SACCIFERA, sp. nov. (Pl. 15. figs. 7, 8, 9.)

Diffugia equicalceus pars, Leidy, Proc. Acad. Nat. Sci. Philad. 1874, p. 156.

Nebela equicalceus pars, Leidy, *ibid.* 1876, p. 118, fig. 15.

Nebela equicalceus, Wailes (16), p. 137.

Nebela hippocrepis pars, Leidy (6), p. 156, pl. 24. fig. 13.

Test of large size, pyriform, compressed, colourless, formed of circular discs usually imbricated; provided with two hollow curved horns, projecting

internally, arising at each side of the test above the widest part, and communicating at the base with the exterior by a small slit-like orifice; test in lateral view narrowly pyriform; transverse section elliptical, prolonged at each end into a shallow keel; aperture elliptical; nucleus large, placed posteriorly, containing several nucleoles; plasma normal.

Length 203–240 μ ; breadth 126–145 μ ; aperture 38–45 μ by 20–23 μ ; thickness one half to two thirds of the breadth; length of horns 35–60 μ .

Habitat. Sphagnum.

Distribution.—Lakehurst; Absecom (*Leidy*), N.J.; Good Ground, Long Island (16).

Leidy found only two empty tests of this species, and he realised that although related to, they were distinct from *Nebela equicalceus*; from which species it is distinguished by the absence of the horseshoe-shaped keel around the fundus, by the horns not being solid, and the smaller size of the test with a shorter neck. The small openings at the base of the horns are very narrow slits usually indistinguishable but readily detected if a test be removed from water into oil of cloves, when the oil can be seen entering through them: although not uncommon in several gatherings and many living individuals were seen, none were active. No specimens of *N. equicalceus* were found. It may perhaps be more than a coincidence that if the space occupied by the horns were vacant the test would then be similar to that of *N. ansata*, and the small discs often attached to the horns of that species (*Leidy*, Pl. 25. fig. 1) may represent the discarded material.

COCHLIOPODIUM ECHINATUM, *Korotneff*.

In Arch. Zool. expér. viii. (1879) p. 480, pl. 25. fig. 9.

C. vestitum pars, *Leidy* (6), p. 188, pl. 32. figs. 27, 28.

A form occurs at Good Ground, Long Island, similar to *Leidy's* figs. 27 & 28, which *Cash & Hopkinson* (Ray Soc. 1908) consider to represent this species; this form possesses spines intermediate in length between those of this species and *C. vestitum*. The aperture varied from being about two-thirds the diameter of the test to a narrow slit, according to the movements of the animal. The pseudopodia, nucleus, etc., are accurately represented by *Leidy*.

Diameter 32–35 μ ; nucleus 6 μ dia. with a well-defined central nucleole; spines about 8–10 μ in length.

Distribution.—Trout Pond, Good Ground, Long Island.

FAMILY EUGLYPHINA.

EUGLYPHA DENTICULATA, *Brown*.

In Scott. Nat. 1912, p. 111, pl. 5. figs. 5–11.

This recently described species bears a close resemblance to a colourless

form of *Assulina muscorum* devoid of the membrane bordering the aperture ; the plasma, nucleus, and pseudopodia are also similar ; it is widely distributed but not very numerous, and seems always to occur in association with *A. muscorum*.

Length 42–52 μ ; breadth 23–30 μ .

Distribution.—West Point, N.Y. ; South America ; Java ; Great Britain.

EUGLYPHA FILIFERA var. *PYRIFORMIS*, var. nov. (Pl. 15. fig. 6.)

E. ciliata pars, Leidy (6), p. 214, pl. 36. fig. 14.

E. filifera, form "c," Wailes (16), p. 148.

Test usually smaller than the type, pyriform with elongated neck, the lateral margins furnished with 5–7 long spines arranged in a single row ; transverse section elliptical ; aperture circular bordered by 8 denticulated scales ; plasma and pseudopodia as in the type.

Length 48–60 μ ; breadth 24–30 μ ; aperture 6–10 μ ; thickness 17–23 μ ; spines 18–26 μ in length.

Distribution.—Good Ground, Long Island ; Pennsylvania (*Leidy*).

This variety is referred to as form *c* on p. 148, Journ. Linn. Soc., Zool. vol. xxxii. (1912), but specimens submitted to Dr. Penard were declared by him not to be *E. filifera*, Penard.

The tests of this variety are usually somewhat more compressed than in the type, the thickness varying from two-thirds to three-quarters of the breadth. It is not of common occurrence.

EUGLYPHA STRIGOSA var. *MUSCORUM*, *Wailes* (17), p. 42.

Forma *HETEROSPINA*, f. nov.

This form was recorded with the test thickly covered with spines of various lengths.

Length 65–70 μ ; breadth 55–58 μ ; aperture 16–17 μ ; spines 6–26 μ in length.

Distribution.—Palisades, N.J.

ASSULINA SEMINULUM var. *SCANDINAVICA*, *Penard* (8), p. 519.

A. scandinavica, Penard in Mém. Soc. Genève, xxxi. (1890) no. 2, p. 176, pl. 9. figs. 1–13.

Only one or two individuals were seen and these very small ; it is usually found in elevated situations.

Length 77 μ ; breadth 73 μ ; aperture 24 μ ; nucleus 22 μ in diameter, containing nucleoles $6 \times 4 \mu$; scales 10 μ in length.

Distribution.—Palisades, N.J.

TRINEMA ENCHELYS var. *GALEATA*, *Penard* in Mém. Soc. Genève, xxxi. (1890) no. 2, p. 186.

This variety, approaching *T. complanatum* in appearance, is widely distributed and was occasionally seen in an active state.

Distribution.—Van Cortlandt Park, West Point, Long Island, N.Y. ; Palisades, N.J. ;

Family GROMIINA.

PAMPHAGUS MUTABILIS, *Bailey*.

In Amer. Journ. Sci. & Arts, vol. xv. (1853) p. 341.

Leidy (6), p. 191, pl. 33. figs. 1-9.

In a pool on the Palisades this species occurs numerously; many were seen in an active state.

Length $45-60\ \mu$; breadth about half the length.

Distribution.—New Jersey! (6); West Point, N.Y. (*Bailey*); Pennsylvania (6); Wyoming (6); Iowa (*Edmondson*).

PSEUDODIFFLUGIA FASCULARIS, *Penard* (8), p. 453.

Unusually scarce, being found in only one gathering, where it occurred in association with *P. gracilis*.

The majority of individuals had smoother tests than is usual and one empty test was perfectly smooth with a sharply defined narrow collar around the aperture.

Length $26-30\ \mu$; diameter $18-20\ \mu$; aperture $10\ \mu$.

Distribution.—Palisades, N.J.

DIAPHOROPODON MOBILE, *Archer*.

In Quart. Journ. Micros. Sci. n. s. ix. (1869) p. 394, pl. 20. fig. 6.

In one gathering of sphagnum this species was numerous, but in no instance were the pseudopodia fully displayed. The test is thick but smooth and pliable; its shape is very variable, ovoid, pyriform, or even sometimes constricted in the middle, but it is not usually compressed; the fine cils with which it is thickly covered are colourless, and under a low power appear like a hyaline investment; they are from $8-10\ \mu$ in length and become invisible in Canada balsam, oil of cloves, and glycerine; they are insoluble in cold sulphuric acid.

Length $70-113\ \mu$; breadth $50-65\ \mu$; aperture variable; nucleus about $20\ \mu$ in diameter.

Distribution.—In sphagnum from Trout Pond, Good Ground, Long Island.

Family AMPHISTOMINA.

DIPLOPHRYS ARCHERI, *Barker*.

In Quart. Journ. Micros. Sci. n. s. viii. (1868) p. 123.

On some water-plants a young colony of embryos of this species was seen in an amœboid state; the individuals were $4\ \mu$ in diameter, and the colony, about $50\ \mu$ in length, displayed numerous pseudopodia about $30-40\ \mu$ in length.

Leidy, 1879, Pl. 45. figs. 7, 9, shows such a colony which he doubtfully ascribes to this species, but in reality it belongs to the Heliozoon *Elæorhans cincta*, Greeff, whose embryos contain reddish globules, whereas the globules in *D. Archeri* are usually yellow but sometimes of a pale blue colour (v. Penard, 'Les Héliozoaires,' 1904, p. 228).

Distribution.—Palisades, N.J.

Sub-Class HELIOZOA.

Family ACTINOPHRYIDÆ.

ACTINOSPHERIUM EICHHORNII, *Ehrenb.*

Leidy (6), p. 259, pl. 46. figs. 1-11.

This species occurs numerously in several localities ; many small ones (Leidy, figs. 3 & 5) were seen, the result of the division of mature individuals.

Distribution.—Palisades ; Englewood ; West Point, N.J.

SOUTH AMERICA.

During the years 1911 and 1912 moss and squeezings were received that had been collected by James Murray in South America, for examination for Rhizopoda ; the gatherings from Bolivia and Peru are described in his 'Notes on the Natural History of Bolivia' (1913) ; the others are here described.

List of gatherings :—

- (1) Antofagasta, Chili ; one gathering from a pond : 6 species.
- (2) Valparaiso, Chili ; one gathering from a pond : 7 species.
- (3) Puntas Arenas, Straits of Magellan, Chili ; gatherings from sphagnum, ponds, and stream : 29 species.
- (4) Rio Janeiro, Brazil ; gatherings from moss (shore and inland), ponds, and sphagnum collected on the slopes and near the summits of Mt. Papagaio (4000-5000 ft.) and Mt. Corcovada (2200 ft.) : 55 species.
- (5) Buenos Ayres, Argentina ; moss from trees : 3 species.
- (6) Panama, Central America ; a sample of dry sandy moss : 8 species.

Little is known of the distribution of the Rhizopoda in South America. Ehrenberg (1841) records *Arcella pileus* and two other species, and in 1871

(Abh. Kgl. Akad. Wiss. Berlin) he records from Venezuela six species of which *Trinema enchelys* (*Arcella caudicola*, pl. 2. f. 31) is the only one that can be identified with certainty; of the remaining five Diffugiæ, four are species of *Nebela* and one is a species of *Euglypha*; from Cape Horn he records three species, viz.: *Diffugia phiala* (f. 9), which resembles *Nebela Murrayi* in outline, but the absence of all detail prevents its identification, *D. hermitana* (f. 10), which has an outline resembling *Nebela Certesi*, and *D. antarctica*, which is some species of *Euglypha*. Certes (3) records 28 species and varieties from Cape Horn including four new species*.

From Paraguay, Daday (4) records 34 species including five interesting and curious new ones. Dr. Fuhrman has submitted a collection of material, made during his recent expedition to the Andes of Colombia, to Dr. Penard for examination, but the report is not yet published.

The collections made by J. Murray provided a total of 74 species and varieties, three of which are now first described, and one (*Arcella megastoma*, Pl. 15. figs. 1 & 2) is described above, p. 204. Nearly all the species recorded are of common occurrence in other parts of the world, but the following may be noted as either rare or seldom recorded previously:—

<i>Awerinzewia cyclostoma.</i>	<i>Nebela caudata.</i>
<i>Bullinula indica.</i>	„ (<i>Hyalosphenia</i>) <i>cockayni.</i>
<i>Corycia aculeata.</i>	„ <i>scutellata.</i>
„ <i>flava</i> var. <i>coronata.</i>	„ <i>tropica.</i>
	„ <i>vas.</i>

Of these, *Nebela cockayni* has been recorded previously only from Oceania, and *N. vas* from localities bordering the Pacific Ocean (3, 11); several species recorded by Certes and Daday were not found.

The Nebelæ now first described are interesting owing to their affinities and peculiarities; *N. spicata* occurs at Sandia, Peru, but was not found in time to be described in J. Murray's report.

Judging from the materials examined, many places on the coasts of South America, also large tracts of forest, are very deficient as regards the Rhizopod fauna, owing no doubt to unfavourable conditions as to humidity and sunlight; in localities where conditions are more favourable the number of species still appears to be restricted, but individuals are often numerous. Investigations carried on *in situ* are sure to result in adding many species to those recorded.

Notes on some of the less common species that were found are appended.

Trinema constricta, Certes, is *Corythion dubium*, Taránek, and *Trinema sauvineti*, Certes, is a Rotifer test.

	Chili.			Rio Janeiro, Brazil.	Buenos Ayres, Argentina.	Panama.
	Antofagasta.	Valparaiso.	Puntas Arenas.			
	1	2	3	4	5	6
Class SARCODINA.						
Sub-Class RHIZOPODA.						
Order AMOEBINA.						
Family LOBOSA.						
<i>Amoeba terricola</i> , Greeff	x	..	x			
Order CONCHULINA.						
Family ARCELLIDA.						
<i>Arcella arenaria</i> , Greeff	..	x	x	x	x	
" <i>discoides</i> , Ehrenb.	..	x	x	x		
" <i>megastoma</i> , Penard	..	..	x			
" <i>vulgaris</i> , Ehrenb.	x	..	x			
" " <i>var. gibbosa</i> (Pen.), West	..	..	x	x		
<i>Pseudochlamys patella</i> , Clap. et Lach.	..	..	..	x		
<i>Corycia aculeata</i> (Greeff), Awer.	..	..	..	x		
" <i>flava</i> (Greeff), Pen.	..	..	..	x		
" <i>var. coronata</i> (Pen.)	..	..	..	x		
<i>Bullinula indica</i> , Pen.	..	..	..	x		
<i>Centropyxis aculeata</i> (Ehrenb.), Stein	x	..	x	x		
" " <i>var. discoides</i> , Ehrenb.	..	..	..	x		
" " <i>var. ecornis</i> (Ehrenb.), Leidy	..	x	..	x		
" " <i>var. hemispherica</i> (Barnard), Wailes (7)	x	..	..	x		
" <i>arcelloides</i> , Pen.	..	..	x	x	x	
<i>Plagiopyxis callida</i> , Pen.	..	x	..	x		
" <i>labiata</i> , Pen.	..	..	..	x		
Family DIFFLUGINA.						
<i>Diffugia constricta</i> , Ehrenb. (Leidy)	..	x	..	x	..	x
" <i>gramen</i> , Pen.	..	..	x	x		
" <i>lucida</i> , Pen.	..	..	..	x	x	x
" <i>oblonga</i> , Ehrenb.	..	..	x	x		
" " <i>var. venusta</i> (Pen.), Cash	..	..	..	x		
" <i>tuberculata var. minor</i> , Pen.	..	..	..	x		
<i>Pontigulasia compressa</i> (Carter), Cash	..	..	..	x		
<i>Phryganella hemispherica</i> , Pen.	..	..	x	x		
" <i>nidulus</i> , Pen.	..	..	..	x	x	
<i>Trigonopyxis arcuata</i> (Leidy), Pen.	..	..	..	x		
<i>Lesquereusia spiralis</i> , Bütschli	..	..	..	x		

	1	2	3	4	5	6
Family NEBELINA.						
<i>Hyalosphenia papilio</i> , <i>Leidy</i>	..	..	..	×		
" <i>subflava</i> , <i>Cash</i>	..	..	×			
<i>Nebela caudata</i> , <i>Leidy</i>	..	..	..	×		
" <i>cockayni</i> (<i>Pen.</i>)	..	..	×			
" <i>collaris</i> , <i>Leidy</i>	..	..	×	×		
" <i>dentistoma</i> , <i>Pen.</i>	..	..	×	×		
" " <i>var. hesperia</i> , <i>var. nov.</i>	..	..	×	×		
" <i>gracilis</i> , <i>Pen.</i>	..	..	..	×		
" <i>lageniformis</i> , <i>Pen.</i>	..	..	×	×		
" <i>militaris</i> , <i>Pen.</i>	..	..	..	×		
" <i>Murrayi</i> , <i>sp. nov.</i>	..	..	×	×		
" <i>parvula</i> , <i>Cash</i>	..	..	..	×		
" <i>scutellata</i> , <i>Wailes</i>	..	..	×	×		
" <i>spicata</i> , <i>sp. nov.</i> (<i>Peru</i>)	..	..	..	×		
" <i>tropica</i> , <i>Wailes</i>	..	..	..	×		
" <i>tincta</i> (<i>Leidy</i>), <i>Auerb.</i>	..	..	..	×		
" <i>vas</i> , <i>Certes</i>	..	..	×	×		
" <i>vitrea</i> , <i>Pen.</i>	..	..	..	×		
<i>Quadrula symmetrica</i> , <i>F. E. Schulze</i>	..	..	..	×		
<i>Heleopera sordida</i> , <i>Pen.</i>	..	..	..	×		
" <i>sylvatica</i> , <i>Pen.</i>	..	..	..	×		
<i>Awerinzewia cyclostoma</i> (<i>Pen.</i>), <i>Schout.</i>	..	..	..	×		
<i>Cochliopodium bilimbosum</i> (<i>Auerb.</i>), <i>Leidy</i>	..	..	×			
Family EUGLYPHINA.						
<i>Euglypha armata</i> , <i>Wailes</i>	..	..	..	×		
" <i>alveolata</i> , <i>Duj.</i>	×	..	×	×	..	×
" <i>ciliata</i> , <i>Ehrenb.</i>	..	×	..	×		
" <i>cristata</i> , <i>Leidy</i>	..	..	×			
" <i>compressa</i> , <i>Carter</i>	..	×	..	×		
" <i>denticulata</i> , <i>Brown</i>	×	..	×	×		
" <i>filifera</i> , <i>Pen.</i>	..	..	×			
" <i>laevis</i> , <i>Perty</i>	..	..	×	×	..	×
" <i>strigosa</i> (<i>Ehrenb.</i>), <i>Leidy</i>	..	..	×	×	..	×
" <i>f. glabra</i>	..	..	×	×		
" <i>f. heterospina</i>	..	..	..	×		
" <i>var. muscorum</i> , <i>Wailes</i>	..	..	..	×	..	×
<i>Assulina muscorum</i> , <i>Greeff</i>	..	..	×	×		
<i>Cyphoderia ampulla</i> (<i>Ehrenb.</i>), <i>Leidy</i>	..	..	×			
<i>Trinema enchelys</i> (<i>Ehrenb.</i>), <i>Leidy</i>	..	..	×	..	..	×
" " <i>var. galeata</i> , <i>Pen.</i>	..	..	..	×		
" <i>complanatum</i> , <i>Pen.</i>	..	..	..	×		
" <i>lineare</i> , <i>Pen.</i>	..	..	×	×		
<i>Corythion dubium</i> , <i>Taránek</i>	..	..	×	×		
<i>Sphenoderia fissirostris</i> , <i>Pen.</i>	..	..	×			
Family GROMIINA.						
<i>Pamphagus mutabilis</i> , <i>Bailey</i>	..	..	×			
<i>Pseudodiffugia fascicularis</i> , <i>Pen.</i>	..	..	..	×		
" <i>gracilis</i> , <i>Schlumb.</i>	..	..	×			

Order AMŒBINA.

AMŒBA TERRICOLA, Greeff, in Arch. f. mikr. Anat. i. (1866) p. 300, pl. 17. figs. 1-11.

A. verrucosa, Ehrenb. Infus. 1838, p. 126, pl. 8. fig. 11.

A. papyracea, Penard (10), Bd. 6, 1905, p. 201.

Owing to the possession of a comparatively firm pellicle this species is able to withstand desiccation for quite lengthy periods, and often to be identified in preserved gatherings. A study of this species and its allies by Penard has recently appeared (Archiv f. Protist. 1912).

Order CONCHULINA.

BULLINULA INDICA, Penard (11), p. 225, pl. 22. fig. 1.

Bulinella indica, Penard (12), p. 274, pl. 14. figs. 1-4.

Occurs in sphagnum on Mt. Papagaio, Rio Janeiro.

Length about 200 μ ; breadth about 180 μ .

Distribution.—Peru (7); United States (16); Canada (11); Europe (17, 9, 1912); Australasia (11); India (12); Seychelles (16).

CORYCIA ACULEATA (Greeff), Awerinzew (1), p. 142.

Pseudochlamys aculeata, Greeff (5), p. 104.

Corycia coronata, Penard (8), p. 178.

This rare species occurs in moss on the shore near Rio Janeiro; the spines, usually numerous (8-12), are well developed but never long. The tests were of medium size.

Diameter 90-100 μ .

CORYCIA FLAVA (Greeff), Penard (8), p. 173.

Amphizonella flava, Greeff, in Arch. f. mikr. Anat. ii. (1866) p. 329, pl. 18. fig. 19.

In addition to tests of typical size, 80-100 μ in diameter, several large tests were seen, similar to those which occur in Bolivia (7) measuring from 120-165 μ in diameter; some of these were circular, others folded up; they may perhaps be *Parmulina brucei*, Penard (13), but the facets present on the tests of that species were never distinguishable; it is to be hoped that specimens will be found in the materials collected by the Fuhrman expedition that will enable Penard to complete his description of that species and render its identification more certain.

C. FLAVA var. CORONATA (Penard).

Corycia coronata var. *simplex*, Penard (8), p. 179.

Corycia penardi, Awerinzew (1), p. 143; Schouteden (15), p. 332.

A few tests that belonged to this variety were found in moss; the projecting ring around the crown of the test is often only rudimentary and

the animal is scarcely distinguishable from *C. flava*; for this reason Dr. Penard is now of opinion (private letter) that it should be regarded as a variety of that species.

Diameter 93–100 μ .

Distribution.—Rio Janeiro, Brazil.

NEBELA CAUDATA, *Leidy* (6), p. 160, pl. 26. figs. 21–24. (Pl. 15. fig. 17.)

Although never numerous this species is widely distributed throughout the world. In order that a comparison can be made with *N. spicata*, sp. nov., a drawing is given of an individual from near the summit of Corcovada Mt.

Length, without spines, 80–90 μ ; breadth 65–75 μ ; aperture 20–25 μ ; spines 3 or 4 in number.

Distribution.—Brazil, Bolivia, and Peru (7); Gough Island (13); United States (6, 16); Canada (11).

NEBELA COCKAYNI (*Penard*).

Hyalosphenia cockayni, Penard (11), p. 238, pl. 22. fig. 5.

The individuals found by Penard in Oceania possessed transparent tests with very faint indications of the plates or scales; those at Puntas Arenas are distinctly marked, having typical *Nebela*-like tests composed of small oval plates closely cemented together; they are considerably larger than any previously recorded, also less compressed, the thickness being about 0.6 of the breadth; the aperture in one case was $28 \times 10 \mu$, in another $25 \times 14 \mu$, being narrowly elliptical. There are, as shown by Penard, two small pores in the sides of the neck and no other openings in the body of the test. Only empty tests were found.

Length 120–126 μ ; breadth 74–75 μ ; aperture 25–28 μ ; thickness 42 μ .

Distribution.—Puntas Arenas; Australasia (11); Auckland Islands (l. 89–100 μ); Sydney (l. 100 μ); Mt. Cook, New Zealand (l. 115 μ).

NEBELA DENTISTOMA var. HESPERIA, var. nov. (Pl. 15. fig. 13.)

In addition to a few individuals of the typical *N. dentistoma*, Penard, a form with a much larger test was found numerous in some gatherings, which is here recorded, at least for the present, as a variety of that species; a future examination of living individuals may perhaps result in it being regarded as an autonomous species. The following is a description of the tests, no information as to the plasma, etc., being available.

Test large, pyriform, compressed, composed of oval, round, or square plates in varying proportions with an occasional admixture of diatom frustules and *Euglypha* scales; transverse section elliptical; aperture elliptical, its border not thickened, slightly undulate and usually formed of oval scales; in narrow side-view, the fundus rounded, and the sides tapering in convex lines to the aperture.

Length 155–190 μ ; breadth 100–142 μ ; aperture 32–50 μ ; thickness 0.5 to 0.6 of the breadth.

The proportions of the test vary considerably, the breadth ranging from 0.6 to 0.8 of the length, the narrow tests having an ovoid outline. The average of 13 tests gave: length 175 μ , breadth 128 μ , aperture 38 μ ; two tests each 170 μ in length measured 100 μ and 140 μ in breadth respectively.

This variety is distinguished from *N. dentistoma* var. *lacustris*, Wailes (16), by the absence of any definite neck and by the structure of the test, which consists of small plates with regular outlines.

Distribution.—Puntas Arenas; Mt. Corcovada, Rio Janeiro (sphagnum).

NEBELA MURRAYI, sp. nov. (Pl. 15. figs. 18, 19.)

Test of medium size, broadly pyriform, compressed, nearly colourless, usually formed of oval or circular plates; in broad view nearly circular, with a short, wide, parallel neck; furnished with two orifices on each side situated in depressions at the base of the neck, each pair of orifices contracted by an internal tube; the neck bearing a variable number of small circular granules; the test in narrow side-view having a slightly protuberant apex, widening to the centre of the body thence tapering gradually to the neck; transverse section elliptical; aperture elliptical with thickened lip; plasma grey, granular, containing numerous food-particles; nucleus moderately large with several nucleoles; pseudopodia not observed.

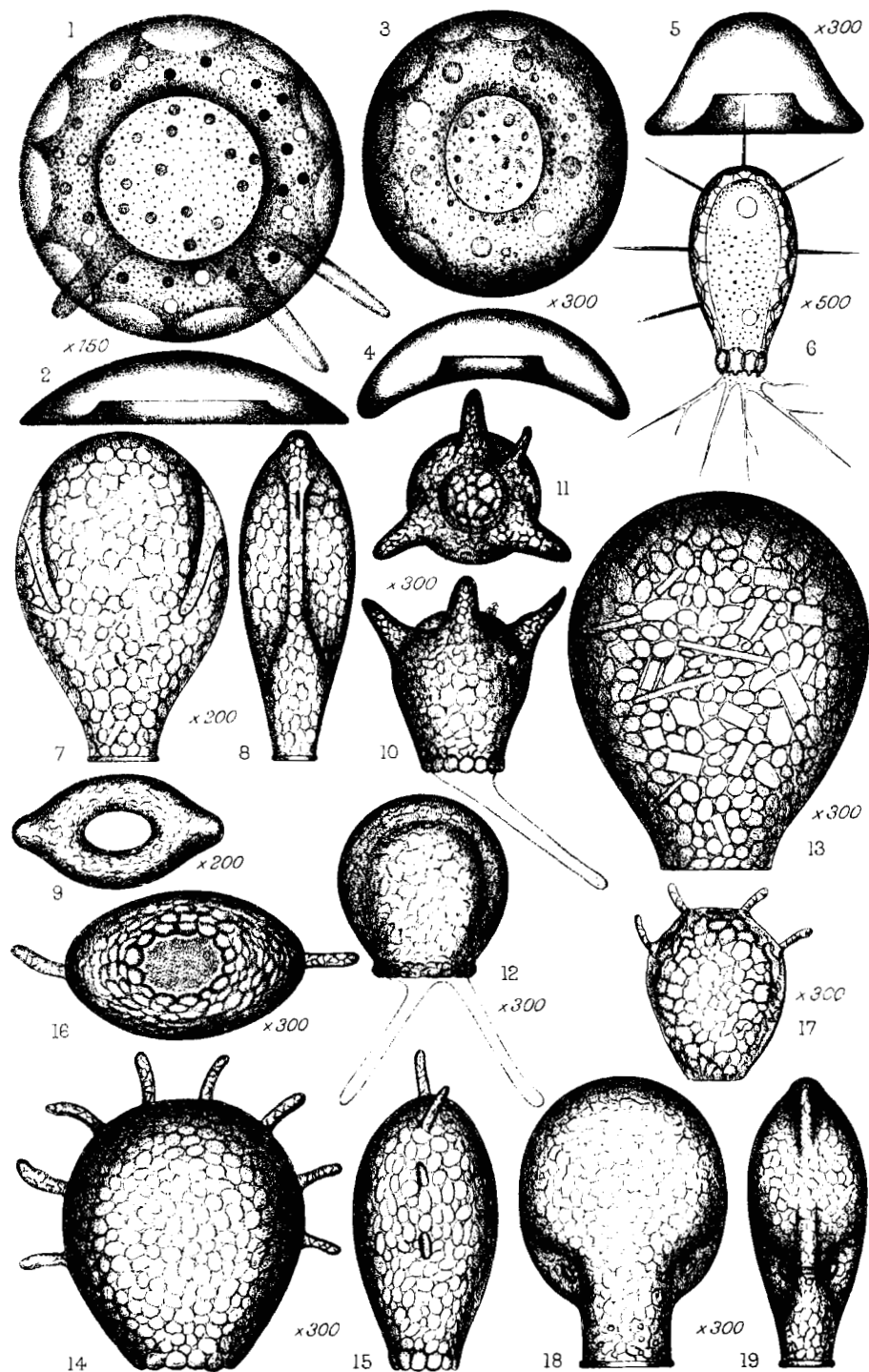
Length 120–136 μ ; breadth 95–100 μ ; aperture 30–35 μ ; thickness about half the breadth.

Distribution.—Puntas Arenas; Mt. Papagaio, Rio Janeiro.

This species belongs to a group of *Nebelæ* in which the curious lateral pores are characteristic; the other members are *N. bigibbosa*, Penard, *N. martiali*, Certes, *N. Certesi* (Certes), Penard, but none of these were found in the gatherings under examination. So far as is known at present *N. bigibbosa* is peculiar to the Northern Hemisphere, and *N. Certesi* to the Southern; the latter and *N. martiali* are also distinguished by the presence of the small nodules on the neck. *N. Certesi* has in addition tubular channels running up the neck from the aperture, and the lateral internal tubes are sometimes only rudimentary.

NEBELA SPICATA, sp. nov. (Pl. 15. figs. 14, 15, 16.)

Test of medium size, of a grey colour, ovoid, moderately compressed, formed of various-sized oval or irregularly shaped scales; the crown circular, furnished with a single row of 6–8 hollow spines; test in narrow side-view pyriform; transverse section elliptical, ratio of axes about 5:3; aperture broadly elliptical with undulate margin bordered by a row of oval scales; plasma normal; pseudopodia not observed.



G.H. Wailes del.

West, Newman lith.

RHIZOPODA FROM NORTH & SOUTH AMERICA.

Length (without horns) 120–140 μ ; breadth 100–125 μ ; aperture 32–40 μ ; thickness 0.5 to 0.6 of the breadth ; length of horns 20–30 μ .

Habitat. Sphagnum.

Distribution.—Sandia, Peru.

In the small quantity of material available some ten individuals were found, but owing to the fragile nature of the horns many of these were imperfect. The test is opaque, strongly constructed, and of a robust form, the outlines follow regular curves, being free from excrescences ; the crenulations around the aperture are often pronounced, resembling those of *Nebela dentistoma*, a species to which it bears a close likeness when deprived of the spines. It is distinguished from *Nebela caudata* (fig. 17), a species found in association with it, by its much larger size and robust form, its more regular outlines and greater number of spines. Encysted individuals contained plasma of normal appearance.

NEBELA SCUTELLATA, *Wailes* (16), p. 139, pl. 12. figs. 11, 12.

Not uncommon and quite typical.

Distribution.—Puntas Arenas (sphagnum) ; Mt. Corcovada (sphagnum) and Rio Janeiro (shore moss) ; United States (16) ; Seychelles (16).

NEBELA TROPICA, *Wailes* (16), p. 140, pl. 12. figs. 13, 14.

Found in association with the preceding.

Distribution.—Puntas Arenas ; Rio Janeiro ; Peru (7) ; Borneo (16) ; Seychelles (16).

NEBELA VAS, *Certes* (3), p. 15, pl. 1. figs. 4 & 5.

Not uncommon in some of the gatherings of sphagnum, and of moderate size. A certain amount of variation was observable in the neck, the base varying considerably not only in width but in the depth of the depression or groove at the point where the neck is attached to the body of the test ; some individuals in broad view closely approached *N. lageniformis* in appearance, but in side view the difference was pronounced.

Length 130–155 μ ; breadth 85–103 μ ; aperture 26–32 μ .

Distribution.—Puntas Arenas ; Rio Janeiro ; Cape Horn (length 140–170 μ , *Certes*) ; Antarctic, Australasia, Fiji, Hawaii, and British Columbia (*Penard*).

Penard found the usual size to be 160–165 μ in length, but in New ealand a small form occurs 95 μ in length (11).

LITERATURE.

1. AWERINZEW, in Trudui S. Petersburg Obshch. xxxvi. (1906).
2. BROWN, J. M., in Journ. Linn. Soc., Zool. xxx. (1910) & xxxii. (1911).
3. CERTES, A.—'Mission scientifique du Cap Horn,' vi. Zool. (1889).
4. DADAY, E. VON, in 'Zoologica,' Stuttgart, Bd. xviii. Hft. 44 (1905).
5. GREEF, R., in Sitzung. der Gesell. Beför. ges. Natur. Marburg, 1888.
6. LEIDY, J.—'Freshwater Rhizopods of North America,' U.S.A. Geol. Surv. xii. (1879).
7. MURRAY, J.—'Notes on the Natural History of Bolivia,' including a report on the Rhizopoda by G. H. Wailes, 1912-13.
8. PENARD, E.—'Faune Rhizopodique du Bassin du Léman,' 1902.
9. — in Revue Suisse de Zoologie, 1899-1912.
10. — in Archiv für Protistenkunde, 1905-1912.
11. — British Antarctic Exped. Reports, Biol. vol. i. pt. vi. (1911).
12. — "Rhizopoda from the Sikkim Himalaya" in Journ. Roy. Micro. Soc., 1907.
13. — "Rhizopoda from Gough Island," in Proc. Roy. Phys. Soc. Edinb., 1912.
14. SCHEWIAKOFF, W., in Mém. Acad. Sci. S. Pétersbourg, 7 ser. vol. xli. no. 5.
15. SCHOUTEDEN, H., in Ann. Biol. lacustre, i. iii. 1906.
16. WAILES, G. H., in Journ. Linn. Soc., Zool. xxxii. (1912).
17. WAILES and PENARD, Clare Island Survey, pt. 65; in Proc. Roy. Irish. Acad. xxxi.

EXPLANATION OF PLATE 15.

- Figs. 1, 2. *ARCELLA MEGASTOMA*, sp. nov., Penard. Dorsal and side views, $\times 150$. New Jersey.
- 3, 4. *ARCELLA CURVATA*, sp. nov. Dorsal and side views, $\times 300$. Norfolk, Virginia.
5. *ARCELLA VULGARIS*, forma. Side view, $\times 300$. Norfolk, Virginia.
6. *EUGLYPHA FILIFERA* var. *PYRIFORMIS*, var. nov. Side view of active individual, $\times 500$. Long Island, U.S.A.
- 7-9. *NEBELA SACCIFERA*, sp. nov. Broad, narrow, and oral views of test, $\times 200$. Long Island, U.S.A.
- 10, 11. *DIFFLUGIA BICORNIS*, Penard. Three-horned form; side and dorsal views, $\times 300$. New Jersey.
12. *DIFFLUGIA OLLIFORMIS*, Lagerheim. Side view of active individual, $\times 300$. New Jersey.
13. *NEBELA DENTISTOMA* var. *HESPERIA*, var. nov. Broad view of test, $\times 300$. Rio Janeiro, Brazil.
- 14-16. *NEBELA SPICATA*, sp. nov. Broad, narrow, and oral views, $\times 300$. Sandia, Peru.
17. *NEBELA CAUDATA*, Leidy. Broad view, $\times 300$. Sandia, Peru.
- 18, 19. *NEBELA MURRAYI*, sp. nov. Broad and narrow views, $\times 300$. Puntas Arenas, Chili.
-